

# **SatMagazine**

**Nanos...  
Picos...  
Minis...  
Micros...**

**Microsatellite  
Markets**



**Image: UKube-1  
from Clyde Space**

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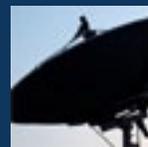
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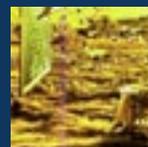
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## 'Tis Scotland's First

### Scotland's first satellite will be launched from a Russian Soyuz-2 rocket in March of 2013.

UKube-1, built by Clyde Space in Glasgow, is now completing final testing at the company's headquarters before making the journey to the Baikonur Cosmodrome in Kazakhstan for the launch.



Steve Greenwood of Clyde Space receives the AMSAT-UK FUNcube-2 boards that will be incorporated into the UKube-1 nanosatellite

Confirming that agreement had been reached for the Russian rocket to carry UKube-1, Clyde Space CEO Craig Clark, said: "UKube-1 aims to be the first of many nanosatellites produced at Clyde Space, and is a fantastic mission for us to demonstrate our capabilities as a spacecraft mission lead. I'm proud of the team here at Clyde Space in achieving such a critical milestone in the mission."

The UKube-1 nanosatellite has been designed and manufactured by Clyde Space at their high-tech facility at the West of Scotland Science Park.

The satellite is one of the most advanced of its kind and the mission is the pilot for a collaborative, national CubeSat program bringing together UK industry and academia to fly educational packages, test new technologies and carry out new space research quickly and efficiently.

Payloads in UKube-1 include the first GPS device aimed at measuring plasmaspheric space weather, a camera that will take images of the Earth and test the effect of radiation on space hardware using a new generation of imaging sensor and an experiment to demonstrate the feasibility of using cosmic radiation to improve the security of communications satellites and to flight test lower cost electronic systems.

It will also carry a payload made up of five experiments that UK students and the public can interact with and an outreach program that also allows school children to interact with the spacecraft.



As well as the platform and payload elements of the mission, UKube-1 is being supported by three UK Ground Stations. Led by the STFC Rutherford Appleton Laboratory's Ground Segment in Oxfordshire, these crucial elements will provide the link to the orbiting spacecraft, as well as full planning of the operations.

The supporting ground stations are provided by Dundee and Strathclyde Universities. The university of Strathclyde groundstation was installed by Clyde Space during an earlier phase of the spacecraft development. #

UKube-1 is a UK Space Agency mission. The mission has been funded jointly by Clyde Space (mission prime) and a number of funding partners including the UK Space Agency, the Science and Technology Facilities Council, the Technology Strategy Board and there has also been support from Scottish Enterprise.



## A Roaring Conclusion To 2012...

### **Arianespace's Ariane 5 flight with the Skynet 5D and Mexsat Bicentenario satellite passengers has wrapped up another busy year of company launch activity.**

During 2012, the Arianespace launcher family performed a total of 10 missions from the Spaceport in French Guiana, led by the heavy-lift Ariane 5 with its 10-metric-ton payload lift performance, which has logged 53 consecutive successes during the past 10 years.

Arianespace's mission cadence in 2012 was called "remarkable" by Chairman & CEO Jean-Yves Le Gall. "It confirms the interest, effectiveness and availability of our launcher product line, which enables us to launch all satellites, for all of our customers, to all orbits," he said during comments after today's flight.

"In addition, 2012 also marked a yearly record in terms of payload mass placed into orbit, since—for the first time—we have reached a total of nearly 75 tons, of which 20 tons was for the Edoardo Amaldi Automated Transfer Vehicle! And, I can add, that if you liked 2012, you will love 2013!" Le Gall stated in his concluding remarks.

The Arianespace launcher family missions performed from French Guiana this year were composed of seven heavy-lift Ariane 5 flights, two with the medium-lift Soyuz, and the lightweight Vega's inaugural launch.

There was also an additional Soyuz mission, performed from the Baikonur Cosmodrome in Kazakhstan by Arianespace's Starsem affiliate. Skynet 5D was orbited for Astrium Services as the fourth in the British military's Skynet 5 satellite system, and weighed approximately 4,800kg. at launch. This spacecraft is designed to reinforce and extend the operational services provided by the three other Skynet 5 satellites—all orbited by Ariane 5—and will be located over the Middle East at a 53 degrees East orbital slot. The Skynet program is operated as a Private Finance Initiative with the United Kingdom's Ministry of Defence.

Mexsat Bicentenario weighed an estimated 3,000kg. for liftoff, and is based on Orbital Sciences Corporation's GEOStar-2 platform. It is to provide communications services to Mexico and its surrounding waters from the 114.9 degrees West orbital slot. Orbital was designated by Boeing to provide the Fixed Satellite Services (FSS) segment of the Mexsat satellite system for the Federal Government of Mexico.

As Arianespace celebrated a 2012 to remember in terms of its launch activity, the company already is looking to next year's activity. Preparations are well advanced for a Starsem Soyuz mission from Baikonur Cosmodrome with six Globalstar constellation spacecraft at the start of February, as well as an Ariane 5 launch at the Spaceport—which is to orbit the Amazonas 3 and Azerspace/Africasat-1 telecommunications satellites during the first week in February. #



## Solid To The Core

**The team designing America's new flagship rocket has successfully completed a major technical review of the vehicle's core stage.**

NASA's Space Launch System (SLS) will take the agency's Orion spacecraft and other payloads beyond low-Earth orbit, providing a new capability for human exploration.

The core stage preliminary design review (PDR) was held Thursday at NASA's Marshall Space Flight Center in Huntsville, Alabama, and included representatives from the agency and The Boeing Co. Boeing's Exploration Launch Systems in Huntsville is the prime contractor for the core stage and its avionics. Marshall manages the SLS Program.

"Passing a preliminary design review within 12 months of bringing Boeing on contract shows we are on track toward meeting a 2017 launch date," said Tony Lavoie, manager of the SLS Stages Element at Marshall.

"We can now allow those time-critical areas of design to move forward with initial fabrication and proceed toward the final design phase—culminating in a critical design review in 2014—with confidence."

The first flight test of the SLS, which will feature a configuration for a 70-metric ton lift capacity and carry an uncrewed Orion spacecraft beyond the moon, is scheduled for 2017.

As the SLS evolves, a two-stage launch vehicle using the core stage will provide a lift capability of 130-metric tons to enable missions beyond low-Earth orbit and to support deep space exploration.

The purpose of the PDR was to ensure the design met system requirements within acceptable risk and fell within schedule and budget constraints.

An important part of the PDR was to prove the core stage could integrate safely with other elements of the rocket's main engines and solid rocket boosters, the crew capsule and the launch facilities at NASA's Kennedy Space Center in Florida. Core stage designers provided an in-depth assessment to a board of engineers comprised of propulsion and design experts from across the agency and the aerospace industry.

"Each individual element of this program has to be at the same level of maturity before we can move the program as a whole to the next step," SLS Program Manager Todd May said. "The core stage is the rocket's central propulsion element and will be an optimized blend of new and existing hardware design. We're building it with longer tanks, longer feed lines and advanced manufacturing processes. We are running ahead of schedule and will leverage that schedule margin to ensure a safe and affordable rocket for our first flight in 2017."

The core stage will be built at NASA's Michoud Assembly Facility in New Orleans using state-of-the-art manufacturing equipment.

The plant continues modifying its facilities and ordering materials for construction of the rocket. Michoud has built components for NASA's spacecraft for decades, most recently, the space shuttle's external tanks. #

## Taking A Transponder

**SES has struck a long-term capacity agreement with Anadolu Networks for one transponder at the ASTRA 31.5 degrees East orbital position.**

Anadolu Networks will start using the capacity from January 1, 2013, onwards to launch its DTH platform that will broadcast local TV channels to the whole of Turkey.

The initial channels to be broadcast will include TRT Turk, Karadeniz Kackar TV, Kanal 2000 Mersin and Kanal 15 Burdur, with more channels to be added in the course of the year.

The 31.5 degrees East orbital position is SES' prime orbital position for Turkey and the larger region, offering services via the ASTRA 1G satellite.

The launch of ASTRA 5B, with its wide beam in Q3 2013, will bring further opportunities for Anadolu Networks to broadcast its content to countries including Germany and the CIS region.

SES also revealed that ASTRA is now broadcasting the Swiss private channel 3+ from its prime orbital position 19.2 degrees East.

3+ is the first broadcaster based in Switzerland to use SES' satellite capacities. The transmission will expand the reach of 3+ by approximately 400,000 households in Switzerland.

The reception of the encrypted private channel 3+ requires a satellite receiver and the SRR Sat Access Card from the Swiss Broadcasting Organisation SRG.

SES Platform Services near Munich provides the uplink and the encryption of the channel.

3+ is one of the leading Swiss broadcasters and reaches an average of 1.7 million viewers—1/3 of the German-speaking Swiss population. #



Artistic rendition of an SLS launch, courtesy of NASA



## Four Down, One To Go

**Ball Aerospace & Technologies Corp. has successfully integrated four of the five payloads and a spacecraft de-orbit module onto STPSat-3, the Department of Defense Space Test Program's Standard Interface Vehicle (STP-SIV) slated to launch August 1, 2013. Integration of the four instruments and the MMA Design LLC De-Orbit Module was completed in 18 days.**

STPSat-3 is a common spacecraft, standard payload interface series of satellites built by Ball Aerospace for the Air Force Space and Missile Systems Center, Space Development & Test Directorate. The standard interface vehicle supports a variety of experimental and risk reduction payloads at various low-Earth orbits. The design is based on the flight-proven Ball Configurable Platform 100 (BCP-100) which is compatible with multiple launch vehicles.

The first payload integrated to the spacecraft was the NOAA Total Solar Irradiance Calibration Transfer Experiment (TCTE), built by the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado, Boulder. This instrument will help determine the effects of solar radiation on

Earth's climate and will provide continuity of climate data record measurements prior to the launch of the Joint Polar Satellite System in 2017. The JPSS-1 satellite is also being built by Ball Aerospace.

The additional four payloads integrated include: iMESA-R (Integrated Miniaturized Electrostatic Analyzer Reflight); SSU (Strip Sensor Unit); and SWATS (Small Wind and Temperature Spectrometer). All of the integrated instruments have been individually tested. The spacecraft is currently proceeding through space vehicle system performance testing. Arrival and installation of the final payload, J-CORE (Joint Component Research), will be completed by the end of 2012.

Ball Aerospace & Technologies Corp. supports critical missions for national agencies such as the Department of Defense, NASA, NOAA and other U.S. government and commercial entities. The company develops and manufactures spacecraft, advanced instruments and sensors, components, data exploitation systems and RF solutions for strategic, tactical and scientific applications. #



STPSat-3 spacecraft in a Ball cleanroom, awaiting integration of instruments in 2012 for a 2014 launch. Photo courtesy of Ball Aerospace.

## The Dream Becoming A Reality

**Sierra Nevada Corporation's (SNC) Space Systems' Dream Chaser® Space System Program has been selected by NASA's Commercial Crew Program to receive a Certification Products Contract (CPC).**

This award is the first step on the path to enabling International Space Station transportation services and to provide for government certification of the Dream Chaser commercial crew orbital transportation system.

The contract, which was the largest award by NASA in this round, is valued at \$10 million to be completed by May 30, 2014. It will start in January 2013 and will provide a path for a robust relationship between SNC and NASA for the communication of technical interchange, concluding with the delivery of certification documentation to the agency.

Craig Gravelle, Space Systems senior director who led the SNC proposal effort, said, "The SNC team is thrilled with the opportunity to work with NASA to certify the Dream Chaser® Space System for crewed low Earth orbit flight. This FAR-based contract will leverage SNC's success to date working with the Commercial

Crew Program, as well as our partners' expertise in developing human spaceflight hardware."

"The SNC team is now working with NASA through two Space Act Agreements which rapidly advance Dream Chaser® Space System design and development. This contract brings NASA's investment in the program to approximately \$350 million and allows SNC and NASA to jointly approve our Dream Chaser crew transportation certification plan.

SNC will execute some of the tests and analyses in the plan over the coming months to begin working toward achieving NASA certification of Dream Chaser as this Nation's next human space transportation system.

SNC is committed to reestablishing the critical space transportation services lost after Space Shuttle retirement," said John Curry, Space Systems director responsible for systems engineering and integration of the Dream Chaser.

The Dream Chaser orbital crew vehicle is on schedule to complete its first free flight test, in conjunction with NASA's Dryden Flight Research Center at Edwards Air Force Base, in early 2013. #



Dreamchaster's test flight. Photo courtesy of Sierra Nevada Corporation.



## OpEd: A New Approach Is Needed

### The recent "guidance" from the Pentagon's Chief Information Officer on hosting military payloads on commercial satellites has caused much confusion among satellite operators.

The three-page document, issued in late September, sets out policies that should be followed when radiofrequency spectrum set aside for military capabilities is used on a separate payload attached to a commercial satellite operating in civilian spectrum bands.

At the recent SATCON conference in New York, Charles L Beames, strategic adviser, space and intelligence, in the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics, described the guidance document as "well intentioned" but said the DoD intended to issue a clarification of the document by the end of the year.

The CIO document certainly does need clarification. For one thing, the guidance document seems to blur the dividing line between commercial ownership of a satellite and DoD control over the use of government spectrum. Although a hosted payload can rely on both of these resources, they remain distinct, with unique legal and regulatory characteristics.

For example, the guidance suggests that the hosted payload would have priority for satellite resources, yet resource priority has nothing to do with spectrum but is, rather, the outcome of an often complex commercial negotiation.

Similarly, the document seeks to declare that the commercial operator would be responsible for mitigating any interference to the hosted payload, yet there is a high probability that because the payload is utilizing military spectrum, it would require at best a joint effort around interference mitigation since blue-on-blue interference

is the vast majority of all interference incidents.

Rather than creating a list of "well intentioned" guidelines internally within the government, it would have been far preferable for the CIO's office to seek a creative dialogue with industry.

Almost every one of the issues raised in the guidance memo was identified and successfully negotiated within the context of the Intelsat/Australian Defense Force (ADF) Agreement regarding the IS-22 satellite.

Intelsat hosted the ADF's military UHF payload aboard the IS-22 satellite. The satellite, launched last April, has commercial C- and Ku-band transponders serving Africa, Europe, the Middle East and Asia and a UHF payload supporting the Australian military in the Indian Ocean Region. The ADF has leased part of the payload to the U.S. Navy to support its operations in the region.

The guidance document appears to reflect DoD's anxiety about losing control of valuable spectrum. The DoD has become more protective of its spectrum assets after the planned LightSquared network threatened to interfere with the military's Global Positioning System and the White House began pushing to free up unused DoD spectrum for non-military terrestrial applications.

We agree that spectrum is indeed a valuable asset, and should be a key strategic advantage. We believe combining military and commercial spectrum on satellites and payloads is an even greater capability than the DoD should investigate.

The ownership of the spectrum has never been the issue—it clearly would be licensed to the DoD. But the satellite would clearly remain commercial property. The DoD needs to recognize that a commercial satellite operator

serving global customers would need to coordinate that activity with the hosting service provided to the DoD.

The CIO needs to hit the reset button on spectrum guidance and come back with a policy document that can foster a creative partnership between the DoD and commercial operators offering hosted payload opportunities to the military.



OpEd by Kay Sears, President, Intelsat General Corporation—this article was published in the Company's "From The Top" eNews site.

#

## Natural Resources

### Intelsat S.A. + ITC Global have signed two, multi-year agreements for broadband capacity.

In the first agreement, ITC Global will leverage Intelsat 18 at 180 degrees East to provide C-band services to its mining customers in eastern Russia.

ITC Global will integrate its services into a sophisticated network, incorporating carrier-in-carrier technology, to achieve optimal efficiency in delivering high-throughput broadband Internet to remote locations.

ITC Global also signed a contract for capacity on Intelsat 906 at 64 degrees East, enabling broadband service to a major natural resources provider in Western Australia.



Intelsat 18

## Component Considerations

### COM DEV International Ltd. has been awarded an Authorization to Proceed (ATP) contract from MacDonald Dettwiler and Associates ("MDA").

The project will culminate in the delivery of Ku- and Ka-band multiplexers, switches and microwave components. The funding release of \$5.1 million is to cover the initial engineering and procurement activities.

The components will be used for a communications satellite, which is expected to launch in 2014 and will enhance the capacity of an existing satellite constellation.

The full contract value is expected to be in excess of \$11 million with an option for a replacement flight set for an additional amount in excess of \$10 million.

Work will be carried out at the Company's facility in Cambridge, Ontario, Canada, with completion of the original flight set expected by November 2013.

"We are pleased to have been awarded this contract from one of our long-term customers," stated Mike Williams, President of COM DEV International Products. "This reflects our acknowledged expertise in providing communication satellite components with the highest quality and efficiency and the continued trends in the marketplace for increased capacity." #

## Airborne Access Renewed

**ViaSat Inc. (Nasdaq: VSAT) will provide broadband airborne SATCOM services for a U.S. government customer under a contract award valued at \$52 million.**

The one year contract is a renewal for services already provided using ViaSat ArcLight® technology over a managed private network established in 2009 to support military missions for the War on Terror.

ViaSat mobile broadband systems are designed to provide high-speed, beyond line-of-sight (BLOS) communications for media-rich ISR, C2, and other applications.

Typical operational data rates range from 1 to 8Mbps off the aircraft using Ku- and Ka-band SATCOM links. These systems are flown on more than 300 government aircraft such as the C-130, C-17, U-28, and various King Air models, accumulating over 500,000 mission hours.

These same terminals can operate seamlessly on the global Yonder® satellite network. In addition, ViaSat offers higher priority regional service overlays to Yonder network coverage with a range of connectivity and performance options. #



## OOS + ADRs

**On February 20, 2013, at the Sheraton Towers in Singapore, SWF will hold a conference entitled "On-Orbit Satellite Servicing and Active Debris Removal: Opportunities and Challenges for the Space Sector."**

On-orbit satellite servicing (OOS) and active debris removal (ADR) are part of an emerging category of future on-orbit activities that are critical for taking the next leap in our use of Earth orbit.

The ability to repair or refuel satellites, construct new satellites in orbit, and even remove orbital debris can help drive innovative uses of space

and create new possibilities. These activities also raises a host of diplomatic, legal, safety, operational, and policy challenges that need to be tackled for this future to be possible. The draft agenda for the On-Orbit Satellite Servicing and Active Debris Removal Conference can be found here.

This conference will be held the day before the Global Space

and Technology Convention (GSTC) 2013, organized by the SSTA. The GSTC provides a platform for latest technology in space engineering and design. Over two days, the GSTC will bring together global industry leaders and research organizations for business-to-business interaction and networking. [More info here.](#)

#

## Making A Broad Reach

**Moog Inc. has acquired Golden, Colorado, based Broad Reach Engineering Company for approximately \$48 million to add spacecraft avionics and communications products and services to Moog's line-up of precision control systems for satellites and launch vehicles.**

"This acquisition gives us a capability from mission design through mission execution for commercial and military aerospace customers worldwide," said Jay Hennig, president of Moog's Space and Defense Group. "Broad Reach has extensive spaceflight heritage and an entrepreneurial spirit that impresses us."

Broad Reach's partnership with JPL to develop a new generation of GPS along with its strategic work with organizations such as Boeing, Lockheed, NASA and Orbital Sciences Corporation are just some of the projects and alliances that attracted Moog.

Broad Reach Engineering's products include spacecraft core avionics, a radiation-hardened microprocessor (i.e., BRE440 PowerPC™), spacecraft bus software, GPS, payload avionics, and ground support hardware and software. Broad Reach has supplied avionics for the AFRL's XSS-11 mission, NASA's LRO and LADEE lunar missions and gimbal drivers on the International Space Station.

"Broad Reach's and Moog's avionics products are different,

but obviously complementary and proven," said Chris McCormick, CEO of Broad Reach Engineering. "But it's the spaceflight heritage between our respective companies' ears that can help us capitalize on market trends like the move toward small, reliable spacecraft."

Broad Reach Engineering employs approximately 60 people at locations in Golden, Colorado, San Jose, California and Tempe, Arizona. These employees—a mix of engineers, support personnel and manufacturing workers—will begin working for Moog effective immediately.

McCormick will join Moog as group vice president of the Space and Defense Group's Space Sector replacing industry veteran Doug Morash who is retiring.

"Doug has been the face of our space business for more than 30 years," added Hennig. "You can't replace someone like Doug. But you can ensure the level of excellence continues by tapping into Chris' expertise and entrepreneurship."

Prior to the acquisition, Moog joined Broad Reach Engineering as an investor in PlanetIQ, a start-up company that plans to launch a constellation of micro satellites to gather real-time data about the Earth and its atmosphere.

Before McCormick founded Broad Reach Engineering in 1997, he worked at Spectrum Astro and as a contractor for DARPA's Advance Space Technology Program offices. #



## Change That Date

**Last year this event went on despite Hurricane Sandy's attempt to shut it down, and now...**

"We are excited to announce that the Javits Center has adjusted its event schedule to accommodate our request for earlier dates in 2013. Please be advised that the new SATCON & CCW dates are now confirmed for Wednesday-Thursday, November 13-14, 2013.

We have recently consulted with major satellite operators, and attendees and speakers, including those from several important branches and units of the DoD. They all support the date change and are planning to participate next year in SATCON."

At SATCON, you stand at the crossroads of innovation and communications. Thousands of attendees and exhibitors alike participate in the ever-changing

conversation surrounding satellite-enabled communications and content delivery.

Government/military, media & entertainment, telecommunications, commercial, mobile satellite and enterprise organizations attend SATCON to see the latest products and technologies, network with peers and find potential partners and solution providers.

SATCON provides you with actionable information and knowledge to keep pace with the ever-changing global communications market.

Collaborate with industry leaders who deliver insight and information on emerging technologies. Keep up with what's trending in the world of satellite communications. SATCON is part of the Content & Communications World (CCW) family of events. #



## Moving On Up

**ARINC Incorporated has appointed Michael DiGeorge a Managing Director of the company's Asia Pacific Division based in Singapore.**

Mr. DiGeorge was, formerly, the Senior Director for E-enabled Programs based in ARINC's Hong Kong office.

In his new position, Mr. DiGeorge will focus on growing ARINC's business and solution infrastructure in Asia Pacific, and enhance customer service and support throughout its multiple business lines including aviation communications,

networking, airport operations and security. #





# Expanding The View

by Mary Jo Wagner



**O**n July 22, 2012, exactEarth launched the latest satellite into the *exactView*<sup>™</sup> constellation. *exactView-1* (EV-1) is the highest detection *Automatic Identification System* (AIS) satellite ever built and is the fifth satellite in the advanced vessel monitoring satellite constellation from exactEarth. Because of this constellation, many in the industry regard exactEarth as pioneers of space-based AIS services as the Company has increased the visibility range as well as enabled the monitoring of vessels throughout the world's oceans and remote waterways.

In November of 2012, **EV-1** successfully completed the payload performance and went into full commercial operation. EV-1 was designed to be the most advanced AIS satellite built to date, and during the testing phase it lived up to that billing, providing increased detection rates of up to 40 percent better than any previous satellite sensors. Now that EV-1 is in commercial operation, the satellite's performance levels have exceeded industry expectations—its daily detection rates are reaching 45,000 **MMSIs** (**Maritime Mobile Service Identity** number), increasing the total global AIS service to approximately 90,000 unique MMSIs a day.

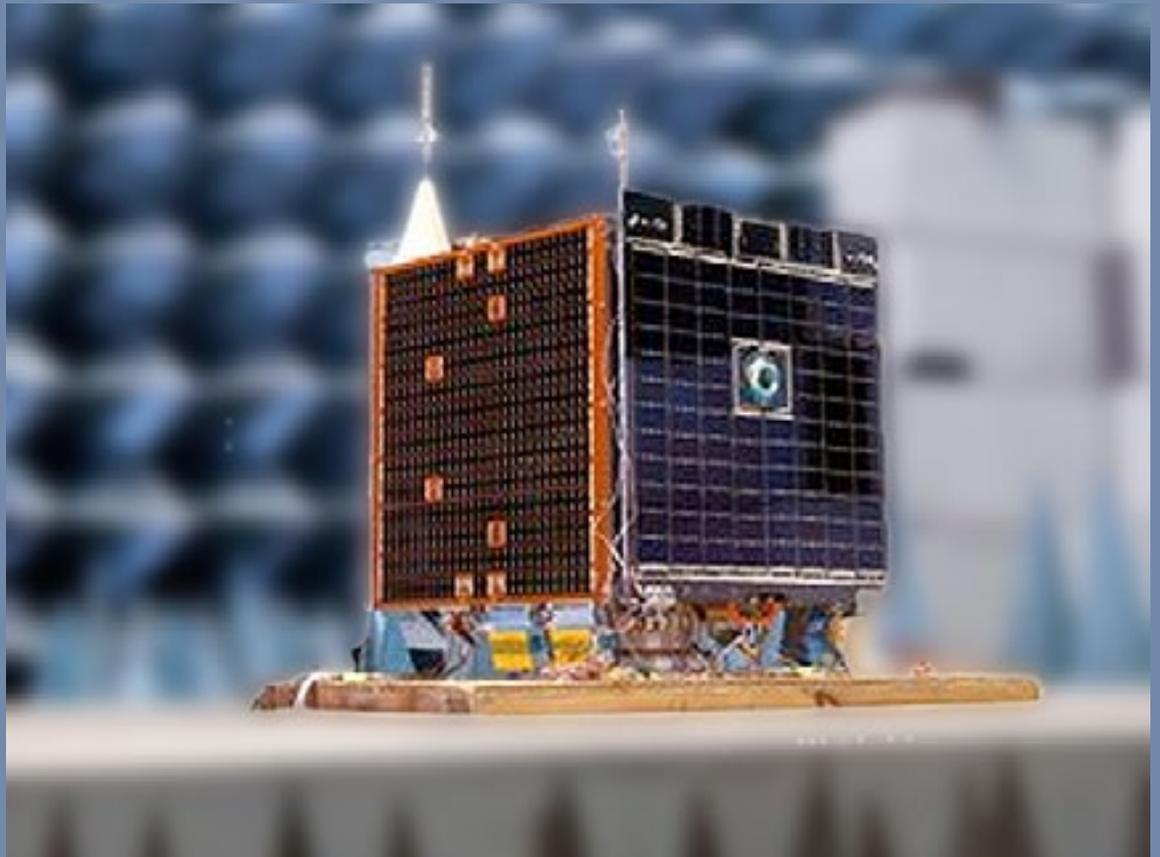
With this significant increase in vessel awareness, customers have been provided with a big step forward in vessel detections from space to complete their maritime picture. This is truly a major accomplishment considering how relatively new **Satellite AIS (S-AIS)** technology is in the marketplace.

## Confronting The Challenges

The deployment of an operational Satellite AIS constellation is not without its challenges—AIS was primarily intended for sea-level reception. Traditional coastal AIS technology provides limited coverage, up to 50 nautical miles off shore, as ships essentially disappear beyond the horizon and AIS signals are not picked up beyond this limit.

The AIS detection protocol was developed for this short-range collision avoidance for large vessels, and not for space-based reception.

Another obstacle in the collection of AIS messages from space is the saturation of the satellite receiver with a high amount of messages broadcast simultaneously and on the same frequency. This is known as "*message collision*" and is a problem, particularly with high density traffics areas, such as the Baltic Sea.



Satellite systems relying on first-generation technology have been required to take multiple passes over areas of high-shiping densities in order to maximize detection opportunities. Ground-breaking technological advancements in AIS detection from **exactEarth** have led to the creation of considerably more efficient satellite performance.

This technology permits a single pass by an exactEarth satellite to detect more data in its first pass than any other system. This means a more accurate and timely initial detection as well as more complete updates on subsequent passes.

These *first pass detection* (**FPD**) levels are an effective measurement of a satellite AIS constellation's performance abilities to satisfy operational maritime requirements. Given that ship populations are always moving, it is critical to maximize the number of ships detected during each and every satellite pass.

FPD is of particular importance when creating an accurate maritime picture, as not all vessels transmit their AIS identity and position and therefore go "dark." Without these targets identified, the picture is not complete, and it is imperative that authorities be able to correctly identify all targets of interest.

By combining multiple satellite sensors (such as radar and optical sources and S-AIS data), one can achieve a comprehensive and accurate view of their maritime domain. It is in these instances where FPD plays an integral role, as it is critical to maximize AIS detections from space as quickly as possible to receive the AIS identification data to verify vessel positions with radar sources.

### **Analyzing The Attributes**

This is a significant attribute of EV-1, as it has proven, remarkable, FPD rates helping to maximize detection of targets in a single observation pass. EV-1 picking up more vessels with each pass, and early results have also shown significant improvements in the number of **AtoN** (*Aids to Navigation*) and **Class-B** detections, which can add tremendous value when tracking the thousands of smaller ships not equipped with Class-A AIS transponders.

The FPD advantages of a satellite such as EV-1 prove extremely valuable in a number of maritime operations and applications. S-AIS is an important tool for search and rescue efforts, enabling authorities to identify ships within proximity of a distress situation, track a drifting vessel, and enhance planning efficiency both for routine and emergency situations.

With effective FPD, authorities can identify the majority of ships within proximity of a vessel in distress, radio those vessels and coordinate immediate and effective rescue operations in an emergency situation.

## Expanding The View (Cont.)

By examining the heading, course over and the navigational status contained in reports, it is possible to determine if a drifting and, provided the current and wind in the area are known, predict where the be once search and rescue assets arrive. coordinating routine patrols the traffic the area of interest can be examined information can be used to increase the and effectiveness of those routine

Environmental protection authorities can also benefit from the FPD rates provided by protect offshore installations and risk of a maritime casualty and marine pollution, traffic exclusion precautionary areas have been set up across the globe. Vessels may be banned from entering these areas due to environmental concerns or to allow endangered marine species and organisms to thrive or recover.

S-AIS provides accurate information on ship behavior and position to help determine when offenses such as pollution violations, route violations, or irresponsible navigation have taken place—even by whom. While S-AIS can only report the position information during a given pass, the quantity of those position reports can establish a pattern of ship behavior.

In the event of a pollution violation, it is of utmost importance to quickly determine all ships that may be responsible for the violation. The high FPD rates of EV-1 maximize the probability that a ship of interest will be identified when authorities are investigating incidents.

### Emergence On The SATCOM Scene

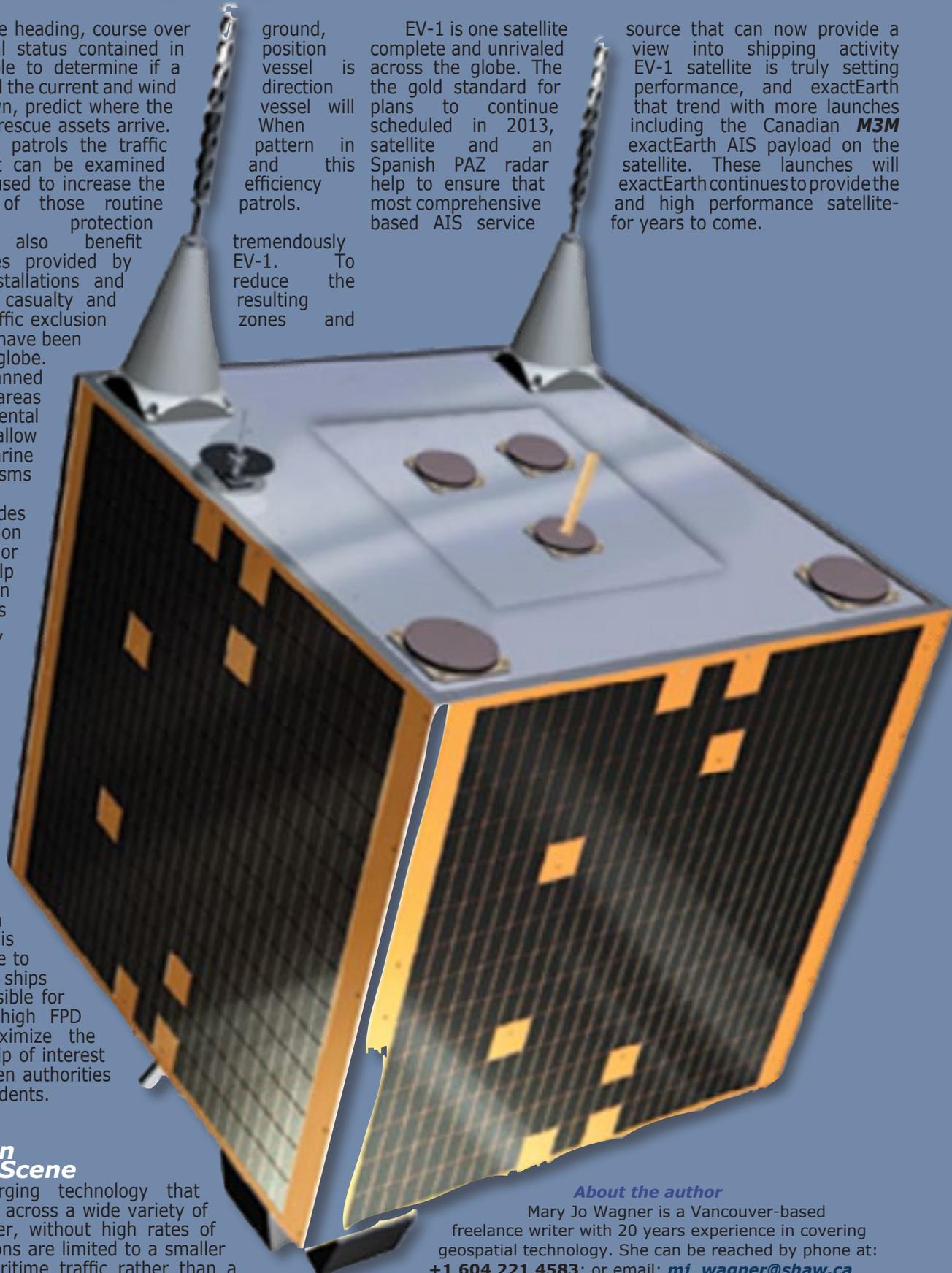
S-AIS is an emerging technology that provides advantages across a wide variety of applications. However, without high rates of FPD, those applications are limited to a smaller sampling of the maritime traffic rather than a complete picture.

ground, position vessel is direction vessel will When pattern in and this efficiency patrols.

tremendously EV-1. To reduce the resulting zones and

EV-1 is one satellite complete and unrivaled across the globe. The the gold standard for plans to continue scheduled in 2013, satellite and an Spanish PAZ radar help to ensure that most comprehensive based AIS service

source that can now provide a view into shipping activity EV-1 satellite is truly setting performance, and exactEarth that trend with more launches including the Canadian **M3M** exactEarth AIS payload on the satellite. These launches will exactEarth continues to provide the and high performance satellite-for years to come.



#### About the author

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## ***Executive Spotlight: Lisa Scalpone, ViaSat***

**L**isa Scalpone is Vice President Sales, Marketing, and Business Development for Services at ViaSat Inc., and also is responsible for government affairs. She joined WildBlue Communications when it was a start-up company in 2000 and helped develop the organization to its status as a broadband Internet service provider with over 450,000 customers across the U.S. In 2009 WildBlue was acquired by ViaSat, which launched a new high-speed satellite broadband service called ExedeSM Internet in January 2012.

Ms. Scalpone's industry activities have raised the profile of satellite broadband in both Colorado and at the federal level. In 2010, she was appointed by the Colorado Governor to the State's Broadband Council and serves on the Advisory Board to the telecommunications group Silicon Flatirons in conjunction with the University of Colorado School of Law. She has represented the satellite broadband industry in numerous public forums. Prior to her work for WildBlue and ViaSat, she practiced antitrust and corporate law with McDermott, Will & Emery and clerked for a federal judge in Chicago.



### **SatMagazine (SM)**

*Would you please tell our readers about your background? How did your work in your previous employment posts prepare you for your crucial role with ViaSat?*

#### **Lisa Scalpone**

I started out in the 1990s as a lawyer for a big law firm in Chicago. When I began with **WildBlue** as a start-up, I was their in-house counsel, and I learned the business of the company from the ground up. Learning about all the industries related to our business—Internet services, satellite, network technology—and doing deals within those areas prepared me well for my current role.

#### **SM**

*What are your responsibilities with ViaSat? Are they much different than the work you accomplished for the company prior to holding this position?*

#### **Lisa Scalpone**

I am responsible for the sales, marketing and business development functions of our consumer Internet business, called **Exede**, as well as for our legacy service, WildBlue. I was previously general counsel for the division. Coming in from a different background is not just a fresh eye, but it forces our teams to explain their ideas and initiatives in plain English as I wouldn't know the marketing jargon. As a lawyer, the transactions I worked were typically multi-year deals with potential long-term impact on our company and product. That type of perspective

provides a nice balance to the tendency of sales and marketing to be more focused on short term sales jumps.

#### **SM**

*How do you currently see the market for satellite broadband?*

#### **Lisa Scalpone**

The size of our market will be defined by the quality of the service we offer. If we provide a service that is a better trade-off for many people than slower DSL service—and I believe we are—then it's fair to say we've only just begun to understand the potential of the US market for satellite. There are probably about 20 million households that don't have access to a wired broadband solution above 4Mbps. Before Exede, switching to satellite service from a 3Mbps DSL service wouldn't have been seriously considered. Now, our basic package is 12Mbps for \$50/month and that's a viable switch for consumers to make. I'd take that trade myself. I think it's even a more compelling case to switch from DSL if you have no other reason to buy services from the phone company. Worldwide, other countries are just now launching their own programs, so the potential there has been largely untapped. The Australian government is launching a satellite Internet program through **NBNCo**, and we are going to be a part of that by supplying the network infrastructure, including customer equipment, for the program.

#### **SM**

*How about for the commercial and mil/gov segments?*

## Executive Spotlight: Lisa Scalpone, ViaSat (Cont.)

### Lisa Scalpone

There is also great opportunity in the military/government segment for our high-capacity satellite system. Even though the military has much different requirements than consumers, the basic need for high definition video and a lot of bandwidth is the same. High-capacity satellite is excellent for sending HD video and other sensor data back and forth from the battlespace to remote command and control centers, and doing it as fast as possible. With the new generation of very high capacity satellites, these services are now far more cost effective for the government to procure.

### SM

*Please tell us about ViaSat's Exede Internet service. What will this service mean for customers in rural locations? In metropolitan areas?*

### Lisa Scalpone

We completed the rollout of our Exede Internet service this past March and we added over 100,000 subscribers in the first six months. For the 12Mbps Exede service, we use our new ViaSat-1 satellite, which covers the eastern half of the U.S., the west coast, Hawaii and parts of Alaska. It covers about 75 percent of the U.S. population.

We designed the service with the idea that people want the same high speed and also the \$50 monthly price point available to urban consumers. 12 Mbps will let you do whatever you want on the internet, but it's not the only compelling thing about our service. Another important attribute for Internet service is upload speed. Although people pay less attention to that dimension, it's important too if you like to do things like Skype or FaceTime. For those uses, you really need 3 Mbps for good performance. All of our packages through the ViaSat-1 satellite have at least 3 Mbps upstream, which is something that DSL service often can't provide.

### SM

*What has been the consumer response since launching in March 2012?*

### Lisa Scalpone

The consumer response to our service is very important to us and will directly correlate to our ultimate success in the market. So far, it has been extremely positive, but we aren't resting on that initial response and have plans to continually improve the service.

In August, we launched the "Late Night Free Zone." Our customers can now use the service in the nighttime hours without the usage counting against the volume cap. In October, we increased our entry-level plan from 7.5GB to 10GB—a change applicable to our base at no charge as well. We've got more plans in store, as well.

One of our biggest challenges has been to get information about our service out to consumers who might not otherwise think of satellite as an option when considering Internet providers. We'll be launching new efforts toward the end of the year to make consumers aware of satellite Internet as a good choice for them.

### SM

*How does Exede compare with other broadband offerings?*

### Lisa Scalpone

It's hard to beat our basic offer anywhere—12Mbps for \$50/month—so we believe we are competitive or better against many other technologies, including fixed wireless service and lower speed DSL. As we see some of the DSL providers moving toward a bundling requirement, we are now a more affordable

option for consumers who don't want a landline phone service from the telephone company, but might be required to pay for one. VOIP works very well over satellite, if you want a landline phone. Off-the-shelf VOIP devices work just fine with Exede, and we'll offer our own VOIP service early next year.

### SM

*What are the high points of ViaSat's history? To what can the firm attribute its success?*

### Lisa Scalpone

Our CEO, *Mark Dankberg*, along with co-founders *Mark Miller* and *Steve Hart*, started ViaSat in Mark's garage in 1986 with an investment of under \$25,000. The company has about 2,500 employees and \$800 million in sales. Having the co-founders continue to lead the company and encourage all of us to innovate and try new things even if they are hard to do is what makes our company different. It also makes it the kind of place people want to work. That, to me, is a key advantage of our company that can't be easily replicated by others.

Another important milestone was the launch of *ViaSat-1* and the Exede service. Back in 2008, there was a lot of skepticism that our satellite would really have the capacity we said it did and, even if it did, people questioned whether the market needed it. Now, we have proven we can design and launch the world's largest telecommunications satellite, and the question isn't whether we need all of that capacity, but how quickly we can build more satellites with even more bandwidth.

### SM

*Can you tell us about ViaSat's future growth strategy? What products might we see come to fruition over the next few months?*

### Lisa Scalpone

Early next year, we'll launch an in-flight version of our Exede service on *Jet Blue*, with another major airline to follow. It's an exciting market opportunity, especially since a lot of us are pretty excited on a personal basis to finally have great broadband available on flights.

One of my favorite products is our upcoming *ProPortable* service. That service has a terminal that fits inside a luggage-sized case. You can set it up anywhere within our footprint and access Exede service. We haven't yet officially launched ProPortable service, but if our demo units are any indication—well, we can hardly get customers to return them once they've tried them. The terminal sets up in minutes and doesn't require technical skills. The possible applications for the service go on and on—newsgathering, emergency response and public safety uses, military and government application. We even had a ProPortable terminal at the *Burning Man* event in Nevada this year.

### SM

*A major concern for many companies is locating and hiring appropriately trained professionals for crucial positions... the talent pool seems to be shrinking, thanks to a lack of educational concentration on science, technology, engineering and mathematics. How can the industry assist in ensuring STEM is promoted to students to ensure a steady flow of eager candidates for openings?*

### Lisa Scalpone

We can't always rely on other companies or even universities to serve up qualified employees. I'm a strong believer that we should take a farm team system approach to our hiring. I think a trap for companies is looking for the candidate with the perfect background and disregarding candidates who may be

highly talented but need some retraining or who have come from outside our industry. If we are flexible in hiring and have faith in our own mentoring and training on the job, it is an easier job to assemble a great team.

Having said that, for some of our specialized engineering positions, we, too, have struggled to find candidates for these positions. A partial answer can be that we hire engineers that might be more junior than we'd like, with the understanding that need to devote resources to extended training.

### SM

*Is ViaSat currently involved in any STEM-related projects? If so, what might such be?*

### Lisa Scalpone

Although we aren't one of the biggest companies, we have a **ViaSat University** for our high potential employees offering "courses" in problem solving and leadership so that we are able to promote from within. It is easier to hire someone who might not have the exactly the right pedigree in a more junior role, and ensuring our own employees are given the tools to move up is an important part opening up more entry level spots.

In addition to our internal university program, we have done joint programs with local colleges and universities in academic/corporate partnerships. We run a team internship program each summer for university students from mathematics, computer science, and electrical engineering schools all over the U.S. We share real issues we are facing and ask them to develop solutions. We end up offering jobs to a number of the interns. We also sponsor events like the **FIRST** robotics competitions. These programs are important because they reach kids at a young enough age where they might decide to make changes in their education plans toward math and science.

### SM

*The FCC has proposed imposing a broadband tax on consumers' Internet service bills to subsidize telephone companies to build out DSL—at speeds as low as 4Mbps. What's your take on this and how does satellite broadband fit in?*

### Lisa Scalpone

As is well known in the industry, the FCC is converting its telephony support fund, known as **USF**, to broadband. The USF program taxes the long distance portion of a customer's telephone bill, and redistributes the money to telephone companies to support "universal" telephone service. Since this goal of universal telephone service has long been met, the FCC issued an order that, when implemented, will shift the money to support universal broadband deployment. The telephone companies once again will be the primary recipients of the funding.

What has not been decided is how the tax will now work. These are not small dollars, or a small tax. This new USF fund, now known as the **Connect America Fund (CAF)**, will be about \$5 billion each year. We don't believe that any money from this fund should be automatically directed to the phone companies. Satellite is faster and cheaper than extending DSL in a large portion of the areas covered by the CAF. Allowing satellite and wireless to compete for funding (instead of automatically offering support dollars to the telephone companies) would greatly reduce the tax burden on U.S. consumers.

The fact that our service is better than DSL in speeds means that taxpayer money could be used to fund build-out of a service that is worse than the service already available in the market. The CAF will fund a telephone company to build out 4Mbps copper-based DSL service (which really can't be upgraded) even where Exede-12 is available. This doesn't make any sense. At a minimum, we believe the no-bid award process should be

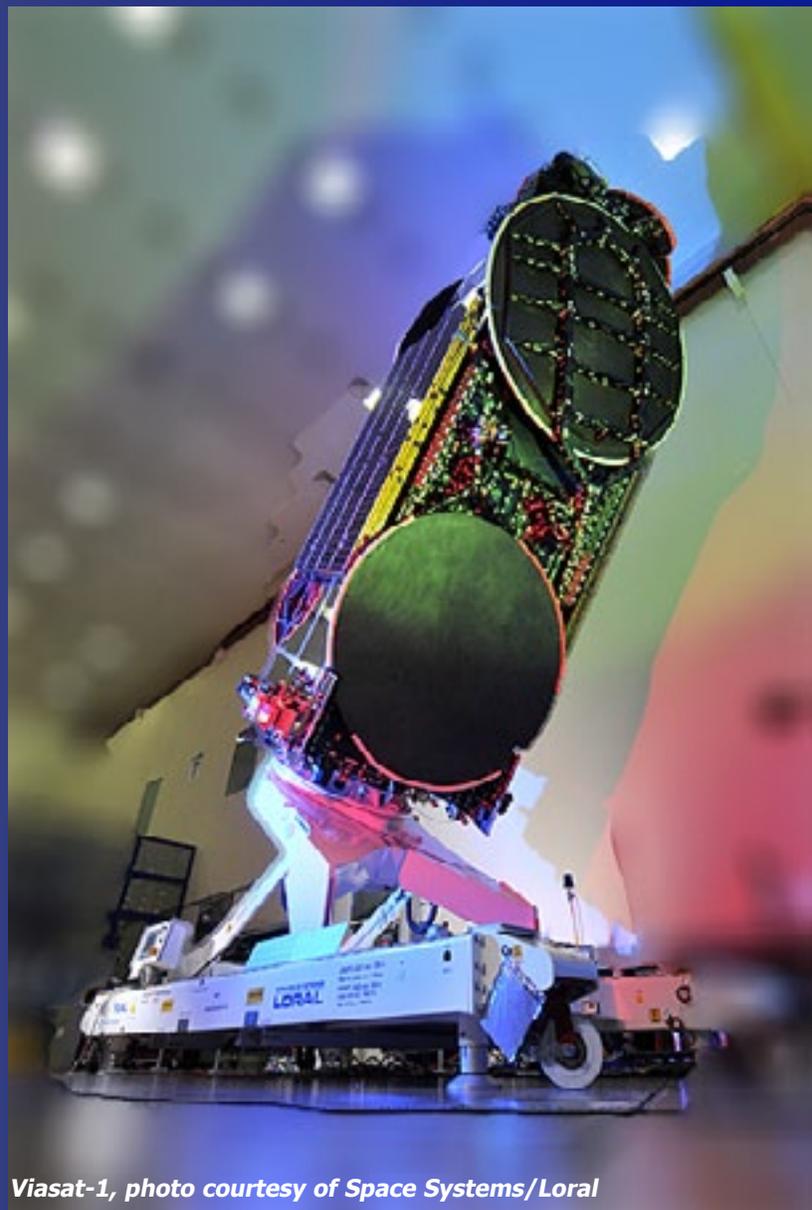
converted to a market-based competitive procurement where any technology provider may bid.

### SM

*Looking back over your career, what projects bring a smile to your face?*

### Lisa Scalpone

It's got to be our satellite launches. Our **ViaSat-1** launch was especially exciting, given that four years of planning for our new Exede service was riding on the back of that rocket. The company was so united in its excitement—and nervousness—for a good outcome.



*Viasat-1, photo courtesy of Space Systems/Loral*

## Truly Educational Experiences... With Nanosats

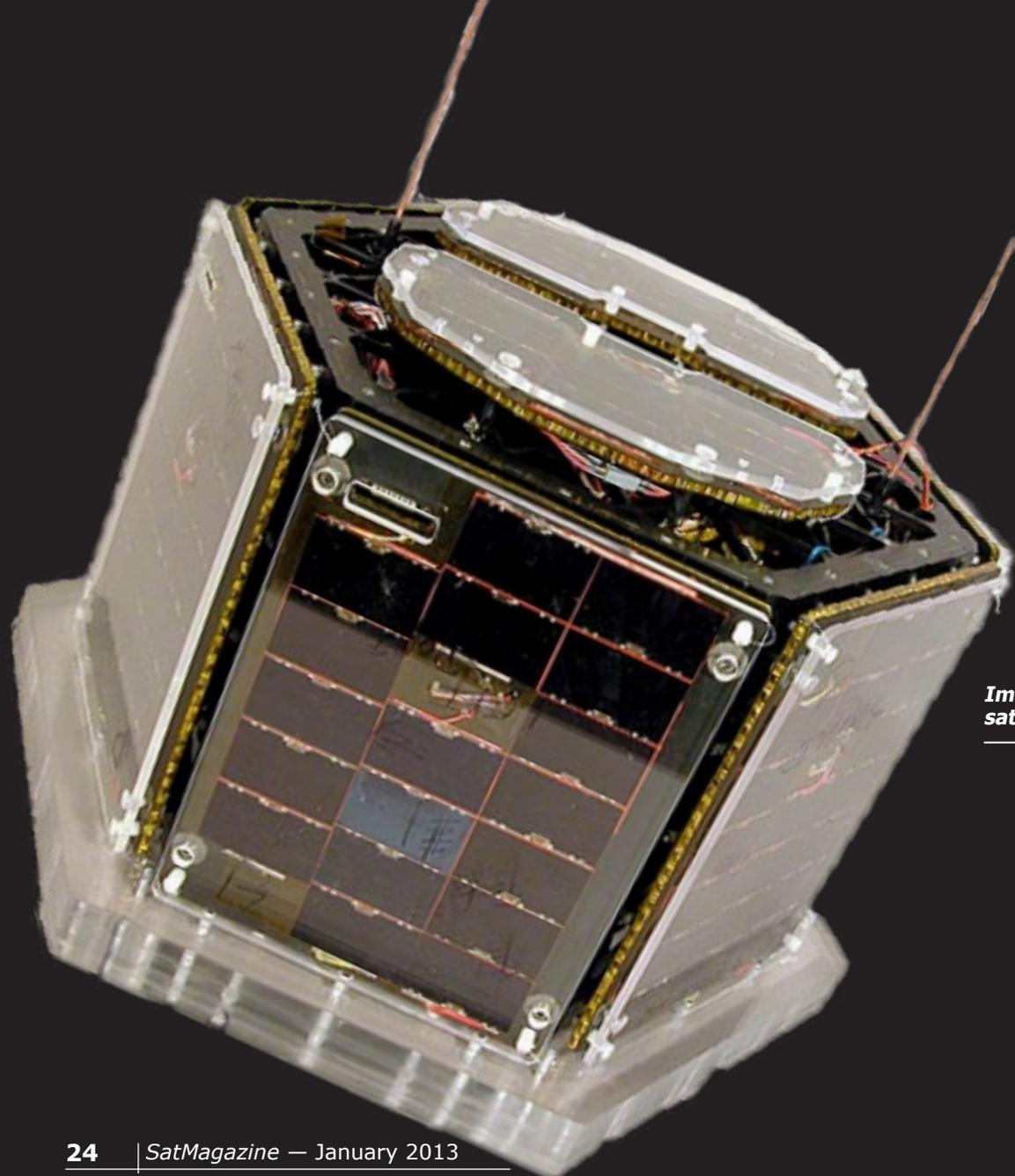
by Jos Heyman, Senior Contributing Editor



**W**ith the winners of the University Nanosat Program-7 to be announced shortly and the commencement of the Nanosat-8 program expected in the coming months, it is appropriate to look back at this program.

In 1999 the Air Force Office of Scientific Research (AFOSR), in cooperation with the Air Force Research Laboratory (AFRL), the Defense Advanced Research Projects Agency (DARPA), the American Institute of Aeronautics and Astronautics (AIAA), and NASA introduced the University Nanosat Program. The purpose of the program was to allow future space professionals, through their universities, experience a satellite development project from the moment of conception right through building and delivery of a flight-ready spacecraft.

Since 1999 more than 4,500 university students at 27 universities have taken part in this program which is, currently, in its seventh competition.



*Image: New Mexico State's Petey satellite*

Of all the projects only a few reached flight status, or will be flown, in the near future.

This does not mean the projects were a failure. They were primarily intended to serve as educational projects. As such, each of the proposed projects can be considered to have been a success in that it achieved an educational objective.

Due to the educational nature of these projects, the 'publicity' effort is usually minimal, especially for those projects that 'did not make it'. To what extent these projects simply vanished and failed to make deadlines, is, of course, a matter of pure speculation.

## Starting Goal

The original program conception was to launch all completed and delivered nanosatellites via the *Space Shuttle*. However, following the **Columbia** disaster of February 1, 2003, all scientific payloads were deleted from such flights.

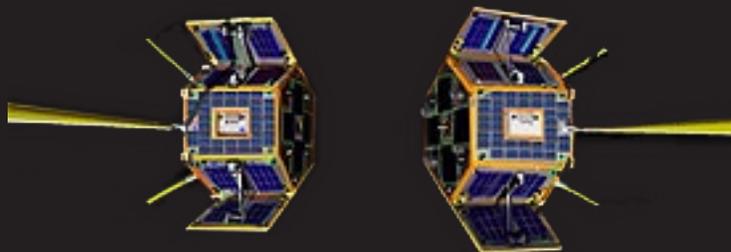
The initial target size was a nanosatellite with a mass of up to 35kg—over time, the mass restrictions were lifted and this resulted in larger, as well as smaller, satellites. The current program schedule is:

- **Fall of Even Years**  
*Apply to next AFOSR University Nanosat BAA*
- **Last Months of Even Years**  
*Universities are selected and notified of pending awards*
- **Spring of Odd Years**  
*Kickoff Meeting: Competition Begins*
- **Spring of Odd Years**  
*Grants arrive at Universities*
- **Spring (mid) of First Year**  
*System Concept Review (SCR)*
- **Spring (late) of First Year**  
*System Requirements Review (SRR)*
- **Summer (early) of First Year**  
*Student Hands-On Training (SHOT) Workshop, Part I*
- **Summer (late) of First Year**  
*Preliminary Design Review (PDR) at Small Satellite Conference*
- **Fall of First Year**  
*Satellite Fabrication Class*
- **Spring of Second Year**  
*Critical Design Review (CDR) at Universities*
- **Summer (early) of Second Year**  
*SHOT II Workshop*
- **Summer (late) of Second Year**  
*Proto-Qualification Review (PQR) at Small Satellite Conference*
- **January of Third Year**  
*Flight Competition Review (FCR)*

## Nanosat-1 and -2

The Nanosat-1 and -2 competitions of January 1999 were run concurrently. The participants in Nanosat-1 were:

- **Stanford University** and **Santa Clara University** with **Orion** (35kg) and two **Emerald** satellites (15kg each), which



**Dual Emerald satellites—Stanford University**

## Truly Educational Experiences... With Nanosats (Cont.)



**University of Colorado's Ralphie, a participant in the Three Corner Sat Project**

were to demonstrate formation flying in a semi-autonomous fashion. The project was cancelled.

- **Boston University** with **Constellation Pathfinder**, to demonstrate the feasibility of fabricating and launching three 1kg satellites capable of collecting and returning quality scientific and engineering data for several months. No hardware was delivered and the project lapsed.
- **Carnegie Mellon University** with **Solar Blade**, which was to fly the first solar sail using solar radiation pressure as its only means of propulsion and attitude control. No hardware was delivered and the project lapsed.

The participants in **Nanosat-2** were divided in two, separate projects:

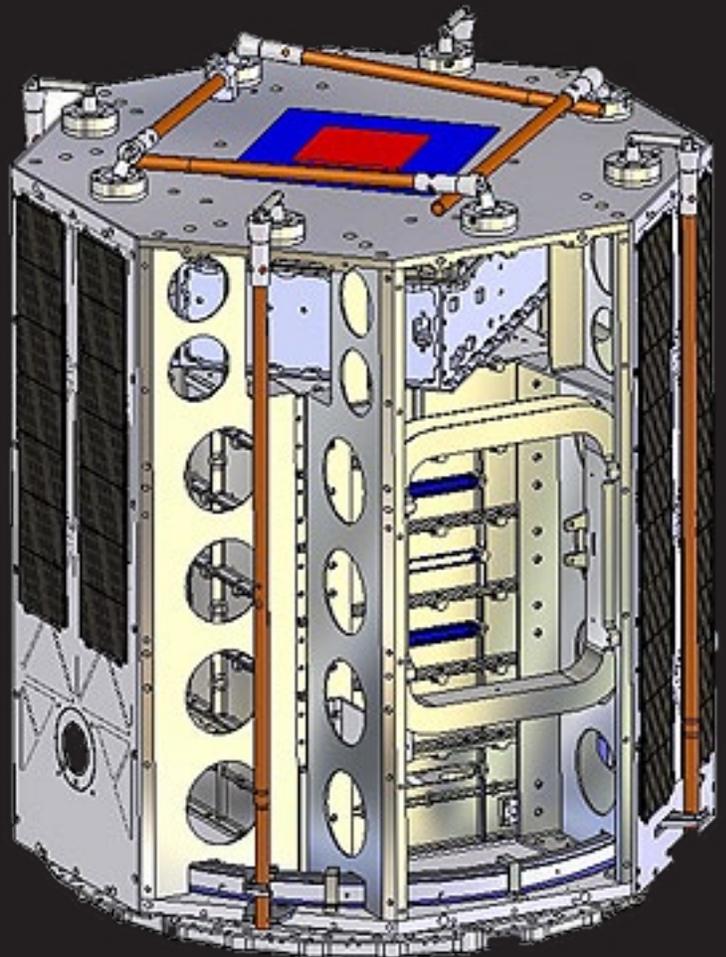
- **Arizona State University**, with **Sparky**, **New Mexico State University** with **Petey**, and the **University of Colorado at Boulder** with **Ralphie**—all three educational institutions of higher learning cooperated in the **Three Corner Sat Project (3CS)**, to demonstrate miniaturized components and other technologies as well as to test low-shock deployment systems for releasing satellites from a launch vehicle. The three satellite were to be launched on a Space Shuttle flight but, following the Columbia disaster, missions of this nature were cancelled. Sparkey and Ralphie eventually flew on a **Delta 4** Heavy Launch Vehicle on December 21, 2004, but failed to achieve orbit. Petey was built and was donated to the **National Air and Space Museum**.

- The **University of Washington** with **Dawgstar**, **Virginia Polytech Institute and State University** with **HokieSat** and **Utah State University's USUSat**, cooperated in the **Ionospheric Observation Nanosatellite Formation (ION-F)** project to investigate satellite coordination while flying in formation as well as management technologies, while also measuring the distribution of the ionosphere. They were to fly on the same Space Shuttle mission as the 3CS satellites, but were all cancelled, although Dawgstar was delivered.

### Nanosat 3

**Nanosat-3** work started in January of 2003 and differed from Nanosat-1 and -2 as a competition based selection process was implemented for the build. All of the universities' work would be reviewed throughout the competition and only the most complete satellite would be selected for delivery to **AFRL** for the flight into space. Thirteen universities participated and each university was required to deliver an **Engineering Design Unit (EDU)** at the end of the two year competition period. These were:

- **Arizona State University** with **ASUSat-3**, which was to demonstrate emerging bio-/nano- technologies and new capabilities as well as demonstrate a micro-propulsion system.
- **Michigan Technological University** with **HuskySat**, which was to measure variations in radio wave emissions that would show how much, if any, man made radiation was



**Montana State University's SpaceBuoy project**

seeping into the frequencies characteristic of soil moisture. The project was awarded third place in the competition.

- **Montana State University** with **MAIA**, which was to demonstrate new technologies including solid state charged particle sensors, deployment of a solar panel through an *Elastic Memory Composite* deployment hinge, and the use of solid state magneto resistive magnetometer devices as part of an active magnetic three-axis attitude control system. Hardware in this project was tested and built and the experience was transferred to the subsequent **SpaceBuoy** project that participated in **Nanosat-5**.
- **New Mexico State University** with **NMSUSat**, which was to perform *Near Ultra Violet (NUV)* emission intensity measurements of the Earth's upper atmosphere over the night side of the Earth.
- **Penn State University** with **LionSat**, which was to investigate the local ambient and perturbed plasma environments surrounding a small satellite in the Earth's ionosphere, to measure the ambient plasma environment and the ram and wake regions using a novel hybrid plasma probe instrument; and to test a miniature RF ion thruster system.
- **Taylor University** with the *Thunderstorm Effects in Space and Technology (TEST)* nanosatellite, which was to carry a plasma probe, a UI photometer and spectrometer, a transient photometer, dual energetic particle spectrometers, VLF receiver, educational pods, and amateur radio communication instruments. This project won second place and the knowledge was shared with Boston University for use in their BUSat project for Nanosat-5.
- **University of Colorado at Boulder** with *Deployment and Intelligent Nanosatellite Operations (DINO)*, to generate topographic maps of the tops of clouds through stereoscopic imaging based on photographs from the on-board digital cameras, with most processing done on the satellite itself.
- **University of Hawaii at Manoa** with **Hokolua (Twin Stars)**, two satellites connected by a tether to determine whether the materials used were appropriate for the connection as well as to study and perform thermal stress analysis. Each of the satellites would be 10x10x17cm.
- **University of Michigan** with **FENIX**
- **Utah State University** with **USUSat II**, which was to measure the intensity of EUV in the **F** region of the ionosphere for tomographic reconstruction of vertical plasma density profile. Hardware was built and tested and the experience flowed on to **USUSat III (TOROID I)**, a **Nanosat-4** project.
- **University of Texas at Austin** with **FASTRAC**, two satellites to investigate technologies for flying in formation, including on-orbit micro-thrust capability, relative navigation, attitude determination, and satellite crosslink communications. This project won first place and the spacecraft were delivered to AFRL in June of 2006 for integration into the **STP-S26** payload, which was launched with a **Minotaur 4/HAPS** on November 20, 2010—the second satellite did not separate until March 20, 2011.
- **Washington University at St. Louis** with the **Akoya** and **Bandit** satellites, which were to demonstrate remote operations of a 1kg service vehicle (Bandit) from a 30kg spacecraft (Akoya) as the parent vehicle. This would have included

## Truly Educational Experiences... With Nanosats (Cont.)

repeatable docking and station keeping. The knowledge flowed on to a similarly named project for Nanosat-4.

- **Worcester Polytechnic Institute** with the *Powder Metallurgy and Navigation Satellite (PANSAT)*, to demonstrate a GPS based navigation and orientation determination system and the use of a *powder metallurgy (P/M)* component design methods to develop the primary satellite bus structure.

### Nanosat-4

The fourth Nanosat competition began in March of 2005. By this time, NASA's **Goddard Space Flight Center** was no longer involved—11 universities took part in this competition. The participating universities included:

- **Cornell University** with *CUSat*, two satellites to demonstrate the use of centimeter accuracy carrier-phase differential GPS for the autonomous navigation of the two satellites. CUSat was selected as the winner and was delivered to AFRL in April 2008 and is scheduled to be launched from Vandenberg AFB in early 2013 via a **SpaceX Falcon 9** launch vehicle.
- **New Mexico State University** with *NMSUSat-2*, to demonstrate control of the platform via passive means. Once this control was to be achieved, the satellite was to conduct robotic motions using a dual-arm robot attached to the satellite.
- **Santa Clara University** with *ON-board autonomy eXperiment, (ONYX)*, to demonstrate advanced technology and design processes for fast-paced, low-cost satellite development as well as operationally validate advanced, distributed space system control techniques while conducting an Earth observing mission.
- **Texas A&M University** with *AggieSat-1*, which was to carry three technology experiments: A simple microsatellite propulsion system using water as the propellant; a versatile miniature positioning mechanism using a reusable shape memory alloy as the actuator; and an enzymatic energy source using glucose as the fuel. Knowledge was carried forward to *AggieSat-2*, which was launched as *Dragonsat-2* on July 30, 2009.
- **University of Central Florida** with *KnightSat*, with the primary goal of obtaining a stereo image of one point on the Earth's surface.
- **University of Cincinnati** with *BEARSat*, to test a solar collector.
- **University of Minnesota** with *MinneSat*, to perform an experiment to determine its attitude using GPS data.
- **University of Missouri at Rolla** with *UMRSat*, the study of two satellites flying in coupled flight as well as formation flight. This project was in third place. It was further developed as projects in the Nanosat-6 and -7 competitions.
- **University of Texas at Austin** with *Autonomous Rendezvous and rapid Turnaround Experiment Maneuverable Inspection Satellite (ARTEMIS)*, to demonstrate rapid, plug-n-play integration and operation of two small satellites, one of which would be capable of autonomous rendezvous, visual inspection, and crosslink with the other. The project evolved into the 2-STEP project of the Nanosat-5 competition.
- **Utah State University** with *TOmographic Remote Observer of Ionospheric Disturbances (TORIOD) I*, to measure the airglow due to electron and oxygen ion recombination in the 150 to 600 km altitude region and vertical density profiles of the night time ionospheric plasma. Also known as *USUSat III*, the knowledge was carried forward to *TOROID II* in the Nanosat-5 program.
- **Washington University at St. Louis** with *Akoya* and *Bandit-C*, to demonstrate on-orbit navigation and control of two 5kg service vehicles (Bandit-C) by a 25kg host vehicle (Akoya). This project, which was a development of the *Nanosat-3* project, won second place.

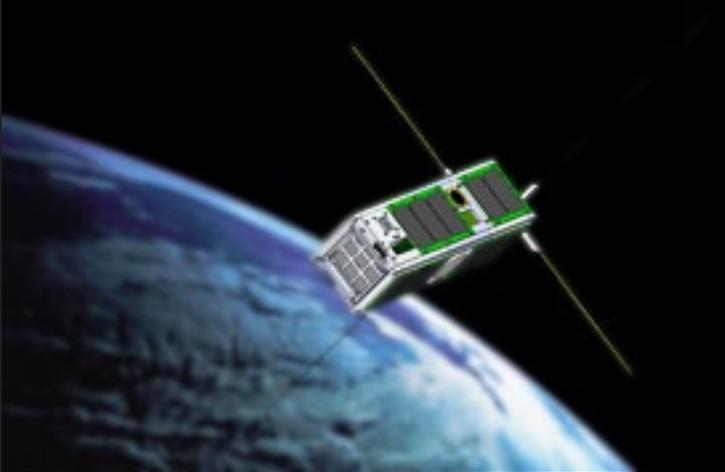
### Nanosat-5

*Nanosat-5* started in January 2007. In this competition, the size requirement imposed by a Shuttle launch was dropped, allowing universities to build larger satellites. Eleven universities took part and the participants were:

- **Boston University** with *BUSat-1*, to acquire energetic electron data at high latitudes as well as to simultaneously acquire optical images of auroral arcs from horizon to horizon.
- **Michigan Technological University** with *Oculus*, to demonstrate a *Narrow Field of View (NFOV)* imager for tracking and monitoring of objects in space, using two deployable cubesats as targets.
- **Montana State University** with *SpaceBuoy*, which was to measure several ionospheric plasma parameters essential to space weather forecasting.
- **Penn State University** with *NittanySat*, to investigate the high-latitude D-region of the ionosphere and its effects on radio frequency communications.
- **Santa Clara University** with *Obsidian*, to develop a robotic positioning system for biotech instrumentation which included the integration of synthetic biological "cells" with a micro-fluidic system to grow the samples, and the provision of a controlled environment to sustain biological growth.
- **Texas A&M University** with *AggieSat-3*, to demonstrate close proximity navigation using a stereo vision system in an advancement towards autonomous rendezvous and docking missions.
- **University of Colorado at Boulder** with *Drag and Atmospheric Neutral Density Experiment (DANDE)*, to perform drag and neutral density measurements of the low Earth atmosphere in order to further research in space weather and atmospheric models. DANDE was declared the winner in January 2009 and the payload is expected to be flown in 2013.
- **University of Minnesota** with *Goldeneye*, to validate the use of a GPS bistatic radar for remote sensing applications with small satellites in low Earth orbit. This project was based on the Nanosat-4 MinneSat project.
- **University of Texas at Austin** with *2-STEP*, two satellites, a larger chaser satellite and a smaller target, to demonstrate navigation and guidance through a rendezvous and on-orbit inspection mission. It was based on the ARTEMIS project of the Nanosat-4 competition.
- **Utah State University** with *TOROID II*, to measure vertical density profiles of the night time ionospheric plasma density distribution using an *Extreme Ultraviolet (EUV) Photometer*. It was based on the TOROID I project of the Nanosat-4 competition.



The Cubesat COPPER—St. Louis University



**The 3U Cubesat, Armadillo—University of Texas**

- **Washington State University at St. Louis** with **Akoya-B** and **Bandit C**, to demonstrate remote operations of a 3kg service vehicle (Bandit-C) from a 29kg spacecraft (Akoya-B) as parent vehicle. Tests were to include repeatable docking and station keeping. This project won second place and was a development of similar project submitted for Nanosat-3 and -4.

### **Nanosat-6**

Ten universities participated in **Nanosat-6** which commenced in January 2009. These were:

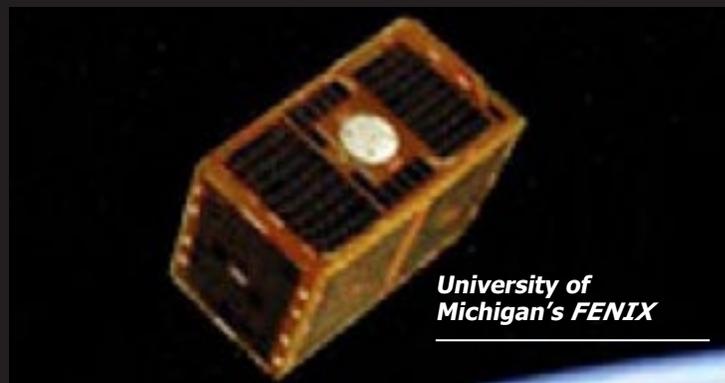
- **Cornell University** with **Violet**, to demonstrate novel CMG steering laws along with an operationally responsive, high-agility space-imaging system. It won second place.
- **University of Central Florida** with **KnightSat-2**, to demonstrate a *Propellantless Space Debris Mitigation Drag Sail* for LEO Satellites using an *Attitude Control and Aerodynamic Drag Sail (ACADS)*.
- **University of Hawaii at Manoa** with **Ho'oponopono**, to provide orbital radar calibration support to the U.S. Air Force by collecting and disseminating ephemeris data in response to radar interrogations. It won third place and was re-submitted as part of the Nanosat-7 program.
- **Santa Clara University** with **Intelligent Responsive Imaging Spacecraft (IRIS)**, to undertake an estuarine science and ecology program by performing critical imaging and communications services.
- **Missouri University of Science and Technology**, formerly known as **University of Missouri at Rolla**, with **M-SAT**, consisting of two microsatellites, *Missouri Rolla Satellite (MR-SAT)* and *Missouri Rolla Second Satellite (MRS-SAT)*. The satellites were designed to be launched as a single unit, then separate and maintain a specific flight formation. In this maneuver, MR-SAT would 'pursue' MRS-SAT and circumnavigate it. This was a development of the URMSat project of Nanosat-4 and was further developed as a project of Nanosat-7.
- **Michigan Technological University** with **Oculus-ASR**, carrying equipment that would allow for the calibration of ground based instruments to track the shapes of orbital satellites. It won the competition and will be launched in 2013.
- **University of Minnesota** with **Twin Sat**, an extension of the **GoldenEye** Nanosat-5 project, this time instead of sensing the Earth's surface, this satellite was to use GPS to sense other satellites in space.

- **Georgia Tech** with *Rapid Reconnaissance and Response (R3)*, to demonstrate a microbolometer, a new type of thermal imager that would give small satellites the capability to perform thermal infrared imaging, a capability previously reserved for large, expensive satellites.
- **Massachusetts Institute of Technology** with *CASTOR* or *Orbital Surveillance Maneuverability Vehicle (OSMV)*, to demonstrate on-orbit performance of the *Diverging Cusped-Field Thruster*, which would have provided enough velocity increment to reach the Moon.
- **St. Louis University** with *COPPER*, a cubesat to capture infrared video of co-manifested satellites during separation and to capture infrared images of Earth's oceans and atmosphere.

## Nanosat-7

The *Nanosat-7* competition commenced in March 2011 and 11 universities participated...

- **Boston University** with *BUSat-2*, to explore the relationship between the Earth's ionosphere and magnetosphere by observing auroral characteristics and atmospheric interactions. The basic scientific payloads are the *Auroral Imager (AI)* and the *Compact Half-Unit Imaging Electron Spectrometer (CHICO)*. The goal is to also include a *Langmuir Plasma Probe*, a microdosimeter, and a *Very Low Frequency (VLF)* receiver.
- **Georgia Tech** with *Prox-1*, to demonstrate autonomous safe trajectory control, with a cubesat to be ejected from Prox-1. Prox-1 will then rendezvous and fly around the cubesat. Prox-1 will use image-based observations for navigation and closed-loop attitude control and will be fitted with a microbolometer thermal imager to acquire thermal images of the target and a visible camera to acquire visible images of the target.
- **Massachusetts Institute of Technology** with *Trapped Energetic Radiation Satellite (TERSAT)*, to use an electromagnetic punch to knock harmful high-energy



University of Michigan's FENIX

particles out of the inner Van Allen Radiation Belt and help protect satellites.

- **Missouri University of Science and Technology** with *M-SAT*, a development of the project in Nanosat-6 that included several improvements to the original design.
- **Montana State University** with a development of the *SpaceBuoy* of the Nanosat-5 competition.
- **St. Louis University** with *Argus*, a 2U cubesat to improve the predictive performance modeling of radiation effects on small, modern space electronics devices by collecting radiation particle collision data from electronics.
- **State University of New York at Buffalo** with *Glados*, to provide photometric and radiometric data of unresolved space objects—specifically that of other satellites.
- **University of Hawaii at Manoa** with a continuation of Nanosat-6's *Ho'oponopono* project.
- **University of Maryland** with *Dynamic Manipulation Flight Experiment (Dymaflex)*, to demonstrate precision manipulator motion on free-flier and validate advanced control schemes for dynamic vehicle motion.
- **University of Michigan** with *CubeSat Investigating Atmospheric Density Response to Extreme Driving (CADRE)*, to solve orbital determination problems with accuracy using an earth gravitational model of degree and order of one's choosing and measure the satellite's position.
- **University of Texas at Austin** with *Attitude Related Maneuvers and Debris Instrumentation in Low (L) Orbit (ARMADILLO)*, a 3U cubesat to will study and characterize sub-millimeter space debris particles currently in LEO using a *Piezo Dust Detector (PDD)*. Additionally, ARMADILLO will obtain radio occultation measurements by collecting GPS measurements using a dual frequency, software-defined **FOTON** GPS receiver.

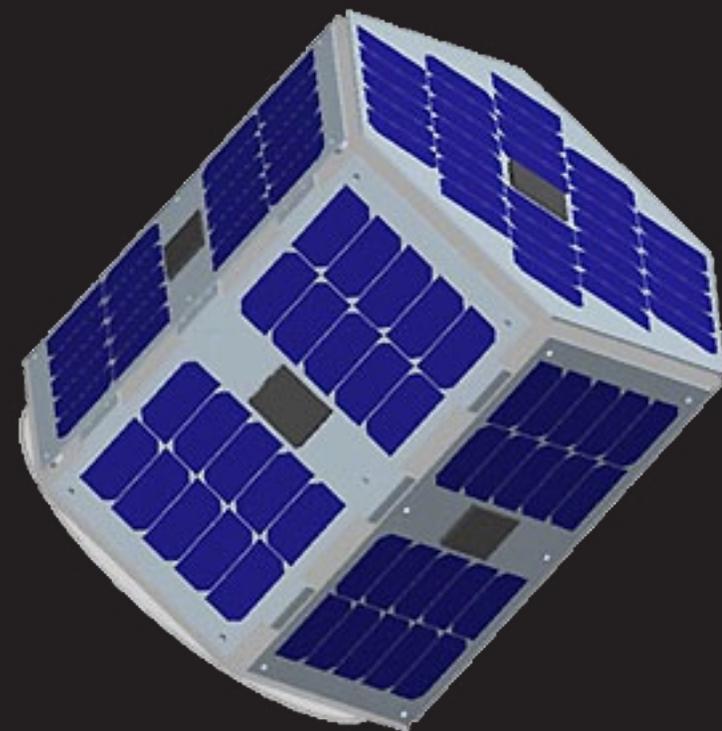
The winner of the Nanosat-7 competition is expected to be announced in March 2013.

## Nanosat-8

The eighth Nanosat program will commence in January 2013 and, as of this writing, there is no indication which universities are participating in the competition.

### About the author

Jos Heyman is the Managing Director of Tيروس Space Information, a Western Australian consultancy specializing in the dissemination of information on the scientific exploration and commercial application of space for use by educational as well as commercial organisations. An accountant by profession, Jos is the editor of the *TSI News Bulletin* and is also a regular contributor to the British Interplanetary Society's Spaceflight journal.





## **Executive Spotlight: Chris O'Dell, Vice President, Hughes Network Systems Europe**

**C**hris heads up the sales and operating organization for the European market of Hughes Network Systems, LLC., a subsidiary of EchoStar Corporation. His responsibility is to drive growth within existing and emerging European markets.

Chris joined Hughes Europe in July 2011. Previously, he spent six years at global telecoms provider Huawei Technologies as UK Sales Director, Fixed Line Service Providers. His early career included three years at Nortel Research & Development before moving on to the parent firm, Nortel Networks, where he held a number of positions in the carrier and enterprise divisions, including Pre-Sales Engineering Manager, Northern Europe Technical Sales Manager and as the EMEA Business Development Manager.

## **SatMagazine (SM)**

*Mr. O'Dell, what initially prompted you to pursue a career in communications and how did you move into the SATCOM arena?*

### **Chris O'Dell**

Since my childhood I have always been interested in how things worked and the impact they have on people's lives. As a result, a career in communications was a natural next step for me after studying Engineering at university. It's a dynamic, fast-paced environment that directly affects almost every aspect of our lives, both in and outside work.

In 2011, I moved into SATCOM at an especially exciting time, as satellite is currently at the forefront of much of what's new in communications technology development. As a highly-successful pioneer in this field, **Hughes Europe** was looking to further grow its managed services business and this ideally fitted both my existing skills-set and career aspirations.

### **SM**

*What are your key responsibilities with Hughes Network Systems Europe?*

### **Chris O'Dell**

I have overall responsibility for sales, pre-sales engineering and the creation and implementation of our marketing strategy. This is happening at a key stage of our parent company Hughes' development, as we look to make the most of the company's acquisition by **EchoStar Corporation** in 2011, bringing together two of the telecommunications industry's largest and most innovative players.

### **SM**

*How long have you been with Hughes Europe and what were your previous role(s)? How did you decide upon making the move to Hughes?*

### **Chris O'Dell**

I joined Hughes Europe approximately 18 months ago and was attracted by the prospect of joining the market's leading VSAT supplier at a time when that market segment was set to significantly expand. A closer look at the company's growth strategy, strong client base and history of success—in terms of technology leadership and customer engagement—made my commitment to join Hughes Europe an easy decision.

### **SM**

*Where were you employed before Hughes?*

### **Chris O'Dell**

My early career included an 11-year spell at **Nortel Networks**, initially in R&D before moving on to pre-sales engineering. I then took on various customer facing roles culminating in an EMEA-wide business development position, across the telco and channel markets. After that, I moved to **Huawei Technologies** as UK sales director, where, over a period of seven years, I grew the company's fixed line service provider division. This provided me with exactly the right kind of experience to take on my current role at Hughes, combining technical, managed services and strategic development skills.

### **SM**

*How would you sum up your experience of the satellite communications industry?*

## **Chris O'Dell**

From the outside and looking in, the satellite industry always looked to me to be one of the more vital and fast-changing areas of telecoms. Since joining Hughes, this view has been totally justified. With so many advances in technology and services coming to market and new satellites bringing advanced communications to businesses and individuals everywhere, it's great to be involved in such an energetic environment.

### **SM**

*How would you describe Hughes Europe and its parent company? Is there a fair amount of independence from the parent company for your firm to operate within its market segment as it deems fit?*

### **Chris O'Dell**

**Hughes Network Systems Europe (Hughes Europe)** is recognized as the market's leading provider of high-quality, resilient broadband network solutions to organizations throughout Europe. This is accomplished by combining the best of breed in satellite, wireless and terrestrial technologies, which are fully supported by world-class *Managed Network Services*. As a result, we are uniquely placed to deliver exactly the right comms solution for each individual customer.

In addition, we are able to leverage a lot of synergies from our parent, **Hughes Group**. We benefit from the market-leading innovative solutions they develop and the global service capability that we are able to offer in conjunction with them.

Overall, Hughes Europe operates as part of the Hughes international organization, yet we do have a degree of independence, which is partly dictated by differences in market focus. The parent company in North America is mostly centered on the consumer and **SME** (*small and medium size enterprise*) market, whereas in Europe our primary focus is on the mid to large enterprise area.

There is another dimension here. There is a compelling fit in bringing together Hughes with EchoStar Corporation. By combining Hughes' operational strength and proven record of customer satisfaction with EchoStar's expertise in cutting-edge satellite video technology, our customers will benefit significantly from our combined portfolio and services expertise.

### **SM**

*What are your company's key products and services?*

### **Chris O'Dell**

Hughes provides managed resilient technology-agnostic services with a variety of applications, enabling customers to change the way they 'do business'.

We offer standard or bespoke services built up from a number of elements and provide development and operational support for all satellite offerings. This can be combined with our Managed Network Services portfolio, which combines **VSAT**, **MPLS**, **DSL**, **3G** and **WiFi** communications.

Hughes' Value-Added Services include security management, Internet access, and WAN traffic optimization. Finally, Hughes offers Media Services, such as training delivery systems and content distribution for business, television and digital signage

### **SM**

*What are Hughes Europe's key USPs?*

## Executive Spotlight: Chris O'Dell, Hughes Network Systems Europe

### Chris O'Dell

Hughes Europe offers a compelling combination of flexibility, ubiquity and broad capability. First, we are able to offer customers the best and most appropriate solution rather than only the network we operate. Second, we can offer all network types—from Ka-, Ku-, and BGAN/C-band satellite, to terrestrial and 3G/GPRS wireless—and will architect the customer network to include the most appropriate communication type for each location.

Third, we offer a global capability. For European customers, the entire global or multi-national network can be managed from our network management centres in Europe. And on top of this, we also have a range of value added applications that deliver true business benefit to customers.

### SM

*What have been the high points of Hughes Network Systems Europe's history and some of the main reasons for its success?*

### Chris O'Dell

One of the major highlights for Hughes Europe to-date has been to run the **UK National Lottery** network. With more than 35,000 connections, including 90 percent VSAT, this represents one of the largest networks in the world. We are also the largest operator of networks for the retail petroleum industry across Europe, with solutions that incorporate VSAT, wireless and terrestrial connectivity as well as the delivery of training and digital signage into retail stores, all based on satellite broadcast technology.

There is a common denominator here. Hughes Europe's success is based on our consultative approach in working closely with customers. By understanding their business drivers and needs in each case, the resulting solutions are the best match and not constrained by any one network technology. As a result, Hughes has become a trusted advisor, one whom customers typically turn to for their current and future communications requirements.

### SM

*What is Hughes' "go to" market/distribution strategy and how are opportunities operated and addressed across the globe? How are such incorporated into the Company's Managed Services Strategy?*

### Chris O'Dell

Hughes Europe has a blended route to market, which depends on the type of end-customer in each case. This includes: Selling direct to large enterprises; indirect through VARs for consumers, SMEs and specific verticals; and jointly with System Integrators and telcos for highly complex enterprise solutions. Hughes has network operations centers around the globe, with the major hubs sited in North America and Europe that are able to manage the global networks of customers, no matter where they may be based.

In general, Hughes Europe will account manage all global business for European-headquartered companies. It will also manage significant regional organizations of non-European headquartered companies in partnership with other parts of the Hughes Group.

### SM

*Managed Services for large enterprises is the key driver for Hughes Europe. Why is this?*

### Chris O'Dell

Though we have a substantial market presence by selling hardware and systems, it is clear that large enterprises and public sector organizations do not have simple networking requirements and it is not a core competency to run them in-house. For these organizations, Hughes Europe is able to take on the management of their networks, freeing up the time and expertise for the enterprise to focus on its core activity and areas of competence. As a result, our strategy for Managed Services is to target multi-national organizations with a large number of distributed locations. Hughes Europe can then be the single centralized point of contact in managing the entire network.

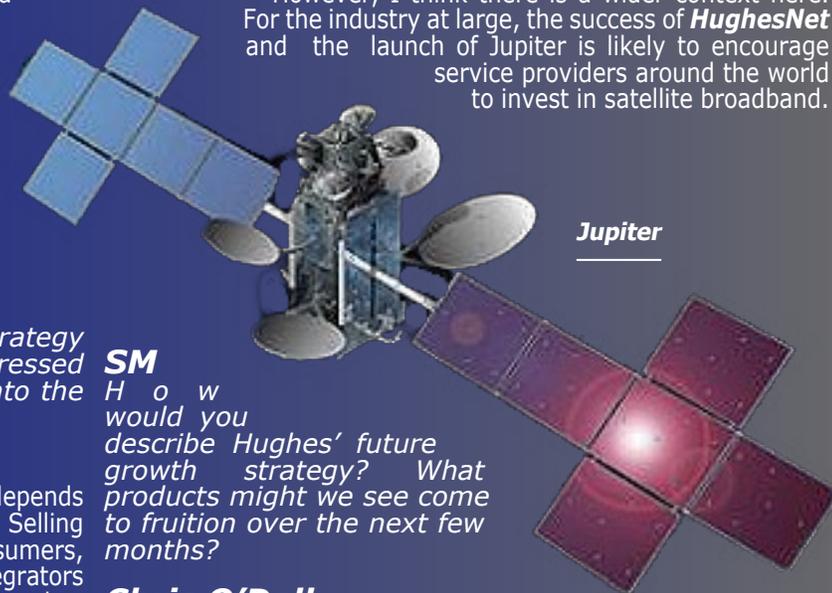
### SM

*What impact will the recent launch of the JUPITER satellite have on the industry? What benefits will JUPITER bring to your firm?*

### Chris O'Dell

Hughes has already demonstrated the success and profitability of satellite-based Internet services. With the recent launch of **EchoStar 17** (also more widely known as **Jupiter**) we can achieve a far lower cost per bit than that previously achieved. The Jupiter satellite means we will be able to offer more services, more economically. In many cases, this means we can now talk about competing against DSL for the first time.

However, I think there is a wider context here. For the industry at large, the success of **HughesNet** and the launch of Jupiter is likely to encourage service providers around the world to invest in satellite broadband.



### SM

*How would you describe Hughes' future growth strategy? What products might we see come to fruition over the next few months?*

### Chris O'Dell

As a diverse corporation, at Hughes we are focused on a number of different growth areas. For example, with the launch of EchoStar 17 (Jupiter), consumer broadband services is currently a hot topic for us. In more established areas, we are also continuing to see strong demand for enterprise and government services. Similarly, there is an ongoing robust market for the sale of equipment to third-party operators who, in turn, use our equipment to address these same market segments.

In the area of new products, it is not Hughes company policy to talk about future developments. Some of our competitors announce new products far in advance. We prefer to announce new products when they are ready for delivery.

## SM

*How would you characterize the current state of the SATCOM market?*

### **Chris O'Dell**

SATCOM is alive and well—in fact, it's never been in better shape. For example, around a million U.S. households use VSAT for their Internet access. In 2011, Hughes shipped more than 300,000 VSATs and we expect to surpass this number by some even larger margin this year. We have now sold three million VSATs in total and these are being used for a wide variety of markets and applications, everything from consumer broadband to high-end enterprise and government services.

The mobile sector, including civil and military maritime and aeronautical applications, is also currently enjoying significant growth. New Ka-band services are being deployed across the globe to service growing end-user domestic and business demand. The reason for this is simple and compelling. Satellite is becoming an increasingly important and central component in a world where it is essential to be connected.

## SM

*What are your thoughts regarding Hosted Payloads and how will such impact the market?*

### **Chris O'Dell**

Hosted Payloads are an excellent way to enter markets without incurring the total cost of a dedicated satellite. These offer clear benefits to all parties involved and can help develop new markets and applications. Ultimately, hosted payloads will also benefit end-users, by enabling new, more innovative players to enter the marketplace and improve competition.

## SM

*What concerns does Hughes have regarding satellite interference and what is the company's role in addressing such concerns?*

### **Chris O'Dell**

Radio frequency interference (RFI) is a major concern to Hughes as well as to the entire satellite industry. We ensure that we use highly skilled and trained installations and operations engineers, with regular audits to maintain our high standards.

We continue to work with industry groups such as the **Global VSAT Forum** and the **satellite Interference Reduction Group (sIRG)** to develop ways to reduce interference levels, improve industry-wide awareness and ensure all satellite users operate to the same high levels that we do.

## SM

*What changes do you see taking place in the next few years, such as satellite repurposing and on-orbit satellite repair?*

### **Chris O'Dell**

The demand for affordable bandwidth has never been greater and the need for that connectivity wherever you are located is increasing all the time. At the same time, continuing budgetary constraints are putting pressure on implementations for all of the actors in the private and public sectors. With the high costs associated with satellite construction and launch, anything that can extend the life of these assets such as satellite repurposing and on-orbit repair will be of real benefit the industry and become more important.

More broadly, the need to connect people anywhere, at any time and with anyone will drive mobility applications and

coverage requirements. This creates the ideal environment for satellite to establish a unique role in meeting these needs, with technology and service innovation becoming ever more important in keeping costs low and the user experience high.

## SM

*For students interested in pursuing a rewarding career in our industry, what subjects do you recommend they undertake in middle and secondary school, as well as college level courses?*

### **Chris O'Dell**

Working in a highly technical field such as satellite communications, subjects such as math, the sciences and engineering are going to be extremely important. However, creativity is also an essential skill in an area where speed of innovation is vital to success.

Students need an insatiable curiosity to learn, to understand how things work and why things happen. They must ask questions, challenge ideas, be creative and think. In short, subject knowledge is obviously critical, but by itself will not be enough to succeed. There is no doubt that we have found it a challenge to find people with the right balance of skills and aptitude. Despite this, we have been able to employ high-calibre candidates into key positions. In our experience, there is significant talent out there in the marketplace, it is just taking longer to find those people at the moment. Persistence, and a clear but flexible focus on what attributes are essential, are being rewarded.

## SM

*Looking back over your career, what projects bring a true sense of satisfaction to you?*

### **Chris O'Dell**

I originally entered into the communications industry in order to play a role in helping improve the way we live through technology. For me, the best projects, therefore, have been those where such impact has been the greatest or most direct.

Since joining Hughes, the best example of this has been my involvement in the launch of Ka-band services via the Avanti Hylas 1 and 2 satellites. For the first time, we are now able to provide consumers and small businesses with consistent high quality, high bandwidth broadband across all geographies. This represents a giant step towards banishing 'not spots' to the dustbin of history.



# NSR Analysis: The FSS Market Leader Board

by Patrick French, Senior Analyst, NSR, Singapore



**M**arket share in the FSS segment can be measured in any number of ways including total revenues or fleet size. One additional metric, used in NSR's *Global Assessment of Satellite Supply & Demand 9th Edition* study, is market share based on total leased commercial capacity either in terms of C-, Ku- and widebeam Ka-band transponders for the classic FSS segment or by Gbps of capacity in the emerging *High Throughput Satellite (HTS)* segment.

For the end of year 2011, NSR once again conducted a leased capacity market share assessment for the world's FSS operators, and the results were both expected and unexpected.

For the leasing of classic C-, Ku- and widebeam Ka-band transponders, NSR's assessment was based on 36MHz transponder equivalents (TPEs) of capacity on both station-kept and inclined orbit capacity. In order to avoid double counting and ensure a favorable treatment for all operators, leased capacity was attributed only to the actual owner of each satellite assessed.

For the HTS market share, leasing was based on NSR's estimate of actual capacity used in the case of satellites dedicated to specific services (e.g., *Spaceway-3* for *HughesNet*).

## Global satellite operators remain on top of the FSS market share rankings

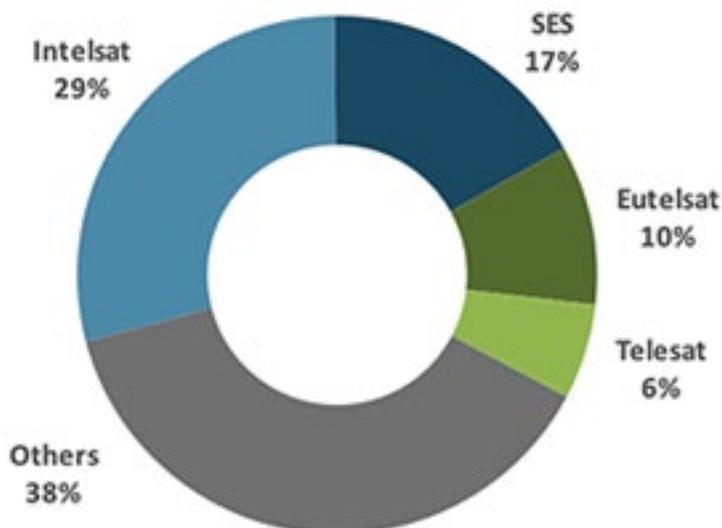
NSR's 2011 market share analysis of all leased C-, Ku- and Ka-band transponders saw once again the same four global operators in the top market share positions. Given that these operators have the largest satellite fleets, their combined position with 62 percent of worldwide leased transponders is understandable.

Yet, this is down two points from 2010 indicating that regional players continue to be strong in many specific market segments around the world and that, in reality, the "global" satellite market remains a very "localized" market in many aspects.

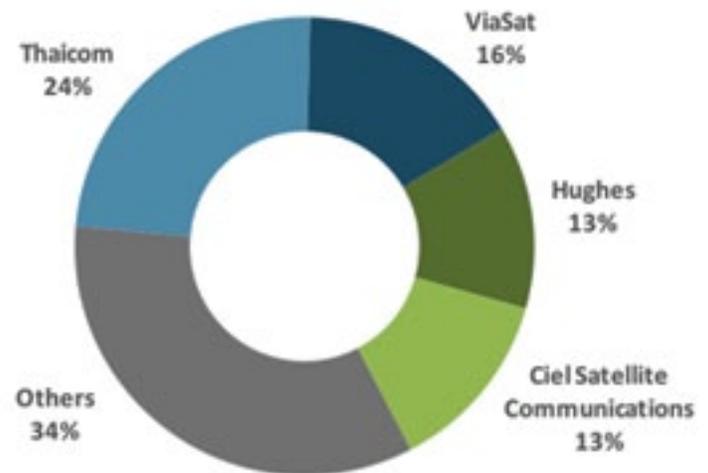
This can be illustrated by assessing, as is done in the *GASSD 9th Edition*, market share within specific regional markets. Such an assessment often shows that regional players are in fact at the top, or quite close to it, in the individual regional market share assessment as well as a number of important regional markets, for example Southeast Asia, being highly fragmented.

NSR has begun to see a reduction in the fragmentation of the HTS market share leadership board with just four operators accounting for 66 percent of all leased HTS capacity in 2011, but the top players are in flux. In 2010, *Telesat* was one of the HTS market share leaders due to use of capacity on *Anik-F2* and *-F3* for broadband access services in North America. But *Telesat* dropped out of a leadership position in 2011 as *ViaSat* increased usage of its *WildBlue-1* and *EchoStar-XVII* satellites in terms of provisioning its broadband access subscriber base.

NSR expects that the same will soon happen to *Ciel Satellite*, where NSR defines the spot-beam payload on *Ciel-2*, currently fully leased for DTH services, as HTS capacity.



Global Market Share Of Leased C-, Ku- and Ka-band TPEs, 2011 — Source: NSR



Global Market Share Of Leased HTS Capacity, 2011 — Source: NSR

Conversely, **Eutelsat** had yet to emerge on the list of market share leaders in 2011 as demand ramp-up on **KaSat** has been slow. Further, other players such as **YahSat** or even **Arabsat** could make an appearance on the leader board in the coming years as demand on their respective HTS payloads increases.

### **The Bottom Line**

The C-, Ku-band and widebeam Ka-band market share assessment of leased commercial TPEs is of no surprise to the industry. However it is interesting to note that **Intelsat** has a far greater lead over its nearest peers than would be the case in a market share based on revenues. This is because **SES** and **Eutelsat** benefit from much higher average revenues per leased transponder than Intelsat, mainly due to their positions in the lucrative European market.

Conversely, a number of surprise entities appear in the HTS market share assessment, such as Ciel Satellite whose role in the market is rather unique. Conversely, other entities like Eutelsat do not yet appear.

NSR expects that ViaSat, Hughes and Eutelsat will come to dominate the HTS market share based on leased capacity within the next one to two years as they begin to drive up usage of their respective large high throughput satellites.

NSR's view is that these same companies will not be quite as dominant in the HTS segment in the future from a revenue perspective as their core markets, consumer-class broadband access services, depend on cheap capacity. The advantage for these companies is not, per se, in capacity leasing, but in building up large broadband access subscriber bases where the main revenues come from monthly service fees and not the capacity leasing itself.

### **About the author**

Mr. French joined NSR in September 2003 and is the lead author for NSR's annual studies Global Assessment of Satellite Demand and Broadband Satellite Markets. He has sought to expand NSR's coverage of the satellite industry into areas such as commercial satellite supply and demand modeling, video distribution and contribution, DTH, telephony and narrowband VSAT networks. In addition, he has undertaken client specific projects in diverse satellite applications and intends to broaden NSR coverage of the European satellite industry. From 1990 to 1999, Mr. French was a staff member of the International Space University (ISU), first in Cambridge, Massachusetts and then 6-½ years at ISU's Central Campus located in Strasbourg, France. Mr. French held numerous positions within ISU organizing conferences, short courses, and workshops. In parallel, he was responsible for managing the development of the new ISU Central Campus facilities that were completed in mid-2003. Following his work at ISU, Mr. French joined Frost & Sullivan where he rapidly advanced to the position of Strategic Analyst for the Satellite Communications group. While at Frost & Sullivan, Mr. French authored eight studies, led numerous consulting projects, and tracked other diverse markets such as satellite television, launch services, emerging satellite applications and content delivery networks. Mr. French holds a Bachelors of Science in Aerospace Engineering from Boston University and attended the 1999 ISU Summer Session in Nakhon Ratchasima, Thailand. He is fluent in French.



## **Out Of The Blue + Into The Black**

by Michael Carlowicz, NASA Earth Observatory

**T**he night is nowhere near as dark as most of us think. In fact, the Earth is never really dark. And we don't have to be in the dark about what is happening at night anymore either. —Steven Miller, atmospheric scientist, Colorado State University



*"City lights provide a fairly straightforward means to map urban versus rural areas, and to show where major population centers are and where they are not," says William Stefanov of the International Space Station program. (Image courtesy of NASA Earth Observatory and NOAA National Geophysical Data Center)*

The night side of Earth twinkles with light. The first thing to stand out is the cities. "Nothing tells us more about the spread of humans across the Earth than city lights," asserts *Chris Elvidge*, a **NOAA** scientist who has studied them for 20 years.

Away from human settlements, light still shines. Wildfires and volcanoes rage. Oil and gas wells burn like candles. Auroras dance across the polar skies. Moonlight and starlight reflect off the water, snow, clouds, and deserts. Even the air and ocean sometimes glow.

A handful of scientists have observed earthly night lights over the past four decades with military satellites and astronaut photography. But in 2012, the view became significantly clearer. The **Suomi National Polar-orbiting Partnership (NPP)** satellite—launched in October of 2011 by **NASA**, the **National Oceanic and Atmospheric Administration (NOAA)**, and the **Department of Defense**—carries a low-light sensor that can distinguish night lights with six times better spatial resolution and 250 times better resolution of lighting levels (dynamic range) than before. Also, as Suomi NPP is a civilian science satellite, data is available to scientists within minutes to hours of acquisition.

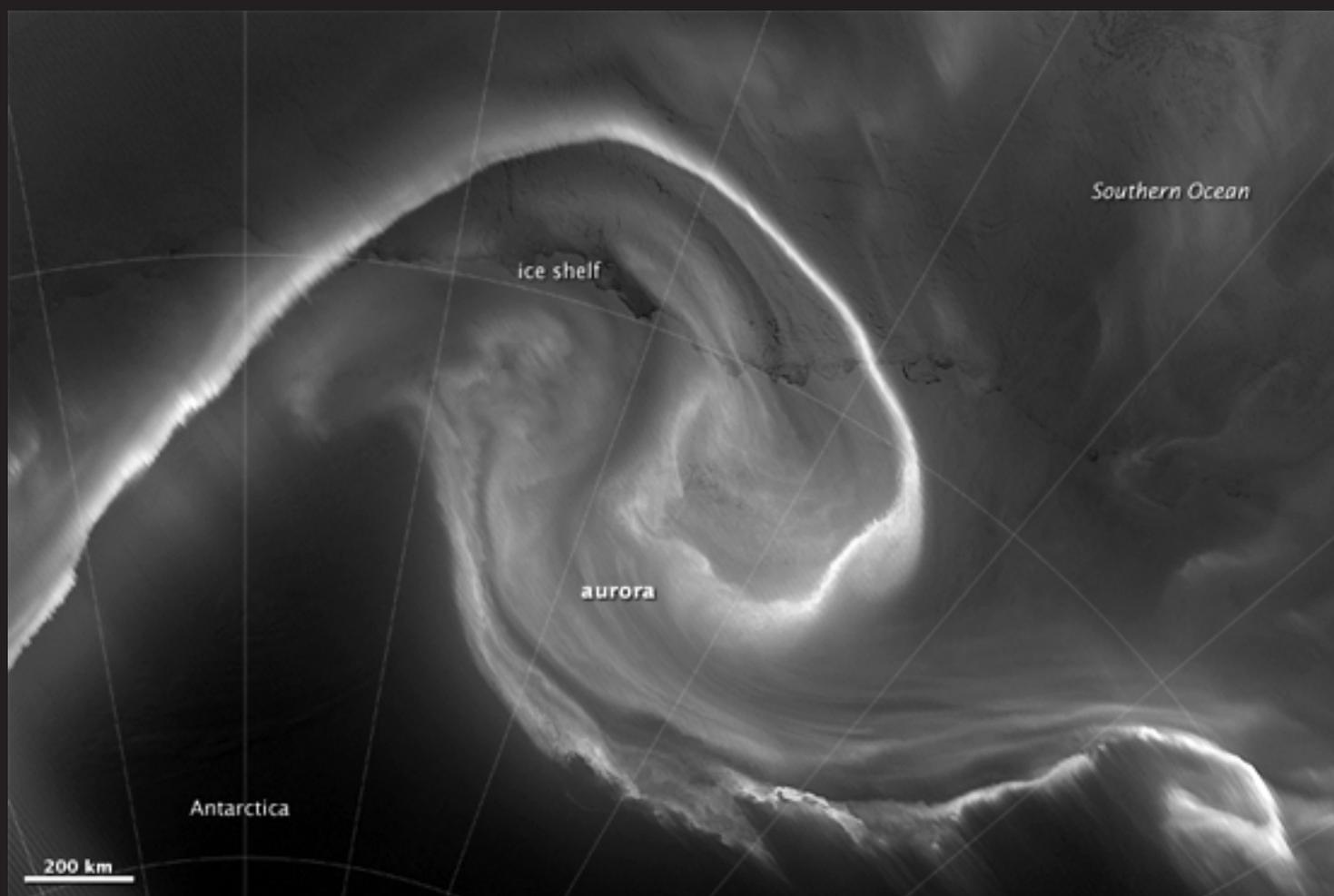
The *Visible Infrared Imaging Radiometer Suite (VIIRS)* on Suomi NPP can observe dim light down to the scale of an isolated highway lamp or fishing boat. It can even detect faint, nocturnal atmospheric light—known as airglow—and observe clouds lit by it. Through the use of its "day-night band," **VIIRS** can make the first quantitative measurements of light emissions and reflections, distinguishing the intensity and the sources of night light. The sum of these measurements gives us a global view of the human footprint on the Earth.

"These lights have always been there, but we've never had an ability to take full advantage of them," *Miller* says. "Now we finally have a way of doing that."

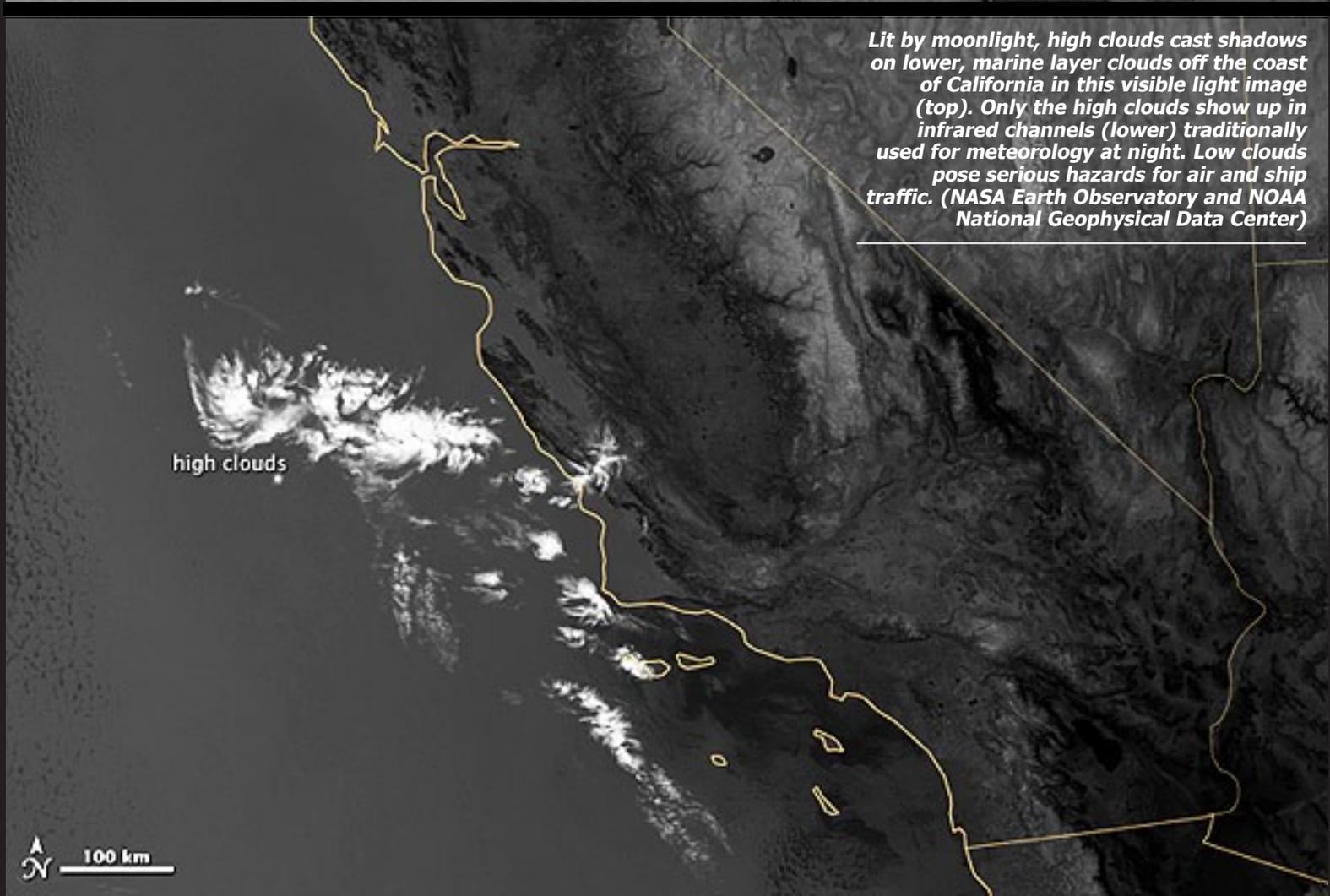
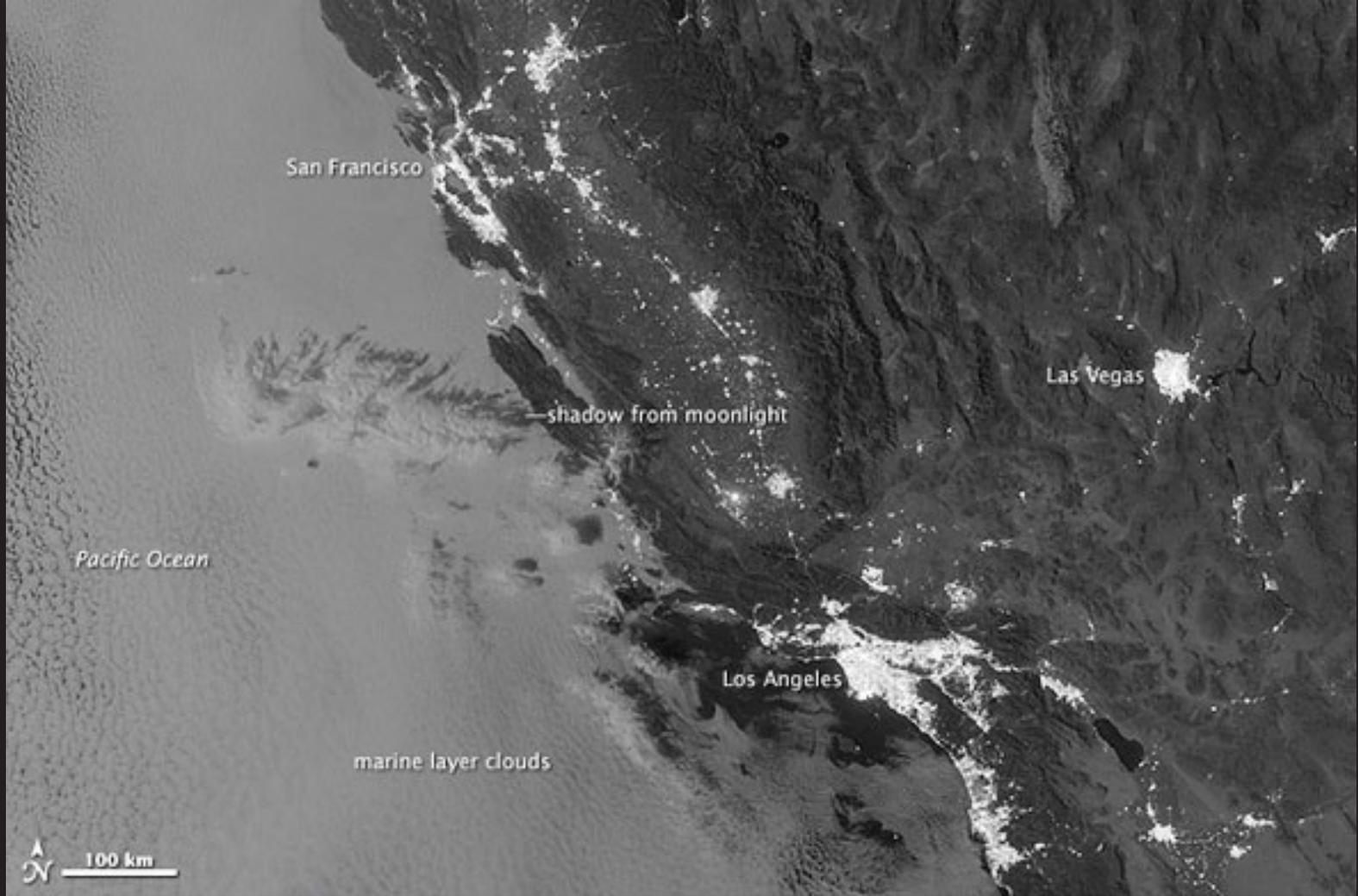
### **Night Vision For Weather Forecasters**

The original motivation for making low-light Earth observations was practical: military meteorologists wanted to track clouds and storms, smoke plumes, and dust storms at all hours. The Air Force, in particular, needed to provide more accurate and timely forecasts for pilots working at night both over land and at sea.

If combined with thermal (infrared) observations, visible images of moonlit skies can be extremely useful in characterizing the nighttime environment. Clouds are always changing, and there are certain kinds that are more prominent during the night. For instance, fog is more likely to form at night, when the air and surface are cooling and moisture condenses. Convective



**Light from the Aurora Australis, or "southern lights," is bright enough to reveal the ice edge in Antarctica's Queen Maud Land. (NASA Earth Observatory and NOAA National Geophysical Data Center)**



*Lit by moonlight, high clouds cast shadows on lower, marine layer clouds off the coast of California in this visible light image (top). Only the high clouds show up in infrared channels (lower) traditionally used for meteorology at night. Low clouds pose serious hazards for air and ship traffic. (NASA Earth Observatory and NOAA National Geophysical Data Center)*

clouds and thunderstorms tend to form during the day as the Sun heats the surface and destabilizes the lower atmosphere. The properties and distributions of many clouds change rapidly in the transition from sunlight to darkness.

Clouds are critical for understanding both daily weather and the long-term climate. As *Miller* points out, measuring cloud properties—such as water content and particle size—is relatively easy to do during the daytime, but not so much at night.

Since the 1960s, the **U.S. Air Force** has operated the **Defense Meteorological Satellite Program (DMSP)**, a series of 18 polar-orbiting satellites that observe clouds and other weather variables in key wavelengths of infrared and visible light. Since 1972, the DMSP satellites have included the **Operational Linescan System (OLS)**, which gives weather forecasters some ability to see in the dark. It has been a highly successful sensor, but it is dependent on older technology with lower resolution than most scientists would like. And for many years, DMSP data were classified.

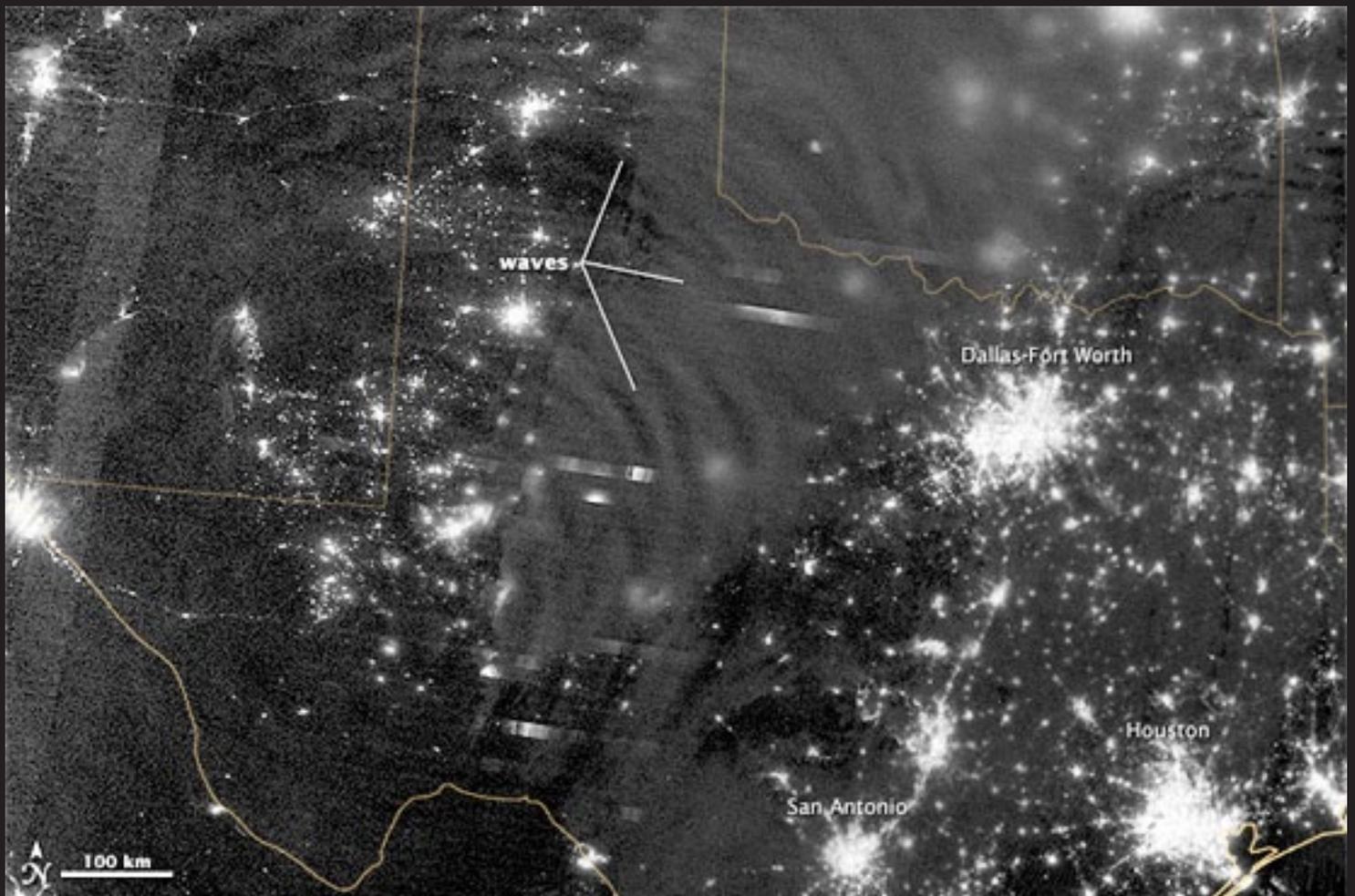
As only a few civilian scientists have had access to nighttime data over the years, the atmospheric science community was eager to have a night-vision tool of its own. The VIIRS instrument and its day-night band was the answer.

“For all the reasons that we need to see the Earth during the day, we also need to see the Earth at night,” says *Miller*, who started working with DMSP data for the Naval Research Laboratory during the wars in Afghanistan and Iraq. “Visible

light information provides a unique ability to detect and characterize atmospheric and surface features that confound thermal emission-based measurements. Unlike humans, the Earth never sleeps; it’s constantly moving, evolving, building up here, and tearing down there. There are many things happening on the nighttime side that we don’t understand because of limited observations.”

“The use of the day-night band by the National Weather Service is growing,” says *Mitch Goldberg*, NOAA’s program scientist for the **Joint Polar Satellite System** (including Suomi NPP). “For example, the NWS forecast office in Monterey, California, is now using the day-night band’s exceptional spatial resolution and contiguous coverage to provide higher confidence in issuing marine dense fog advisories.”

Nighttime observations are particularly valuable to people living at high latitudes. Many weather satellites are parked in geostationary orbit over the equator, and the polar regions are far off on the fringes of what they can see. Most other earth-observing satellites only provide visible observations during the daylight portions of their orbits. But the ground tracks of the polar-orbiting Suomi NPP overlap at high latitudes, providing multiple observations and measurements per day of moonlit clouds, sea ice, snow cover, and open waterways for people whose winter nights can last for months.



**In April 2012, VIIRS spotted waves rippling through the faint airglow in the upper atmosphere over Texas. The waves were provoked by a massive thunderstorm. (NASA Earth Observatory and NOAA National Geophysical Data Center)**

## Out Of The Blue + Into The Black (Cont.)

"As a new capability, I thought everyone would be impressed with the VIIRS day-night band," says *James Gleason*, NASA's project scientist for Suomi NPP. "But the remarkable images and the community response to them has exceeded my pre-launch expectations."

### Putting On Glasses For The First Time

NPP Suomi and its VIIRS instrument pass over any given location on Earth at roughly 1:30 a.m. and 1:30 p.m. local time each day, observing the planet in vertical strips from pole to pole. VIIRS is a spectroradiometer, detecting photons of light in 22 different wavelength bands and collecting them in a similar fashion to the charge-coupled device in your digital camera.

Unlike a film camera that captures a photograph in one exposure, VIIRS produces an image by repeatedly scanning a scene and resolving it as millions of individual picture elements, or pixels. The day-night band goes a step further, determining on-the-fly whether to use its low, medium, or high-gain mode to ensure that each pixel accurately depicts the amount of light emitted.

"On a hand-held camera, there's a nighttime setting where the shutter will stay open much longer than it would under daylight imaging conditions," says *Elvidge*, who leads the *Earth Observation Group* at NOAA's **National Geophysical Data Center**. "The day-night band is similar. It increases the exposure time—the amount of time that it's collecting photons for pixels." If a pixel is very bright, a low-gain mode on the sensor prevents the pixel from over-saturating. If the pixel is dark, the signal will be amplified.

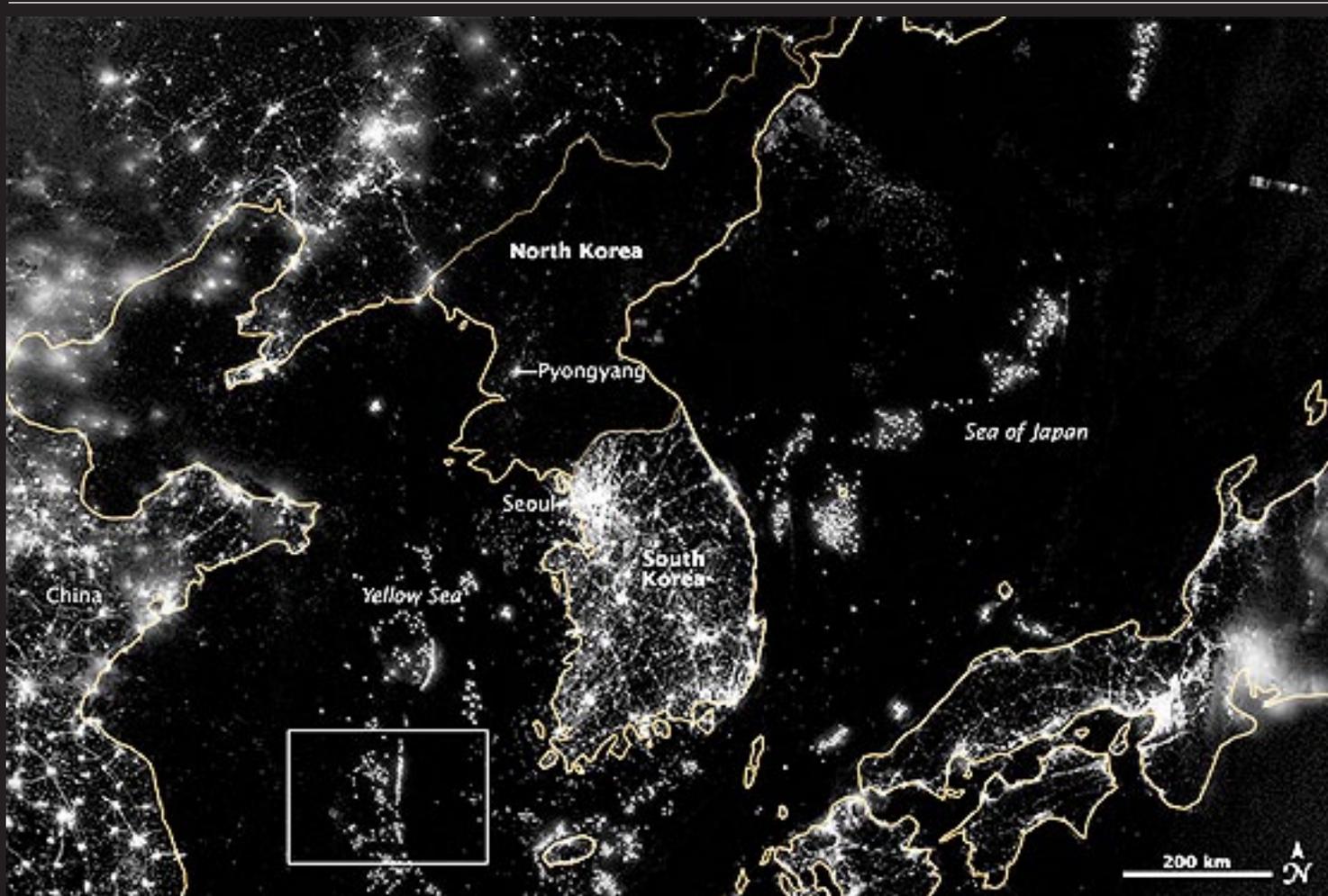
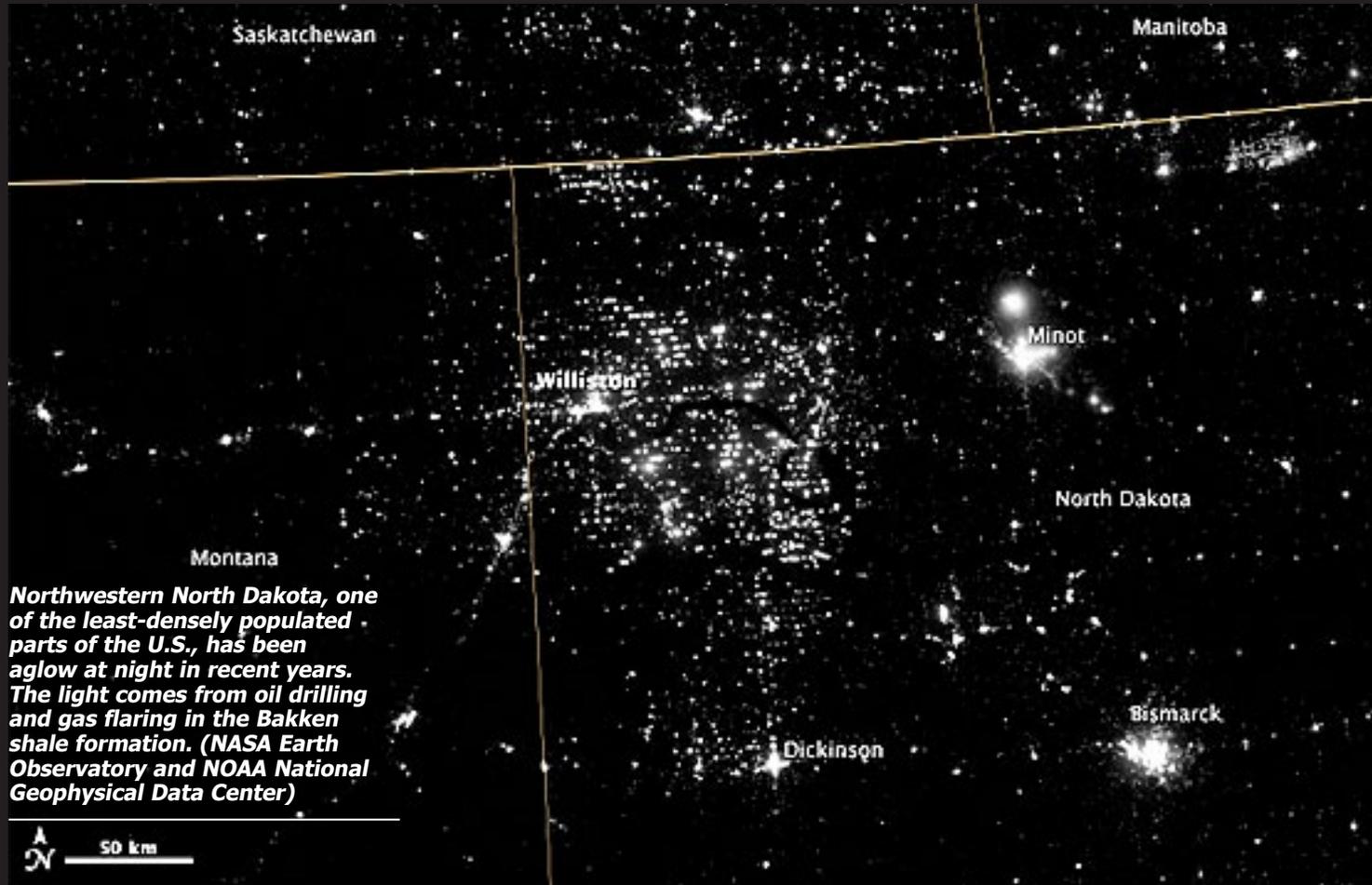
Using this smart technology and improved optics, the VIIRS day-night band is ten to fifteen times better than the OLS system at resolving the relatively dim lights of human settlements and reflected moonlight. Each pixel shows roughly 742 meters (0.46 miles) across, compared to the 3-kilometer footprint (1.86 miles) of DMSP. Beyond the resolution, the sensor can detect dimmer light sources. And since the VIIRS measurements are fully calibrated, scientists now have the precision required to make quantitative measurements of clouds and other features.

"In contrast to the Operational Line Scan system, the imagery from the new day-night band is almost like a nearsighted person putting on glasses for the first time and looking at the Earth anew," *Miller* says. "VIIRS has allowed us to bring this coarse, blurry view of night lights into clearer focus. Now we can see things in such great detail and at such high precision that we're really talking about a new kind of measurement."

Astronauts also take photographs of the Earth at night and, in fact, their images have even higher spatial resolution (typically 10s to 100s of meters per pixel). "But astronauts are not looking at Earth 24/7/365," says *William Straka*, an atmospheric scientist at the **University of Wisconsin**. Due to the orbit of the International Space Station, Straka adds, they cannot see the surface in the extreme polar regions, though they can observe phenomena in the upper atmosphere. Also, the ISS passes over a given point on Earth every two or three days and at variable times, while Suomi NPP flies over the same point twice a day at roughly the same time. Some scientists are interested in making joint observations between VIIRS and the ISS because of the complementary combinations of spatial resolution, timing, and quantitative accuracy.



Data for this map was acquired over 9 days in April 2012 and 13 days in October 2012. It took the satellite 312 orbits and 2.5 terabytes of data to get a clear shot of every parcel of Earth's land surface and islands.  
(NASA Earth Observatory and NOAA National Geophysical Data Center)



**City lights are usually an indicator of where people live, but not on the Korean Peninsula. South Korea's population is roughly 49 million and the land teems with light. North Korea has 24 million people and hardly any lights beyond Pyongyang. Offshore, the seas glow with the light of hundreds of fishing boats lining up along invisible borders. (NASA Earth Observatory and NOAA National Geophysical Data Center)**

## Out Of The Blue + Into The Black (Cont.)

### **The Night Electric**

The nighttime views collected by the day-night band are already proving useful to meteorologists and atmospheric scientists, who have been observing the dynamics of storms such as hurricanes *Isaac* and *Sandy*.

"Having the ability to see at night also helps identify features that could be missed by the other satellite sensors," says Straka. "We can bring out things like thin plumes of smoke, low-level volcanic ash, areas of fog and other features that otherwise would blend in with the background."

*Chris Elvidge* is particularly interested in the view of combustion sources—such as wildfires and gas flares — which glow in different wavelengths than manmade lights. His team can distinguish between the two by simultaneously using visible light and short-wave infrared bands. "We're detecting much smaller gas flares with VIIRS than we could with DMSP, and we're able to estimate the temperature and the total radiant output." Elvidge hopes the measurements could eventually lead to better estimates of carbon dioxide emissions.

But the most popular and poignant use of night-lights imagery remains the study—scientific and aesthetic—of city lights. "Nighttime imagery provides an intuitively graspable view of our planet," says *William Stefanov*, senior remote sensing scientist for the **International Space Station** program office.

"City lights provide a fairly straightforward means to map urban versus rural areas, and to show where the major population centers are and where they are not," *Stefanov* notes. "They are also an excellent means to track urban and suburban growth, which feeds into planning for energy use and urban hazards, for studying urban heat islands, and for initializing climate models."

*Elvidge* has seen dozens of different uses for city lights imagery. "Artificial lighting is an excellent remote sensing observable and proxy for human activity."

Social scientists and demographers have used it to model the spatial distribution of economic activity, of constructed surfaces, and of populations. Planners and environmental groups have used maps of lights to select sites for astronomical observatories and to monitor human development around parks and wildlife refuges. Electric power companies, emergency managers, and news media turn to night lights to observe blackouts.



*City light maps have been used to model the distribution of economic activity and populations, to monitor human development around parks and wildlife refuges, and to observe blackouts. (NASA Earth Observatory and NOAA National Geophysical Data Center)*

*Elvidge's* research group has been approached by groups seeking to model the distribution of carbon dioxide emissions from fossil fuels and to monitor the activity of commercial fishing fleets, who light up the seas to increase their catch. Biologists have examined how urban growth has fragmented animal habitat. He even learned once of a study of dictatorships in various parts of the world and how nighttime lights had a tendency to expand in the dictator's hometown or province.

In recent years, *Miller, Elvidge*, and colleagues have come across unexpected applications for these "dark side" measurements, including the first satellite observations of the mysterious milky seas—the bioluminescence of maritime lore, which causes vast expanses of ocean to glow. And the unanticipated capability of the day-night band to detect reflected airglow and starlight suggests that scientists may never have to be without a visible light measurement, even on nights without moonlight.

"Nighttime light is the most interesting data that I've had a chance to work with in my career," says Elvidge, who has been working with nighttime imagery since 1992. "Even after 20 years, I'm always amazed at what city light images show us about human activity."

"Even as we look toward other planets and the very corners of the universe for the next great discovery," Miller adds, "these nighttime observations are a humbling reminder that there are new frontiers of discovery that still await us in our own backyard."



### **Related Readings**

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NASA (n.d.) [Suomi NPP](#).

NOAA National Geophysical Data Center (n.d.) [Earth Observations Group-DMSP](#).

Lee, T. et al (2006, Feb) [The NPOESS VIIRS Day/Night Visible Sensor](#) Bulletin of the American Meteorological Society, Volume 87, Number 2.

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## ***VSAT: Five "Must-Have" System Characteristics***

*by Jon Manley, Director of Engineering + Business Development, Winegard Company*

**S**atellite communications have come a long way since Russian theorist Konstantin Tsiolkovsky first conceived of the geostationary orbit in the early 1900s, and the launch into space of the first commercial satellite, Intelsat 1, in 1965.

Today, communications satellites are taken for granted. Few people seem to know that virtually every facet of their lives depends in some way on space-based communications of one kind or another.



For business and commercial communications, **VSAT** (Very Small Aperture Terminal) is becoming *the* SATCOM workhorse. It is growing as a cost effective communication medium of choice for applications where there's no fiber and cable available, or where on-the-go mobile communications is required.

Once considered a niche technology, VSAT has garnered a growing market because of its flexibility, adaptability and cost effectiveness.

Due to the shrinking size and growing portability of VSAT antennas and terminals, they are increasingly deployed around the globe for oil and gas, military and defense, emergency management, medical, *satellite news gathering (SNG)*, retail and finance and maritime operations. That includes a lot of mobile command post vehicles used during emergency situations or natural disasters.

VSAT is ideal for establishing two-way links for data, voice, video and Internet connectivity with remote or mobile locations in one compact, economical package. It easily connects distant workplaces with a company's central office or communications center (star topology) or directly with other VSAT units (mesh topology), or a combination of both. VSAT networks can consist of from several dozen antennas and terminals up to as many as 500 units.

Anywhere there's a need for reliable, mission critical or far-flung remote communications, VSAT is a growing part of the solution, because of its rapid setup, high throughput and secure point-to-point nature. It's also relatively simple to integrate into an existing network. You don't need a PC or the Internet to use it and it offers a huge advantage for security and protection of data since information is not transmitted over the Internet.

### **VSAT Considerations**

If you are researching an initial VSAT purchase or wanting to update an older system, there are several critical factors you should consider before you buy.

In addition to making certain you find a quality product with a reasonable price tag, your considerations should extend into the financial stability and reliability of the supplier, as well as that of the antenna and terminal products.

Do the equipment supplier and the integrator have superior engineering expertise and experience? Can they customize the VSAT equipment for your specific needs? And, can they do it in weeks instead of six to nine months? What is the customer service and after-the-sale follow-up service like? Is a lot of technical assistance required?

Of course, cost is always a consideration. But your decision should not be based so much on cost, but on finding a unit that works well for your application. For example, some costly, high end VSAT systems used for mobile applications work well in smooth highway conditions, but have cables or components that may break when the vehicle is driven over rough pavement or on off-road situations.

Some mid-level priced units that are reliable and sport a rugged construction may hold up better than even the most expensive VSAT systems. Here are some all important items to consider before you cut a purchase order.

### **Five "Must-Have" System Characteristics**

There are many manufacturers of VSAT antennas and controllers in the world today because of the growing popularity of the product category. How do you tell them apart and determine the most important system characteristics you should be looking for in a complete system?

Over the lifetime of the VSAT products, users are looking for equipment that works for years with little or no maintenance and downtime. Downtime can mean lost or delayed data that can cost a company hundreds, if not thousands, of dollars per minute.

A wide variety of VSAT products are available on the market today. Industrial models begin at around \$3,000 and go all the way up to \$30,000 per unit. Different types of units are designed for different applications, primarily fixed and mobile. The portability of units is often important in certain industries so that communications can be moved from one location to another quickly to establish a link to the information network.

Many VSAT systems operate with the touch of a button for auto acquisition and there is no special training required to operate them. Others need to be set up manually, which requires more time and more on-site expertise.

### **Reliability**

Experienced users look for a VSAT system that is dependable and does what it is intended to do without a lot of maintenance. Customers want to get to a location and press a button and expect that the system will do its job by acquiring a satellite quickly and start communicating. The fastest VSAT systems usually acquire a satellite in two to three minutes, while others may take longer, depending on location. If you have a large quantity of data that needs to get somewhere in a hurry, you may want to focus on fast connecting systems.

Many users want a VSAT system that is able to automatically acquire a satellite without any operator intervention and without a technician. That's a major plus when considering VSAT, because it can reduce manpower costs and make workers in the field more efficient. A "plug and play" model that virtually any employee can set up to establish satellite communications in a few minutes is a powerful business tool.

Dish sizes typically range from .74 to 1.2 meters in diameter. The rule of thumb is that the more transmitter power that's available, the more bandwidth or throughput available.

Some manufacturers do little engineering, purchase parts from suppliers and assemble them. Other manufacturers engineer and make all or virtually all of their own parts and assemble the VSAT units in the U.S. with American workers. If you believe that *Made in America* delivers a more reliable product, then the choice becomes a little easier. You can just ask if the manufacturer designs, produces and assembles its units in the U.S.

Engineering expertise is another differentiator in the enhancement of VSAT reliability. Manufacturers with extensive antenna design and development experience, as well as the ability to customize a VSAT system to the exact needs of the customer offer a huge advantage in unit performance.

### **Ruggedness**

In remote or extreme environments, the construction of a VSAT antenna and terminal and the protective packaging of the supporting electronics are important considerations. When the units need to be moved by forklift or a crane, they must be well constructed to survive conditions like those found on oil drilling rigs, emergency management situations, electronic news gathering or military green zones.

Weather is another factor that affects VSAT performance. Solidly built units with good anchor systems are moved little, if at all, by the wind. Antenna movement by outside forces is a primary factor in losing satellite connectivity.

Not every manufacturer of VSAT antennas and terminals uses the highest quality materials in the construction of their units. Some units last longer than others. Well protected dishes and electronics are a function of quality manufacturing and the application of intelligent engineering.

VSAT manufacturers and integrators that provide strong, protective shipping containers for transportable units protect your investment. They also protect the electronics that make up the satellite communication transmission and reception station.

A manufacturer's commitment to delivering the highest quality, long-lasting products drives the focus of its quality assurance system. Manufacturers who use rugged parts, such as marine actuators—the gold standard—value antenna performance and reliability.

Throughout new product development antenna designs should undergo rigorous performance, environmental, reliability, durability, regulatory and packaging testing.

During manufacturing processes, a comprehensive quality system of operational work instructions, process and product audits, and product functional and live testing ensure that the manufacturer's antennas meet all established requirements before being shipped to the customer.

### **Key Ruggedness Factors**

Buying a VSAT system is similar to buying a car or truck. Some of the options or some of the elements that ensure rugged construction and reliability are not always apparent. You have to look closely and ask the manufacturer or distributor some questions about their products. Here are some key factors to look for in a VSAT system that assure rugged construction and enhanced reliability. They can usually be answered by calling the engineering department of the manufacturer:

- **Sealed roller bearings in the azimuth base**
- **Solid cast aluminum construction**
- **Aluminum cast sealed motor enclosures**
- **Use of marine grade actuators**
- **Meets CE International Protection Rating 65, or IP65, that prevents dust and water intrusion, as well as CE Low Voltage Directive Standards for safety and flammability**
- **Meets U.S. standards, as well as CE Electromagnetic Compatibility (EMC) standards for emissions, harmonics, voltage fluctuations and immunity**
- **Meets environmental standards issued by various VSAT satellite network operators such as Hughes**

### **Ease of Use**

Many users want a VSAT system that is able to automatically acquire a satellite without any operator intervention and without a technician. That's a major plus when considering VSAT, because it can reduce manpower costs and make workers in the field more efficient. A "plug-and-play" model that virtually any trained employee can set up to establish satellite communications in a few minutes is a powerful business tool.

Ease of use is often a top priority for many customers, especially when they don't necessarily want to cross train multiple employees to understand how the system works.

Put yourself in the user's shoes. You are in a remote location, likely in an extreme environment setting up the antenna. If the setup is simple and requires no technician, all you need to do is plug in the unit, expose it to the sky and push one button and get first time connectivity. Automating satellite acquisition and an uplink makes life easier for the team in the field and it means faster connectivity to the company communications or operations center.

Highly reliable VSAT units can be set to automatically recalibrate the satellite connection every 15 seconds or so in order to maintain constant connectivity.

### **Speed**

Fast connectivity is appealing to many markets, but especially for the satellite news gathering, emergency management and natural disaster segments.

With connectivity speeds (the time required to establish a link between the VSAT ground unit and the satellite, then to the operations center) ranging from two to 15 minutes, users can select what works best for them.

### **Easy Maintenance**

Every VSAT user wants a maintenance free experience. Manufacturers would like that too and the good ones build quality products to minimize the need for maintenance. But we all know that things happen and that maintenance is required for complex electronic equipment.

When you investigate which VSAT unit to purchase, look for one that allows remote troubleshooting of problems that may arise. This can reduce diagnostic and repair times significantly.

Preventive maintenance should be easy to perform on the unit and clear instructions should be provided by the manufacturer and/or the integrator.

### **The Balancing Act**

As one of our favored authorized resellers told me recently, *"Winegard VSAT units are not the cheapest or the most expensive, but they offer the best balance of reliability and price of any units I sell."*

I truly believe that, as well.

Our 60 years of pioneering antenna design and development, combined with our excellent manufacturing and engineering capabilities, makes Winegard a strong contender in the VSAT market. We hope we're on your short list to consider for your network.

Winegard's manufacturing facility, featuring state-of-the-art high-speed automated manufacturing, assembly and packing equipment, operates under the Lean Continuous Improvement model. This systematic approach to the elimination of process variation and waste continues to elevate quality, lower total cost, and shorten customer order fulfillment times.

In a highly competitive global economy, Winegard continues to lead its industry through the integration of these advanced production technologies and lean manufacturing.

Winegard takes great pride in being more than just an assembler, marketing the antennas as *"Made in the U.S.A."*

### **About the author**

Jon Manley has been the Director of Engineering & Business Development at Winegard for nearly 7 years. He oversees all R&D and new product design and development processes for Winegard. Through his vision he has established a diversely skilled engineering team that is capable of designing and building cutting edge antennas, mounts and accessories that have allowed Winegard to not only gain a competitive edge in the marketplace, but to enter new markets as well. Jon achieved his B.S.E.E. from Southern Illinois and later went on to get his M.B.A. from the University of Iowa. Prior to starting his career at Winegard, Jon was a RF Design Engineer and RF Team Leader for two Motorola Cellular divisions. Later he went on to become an Engineering Manager for the Motorola Land Mobile Products Sector before joining Winegard.

## A Case In Point

*For business and commercial communications, VSAT (Very Small Aperture Terminal) are found in some of the most remote locations and hostile environments on Earth, providing voice, data and video communication links back to company headquarters or other locations in a business necessity. Whether those sites are in the Arctic, Malaysia, Saudi Arabia, Texas or the Gulf of Mexico, VSAT satellite systems provide an ideal communication medium because of its data security, no need for a computer and broadband speed of data transmission.*

*Global communications and IT services company DTS was competing with the Goliaths of their industry for a major VSAT contract. The target was one of the largest oilfield services companies in the U.S. The prize was more than 200 VSAT systems that would be used to communicate between remote drilling or well sites and corporate headquarters hundreds or thousands of miles away.*

*Each satellite communication system would need to transmit and receive voice, data and video, as well as provide wireless broadband at the remote locations.*

*Some 40 companies from around the world competed for this enormous communications contract over a period of 18 months. The customer was determined to find the best combination of value and price. DTS was one of the smallest, and the only privately-held competitor for the contract. The ultimate decision would not be made on price alone, but on the ability of the supplier to provide a superior, customized product on a relatively tight timeframe.*

**How to beat the big competitors?**

*DTS teamed up with Winegard Company to pursue the proposal and develop a unique and cost efficient solution for the end customer. The companies complemented each other because of their belief in quality, innovation and timely response.*

*"DTS chose Winegard to supply the VSAT systems because it produces innovative, reliable products and can quickly customize units to fit our customers' unique needs," said DTS President Mike Guidroz. "When we call them and say we need a specific antenna, it's done in days or weeks versus months for some of their competitors. Speed to deliver is a key factor for our customers and that is where Winegard rose to the top. We also like the rugged construction of the Winegard VSAT units along with the tech free set-up."*

**Auto-deploy roof-mounted antenna WX-1200 selected as the antenna solution for DTS SatCom Box™**



**Patent pending DTS SatCom Box™ with Winegard VSAT antenna and controller systems.**

*DTS won the oilfield services company multi-year VSAT contract because of the innovation in product and packaging, as well as the speed to deliver. Many of the DTS competitors were unable to match the speed to deliver and cost effectiveness sought by the customer.*

*Hundreds of Winegard VSAT units are being deployed coast-to-coast and in the Gulf of Mexico to provide the oilfield services company with customized secure, remote communications with its oil rigs and other operations. Winegard's VSAT systems provide a direct link between headquarters and oilfield operations, without using the Internet or a PC, for data, voice and video communications, often in hostile environments.*



# SatBroadcasting™— Futuresource: 4K Channels ICn 2014

by Chris Forrester, Senior Contributing Editor

**R**esearch consultancy Futuresource expects a number of broadcasters to launch 4K channels during 2014. This appears to be the next iteration in the broadcast and media industry and equates to resolutions of approximately 4,000 pixels wide by around 2,000 pixels in height.

Test transmissions from the SES Astra and Eutelsat could start showcasing the technology in 2013. Futuresource's forecasts suggest that by 2020 the sale of 4K-equipped receivers could amount to some 15 percent of the overall TV set market and a healthy 29 percent of sales of 50-inch plus units.





**Brian Sullivan, CEO, Sky Deutschland**

Indeed, on December 1st, **News Corp**-backed **Sky Deutschland** carried out extensive 4K experiments at an important soccer game between *Bayern Munich* and *Borussia Dortmund*. Sky's CEO *Brian Sullivan* admitted this was but the first of many other steps on the road to 4K transmission, but the results were "already amazing".

Technically, *Sullivan's* team used just one camera (a **Sony F65** unit) at the stadium, which they moved to various positions around the ground and used a variety of lenses. The content was captured to memory cards. Sky's local production partner was **Kropac Media** (based at *Ingolstadt*) which is fast building up a reputation for 4K shooting. Kropac also used a **JVC** 4K camcorder in a drone above the ground for aerial shots.

Specifically, **Futuresource**—which mounted a London webinar on the prospects for 4K on November 30th—said that 4K cameras have been around since the introduction of the **RED** units in 2007 and that 4K shooting was now a well-established technique for cameramen. Hollywood has now produced around 50 movies in 4K. Additionally, classic movies, such as *Lawrence of Arabia*, have been re-scanned in 4K.

At the prosumer end of the market, JVC has launched a 4K handheld camera priced at just 4,000 pound, and Sony has a couple of 4K camcorder units planned for launch at the upcoming **NAB** show in Las Vegas.

*Jonathan Tustain*, editor at *3D Focus*, a specialist website, said, "The experts were quick to remind the listeners that many countries, especially in Eastern Europe, are still in the process of upgrading to HD, and that the reality, away from the excitement of IBC, is that there is a long way to go, and there could be an element of 'upgrade fatigue' setting in."

However, he also added, "Broadcasters and payTV operators are already trialling the technology due to the need to continue innovation and maintain competitiveness. TV Globo in Brazil are very proactive in evaluating 4K thanks to the 2016 Olympics and Futuresource Consulting quoted DirecTV, Sky, Comcast, Canal + and SES Astra as all looking at the technology. In fact, a few operators are expected to launch 4K channels in 2014."

Futuresource's panellists (hosted by Adam Cox, Senior Market Analyst—Broadcast, Carl Hibbert, Head of Broadcast, Content & Services, and David Watkins, Research Consultant), explored the reality of 4K and the commercial and technological factors that could drive the technology forward. They made some natural comparisons to 3D and that, although 3D has not gone away, the format has not achieved the expectations predicted for the technology in 2009 and 2010 when nearly every trade show exhibitor was either talking about, or showing off, a new stereoscopic tool.

Nevertheless, problems remain. "In the market today, 4K production, equipment and viewing opportunities are few and far between," said Tustain. "4K is being led by the theatrical industry but outside of the limited number of 4K projector equipped theatres, there are few monitors, camcorders and displays capable of processing the format.

"When questioning the rationale to go to 4K it was stated that it is a natural progression with an undeniable improvement in picture quality, a fact debatable with 3D. It was highlighted that during every 4K presentation at a trade show, crowds flock around the panels, despite only viewing static, slow based images—it is an easy sell. There is also no barrier to consumers—people do not need to wear a pair of glasses to enjoy the experience.

"From a commercial perspective, the vendors simply need it, in a time when technology becomes increasingly commoditized. 3D went from being a premium product to a feature built in by default with little price premium when take-up was so lacking. TV manufacturers will need to deliver desirable technology that encourages people to upgrade, but in today's economic climate, that is going to be a tough call. Throughout history there has always been a new technology feature to sell new sets—color, NICAM digital Stereo, Widescreen, HD, tapeless, flat screens, LED, OLED and 3D. It is one of the arguments that is used when debating whether, like in JAPAN, the industry should wait and skip straight to 8K (also known as Super Hi-Vision)—the cycle of upgrades is essential for TV manufacturers," said Tustain.

He explained that there remain some very real challenges ahead for 4K production and end-user viewer. "There is a lack of industry standard interfaces to cope with the fast transfer of the increased data. Also, acquisition is currently based around large sensors. When sensors are reduced to a quarter inch, less light can reach the individual pixels so sensitivity will need to be increased. Gain can be added but that also causes noise which has implications for encoding. Motion blur is also more apparent with 4K sequences so the frame rate may need to be doubled.

However, that also halves the light and increasing the frame rate will add further bandwidth demands."

Futuresource states that video compression for 4K will be achieved using the HEVC codec (High Efficiency Video Coding), due to be ratified in January, which offers up to 50 percent greater efficiency than H.264. At the IBC 2012 trade show, a HEVC encoder encoded video with a resolution of 3840x2160p at 60 fps with an average bit rate of just 15 Mbit/s.

Looking to the future, Futuresource Consulting predicted 4K will represent 15 percent of total TV sales in the USA by 2020. There is little doubt a whole new set of opportunities could be opened up for 4K. For example, BSkyB proved that millions of subscribers are willing to pay an extra 10 pounds per month for HD channels and, once consumers see more and more 4K, especially during in-store demos, it could command the price premium that 3D has struggled to do so.

The payTV business also has a vested interest in maintaining a video differential compared with the likes of Netflix, Lovefilm and YouTube. 4K, transmitted by satellite, is the answer to that OTT battle.

#### About the author

Senior Contributing Editor 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. In November 1998 he was appointed an Associate (professor) of the prestigious Adham Center for Television Journalism, part of the American University in Cairo (AUC).



**The LG 84LM9600 84-inch 4K TV, which started selling last October in the U.S.**



**The Sony 84-inch Bravia 4K TV**



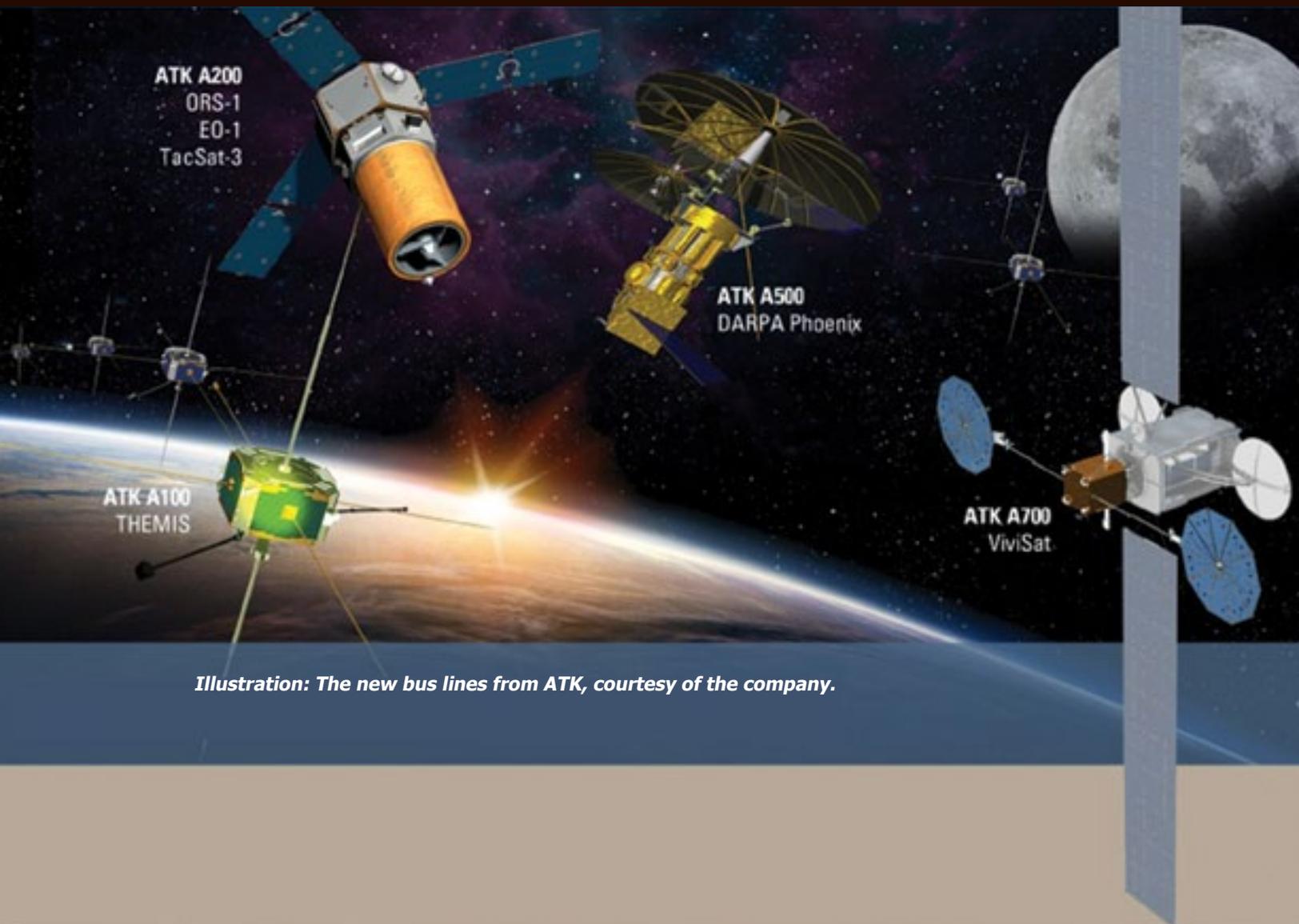
## ***Executive Spotlight: Jim Armor, V.P., Strategy & Business Development, ATK***

**J**im Armor has been Vice President of Strategy & Business Development for Spacecraft Systems and Engineering Services of ATK Space Systems, Inc. at Alliant Techsystems Inc. since April 2009. Major General Armor [U.S.A.F., ret.] was the Founder and Owner of The Armor Group, LLC, and served as its Chief Executive Officer since September 2007. He served as an active duty officer in the United States Air Force from May 1973 to January 1, 2008. As a Major General, he served as a Director, National Security Space Office, Office of the Under Secretary of the Air Force until retiring in January 1, 2008.

*Jim Armor pictured inside  
ATK's new state-of-the-  
art Robotic Rendezvous  
and Proximity Operations  
(RPO) Lab*

Armor was responsible for integrating and coordinating defense and intelligence space activities, and advising the Office of the Secretary of Defense and the Office of the Director, National Intelligence, on matters affecting national security space capabilities. Prior to that, Major General Armor served as Director of Signals Intelligence Systems Acquisition and Operations, National Reconnaissance Office and he directed the development, launch, and operation of the U.S. Signals Intelligence satellite constellation and related global ground systems supporting intelligence and military operations worldwide.

His other positions includes Vice Commander, Warner Robins Air Logistics Center; System Program Director, and Program Director of the NAVSTAR Global Positioning System Joint Program Office, Space and Missile Systems Center. Major General Armor serves as a Director of Navsys Corporation. He served as a Director of Integral Systems Inc., from March 14, 2008 to February 15, 2011. Previously, he served as the Director of the Global Positioning System, the U.S. Government's largest satellite constellation. He served as Director of the GPS Program, and Director of Acquisition and Operations for Signals Intelligence.



*Illustration: The new bus lines from ATK, courtesy of the company.*

## Executive Spotlight: Jim Armor, ATK (Cont.)

### SatMagazine (SM)

Would you please explain what these new buses offer and the differences between the basic and elevated configurations?

#### Jim Armor

ATK's expanded **A-series** product line consists of four basic configurations: the **A100**, **A200**, **A500** and **A700** models, with elevated platforms of **A150**, **A250** and **A550** which aim to provide broader capability and flexibility for customers. The products are designed for a range of mission requirements based on mission class, design life, propulsion, pointing accuracy, payload mass and launch capability.

#### SM

What market segments are the targets for these new offerings?

#### Jim Armor

There is strong interest from both government and commercial sectors. Though mostly government today, commercial interests are growing and government organizations are steadily transitioning to commercial business practices and use of commercial space systems and products.

#### SM

When new satellites are birthed, launch vehicle selection can sometimes be somewhat minimized... how do these new buses fit in with current and future launch vehicle configurations?

#### Jim Armor

The A-series satellite buses are compatible with most launch vehicles, and in many cases are suitable to rideshare in a launch vehicle with other spacecraft. We have a variety of choices to fit customer needs depending on the mission. We have been very successful building small satellites quickly and efficiently over the years. This new family of A-series satellite buses is really just a way to communicate more clearly with a wide variety of customers who are looking for small, rapidly developed spacecraft.

#### SM

Will the buses be available for domestic and overseas satellite manufacturers? How will they be marketed?

#### Jim Armor

Yes, the buses are available for domestic manufacturers and for international markets. Our ability to build this type of spacecraft quickly and affordably is resonating with the marketplace and quite frankly, our timing to announce this expansion is on target. We are marketing this product line through advertising, trade shows, conference panel appearances, video animations and interviews like this one. We have found that our multi-pronged communications platforms are working and that potential customers are actually reaching out to us to learn more about the product line, as are launch providers to insure compatibility.



On June 29, 2011, the Operationally Responsive Space office's inaugural satellite, ORS-1, successfully launched from Pad 0B at the Mid-Atlantic Regional Spaceport, a facility owned by the Virginia Commercial Flight Authority, located at NASA's Wallops Flight Facility, Wallops Island, Virginia. Photo is courtesy of NASA.

We are also seeing an increased need for small satellites in the market given dwindling budgets in both the government and commercial sectors. Plus, the Department of Defense is rethinking how it acquires and manages its satellite programs in order to drive down costs and production timelines. They're looking to launch smaller, less expensive satellites for most military and national security missions. We had demonstrated our capability in that arena with the successful launch of the **ORS-1** satellite for the Air Force. We built the bus from start to delivery in just 17 months when the usual time frame is three to seven years. ORS-1 launched in the summer of 2011 and achieved final operational capability in January.

That kind of "can-do" technology along with today's economic challenges is driving government users to adopt business practices already in place for the most part in the commercial sector. NASA also has begun to appreciate the high payoff of smaller, more specialized science spacecraft. We believe our expanded family of space platforms will enable us to capitalize on the up-swing we expect to see in a number of our targeted market segments.

### **SM**

*How do these new buses fall into line with increasing focus on the concept of Hosted Payloads?*

### **Jim Armor**

They are fully consistent with the concept. Depending on the specific mission, all our buses have capacity for hosted payloads. We look at hosted payloads as another tool in the toolkit for getting missions into space on a timely and cost effective basis. Hosted Payloads are applicable to all mission areas but not necessarily all missions. Clearly, at some point small free-flyers are cost and performance competitive with Hosted Payloads—it is not a given that Hosted Payloads are always a superior offering. Our bus line is ready for both options.

### **SM**

*Will they be amenable to in-orbit servicing and/or capture for repair and refueling?*

### **Jim Armor**

We are highly predisposed to in-orbit servicing and ready to include those features, but most customer missions in low earth orbit or beyond geostationary are not yet amenable to it. On the



**The ViviSat MEV is designed to attach to an existing satellite that is in dire straits as its propellant is dangerously low—the MEV would take over station keeping and attitude control of the target satellite while accomplishing its mission.**

other hand, we believe that satellite servicing is an important new market, whether it involves life extension, satellite repair, in-orbit refueling or spacecraft repurposing.

Our ATK A700 series, the largest mission class, is the foundation of the **ViviSat Mission Extension Vehicle (MEV)**, a significant new satellite servicing spacecraft capable of docking with a client satellite and providing an alternative attitude control and propulsion system for satellites out of fuel but with functioning payloads.

The MEV was introduced in 2011 when **ATK** and its partner, **U.S. Space LLC**, launched **ViviSat LLC**, the first U.S. based company to offer satellite life extension services to commercial and government geosynchronous satellite operators. Through ATK's long, successful history with **Hubble** repair missions and ongoing spacecraft servicing work at **NASA/GSFC**, and now as part of the **DARPA Phoenix** program repurposing a satellite in orbit, we have laid the groundwork for this game changing technology and believe the commercial market is ready.

### **SM**

*Given client specifications, how quickly can the new, smaller buses be built? How cost effective are they when compared to current products?*

### **Jim Armor**

Typically 12-18 months depending on the complexity of the customer's requirements.

In terms of price, we believe our options are highly affordable for today's market expectations. Obviously, the price of a smaller satellite is considerably lower than the larger systems, which could take as long as seven years to build and launch.

### **SM**

*What is the future of the smaller satellite market?*

### **Jim Armor**

I believe the small satellite market is coming of age. Primarily, the government is looking for ways to downsize and reduce costs while increasing the resiliency of their constellations, so they are turning to smaller satellites that can be built in a matter of months instead of years.

However, I also think smaller satellites will generate new uses and applications that don't even exist today. As sensors and payloads become smaller and more innovative, national security, scientific and commercial communities are finding more uses for them. There is a huge interest in cubesats and nanosats in academia which points the way in the future. We are seeing existing companies and start-ups put more capability in smaller packages more affordably increasing the value of small satellites. Based on our heritage and performance, we believe we have positioned ourselves very well with this new and expanded line up of small satellite buses.

The small satellite market will be an active one in both government and commercial sectors.



**O**n December 4th, the Space Foundation released **PIONEERING: Sustaining U.S. Leadership in Space**, which puts forth recommendations to strengthen both NASA's focus, oversight and funding and the overall U.S. civil space program. Following a summary of that report, which can be downloaded at the following direct URL link:  
<http://www.spacefoundation.org/programs/research-and-analysis/pioneering>

## **NASA's Situation**

NASA is an exceptional institution in a tremendous predicament. Its accomplishments have inspired billions and have marked the transition of humanity from earthbound creatures into a spacefaring species. Yet, the last time a human set foot on the surface of another celestial body was in 1972. Many of **NASA's** advocates and supporters wonder why, in these past 40 years, the space program has played backward in slow motion: Going from a presence on the lunar surface, to operations only in *Low-Earth-Orbit* (LEO), to the final flight of the **Space Shuttle** with no capability to send astronauts into space aboard U.S. vehicles.

When NASA was created, it was given the lion's share of responsibility for building the U.S. national civil space enterprise. NASA was built from an amalgamation of different laboratories, offices and programs, assembled in haste and immediately challenged with a high-risk, rapid-turnaround program to land an American on the Moon.

NASA rose to the challenge, marking one of humanity's greatest achievements. Dramatic changes have occurred since then. The space enterprise is now a \$290 billion global endeavor, with NASA accounting for just 6 percent of the total. NASA is no longer the sole creator and manager of the entire U.S. national civil space enterprise. NASA has experienced frequent redirection and constantly shifting priorities, mixed signals from Congress and the administration, organizational conflicts and lack of a singular purpose, resulting in a space agency without a clear, stable direction. It is from this perspective that the Space Foundation undertook a sincere and earnest exploration of NASA's state and future.

A successful organization needs a clear, well-defined purpose to generate unity of action, coordination of strengths and focus of effort, as well as to establish a means to measure success or failure. The Space Foundation believes that NASA needs to embrace a singular, unambiguous purpose that leverages its core strengths and provides a clear direction for prioritizing tasks and assigning resources. In addition, the Space Foundation recommends measures to remove or reduce factors that hamper NASA's ability to execute a clearly defined program,



including divesting activities not related to the core purpose, providing for stability in senior NASA leadership and establishing a planning process. Additionally, the Space Foundation has identified other areas where NASA can improve performance and increase returns on taxpayer investment.

The Space Foundation approached its study with rigor and impartiality, studying 40 years of NASA history and a wide gamut of reports and recommendations and interviewing nearly 100 senior leaders representing a variety of perspectives on management, space exploration and public administration. The product of more than a year of research, the report's findings are presented in the spirit of engagement and constructive counsel, with a sincere desire to catalyze change for the better.

## NASA's Purpose

The Space Foundation believes that one word can embody NASA's purpose and leverage its greatest core strengths to promote, expand and develop a healthy national civil space enterprise: **PIONEERING**.

Pioneering is defined as: **1. being among those who first enter a region to open it for use and development by others; and 2. being one of a group that builds and prepares infrastructure precursors, in advance of others.** The proposed *Pioneering Doctrine* has four phases:

- **Access:** *developing the ability to get to and from targeted destinations.*
- **Exploration:** *learning about those destinations in order to plan for subsequent missions.*
- **Utilization:** *turning theoretical knowledge into technology that justifies continued, longer-term activity at the destinations.*
- **Transition:** *handing off the knowledge and capabilities NASA has developed to other government organizations or the private sector for further long-term engagement.*

Defining this singular purpose provides the framework to better manage ambiguity in direction from Congress and the administration and minimize the impact of shifting political winds. In addition, requiring NASA to develop long-term plans to present to Congress for approval will result in better preparation and guidance for the agency, its contractors and the nation's space workforce. This will increase NASA's accountability to Congress and the taxpayer.

## Strategic Recommendations For Sustaining U.S. Civil Space Activity

NASA's budget and management must have the stability to ensure that its purpose can be fully and effectively pursued. To make this possible, the Space Foundation made the following strategic recommendations...

- **Amend the Space Act:** *Congress should amend the Space Act to officially assign pioneering as NASA's primary purpose. During the amendment process, Congress should also eliminate tasks that are no longer relevant or distract NASA from the Pioneering Doctrine.*
- **Streamline the National Civil Space Enterprise:** *NASA should assess its current activities to align them with its purpose.*

- » **Realign the National Civil Space Enterprise:** *NASA should divest itself of activities that do not fall within its new purpose, dispersing relevant activities to other public and private parts of the national civil space enterprise.*
- » **Rationalize Existing Infrastructure:** *Decision-makers must distinguish between supporting a space program versus archiving the infrastructure that could be used to support a space program. Through an agency-wide evaluation of infrastructure, facilities and capabilities by independent auditors, NASA should consolidate its existing infrastructure and facilities and eliminate excess capacity.*
- » **Pursue Further Commercialization:** *NASA should continue to pursue privatization and commercialization of activities where possible.*

- **Stabilize NASA Leadership and Planning:** *NASA leadership and planning should be stabilized to avoid wasteful disruption.*

- » **Create Stability for NASA Leadership:** *To ensure continuity of leadership and close cooperation and singularity of purpose at the highest levels of NASA management, the NASA administrator should be appointed for a five-year renewable term and he/she should be responsible for nominating the deputy administrator.*
- » **Require NASA to Submit a Long-Term Plan:** *NASA should develop both a 10-year plan with specific dates, goals and objectives and a 30-year plan that provides the broader strategic context in which the 10-year plan can be understood. These plans would be submitted for congressional approval every five years, at which point Congress would evaluate performance during the previous five years, following validation by a congressional commission (described below). This would ensure that Congress is kept apprised of NASA's direction and objectives, providing insight into planning and reducing shifts in priorities that can come with each administration or new piece of legislation.*
- » **Create a NASA Commission:** *To ensure that plans are validated by qualified, trusted individuals, Congress should authorize the creation of a 12-person commission, chaired by the NASA administrator or his/her designee, comprising three presidential appointees, four members appointed jointly by the majority and minority leadership*
  - ◇ *of the relevant committees of jurisdiction in the Senate and four members appointed jointly by the majority and minority leadership of the relevant committees of jurisdiction in the House.*

- **Stabilize NASA Funding:** *NASA can better carry out its new purpose if it has access to more stable and reliable funding streams.*

- » **Create a Revolving Fund for NASA Projects:** *To allow NASA to match program spending with real-life funding profiles rather than compressing and rear-ranging programs to maintain a top-line annual budget, Congress should create a revolving fund for NASA that can be supplemented through annual appropriations.*

## PIONEERING: (Cont.)

- » Expand Funding Options: Congressional appropriators should make use of the full range of appropriations options available to them in law, including multi-year appropriations, no-year appropriations and advance appropriations.
- » Establish Accountability and Oversight Measures: Programs that exceed predefined cost or schedule limits should be removed from special funding arrangements and returned to year-by-year funding managed under the normal appropriations and oversight rules and procedures. The Space Act should stipulate that failure to keep NASA, as a whole, on schedule and within budget would be grounds for dismissal of the NASA Administrator.

### Tactical Recommendations To Help NASA Flourish

The Space Foundation also identified areas that NASA, Congress and the President can address to improve NASA's effectiveness:

- *Set concrete goals to measure the success of the International Space Station (ISS) during the remainder of this decade to provide the most visible opportunity for NASA to demonstrate its capability to manage a large-scale space enterprise and successfully fulfill its new mandate.*
- *Realign space within the Executive Branch to manage and coordinate the growing national space enterprise, both civil and national security. This includes developing cross-sector infrastructure, research and development and industrial policies involving all stakeholders and lets NASA keep a narrow focus on expanding the civil space enterprise rather than addressing coordination at the highest levels.*
- *Clarify NASA's role in developing industrial base policy to provide the private sector with clear and consistent guidance. Stability in NASA's long-term planning will provide the outlook needed for successful long-term technology investments throughout the private sector.*
- *Strengthen personnel management so that best practices are exchanged and disseminated throughout the agency, the national civil space enterprise and private sector by:*
  - » Making greater use of Intergovernmental Personnel Act assignments to host outside personnel at NASA and vice versa for extended periods.
  - » Overhauling regulations affecting the transition of skilled personnel to and from NASA.
- *Improve relationships among the centers and headquarters to address operational dysfunction stemming from divergent cultures and goals by:*
  - » Strengthening management across enterprises.
  - » Increasing promotion incentives for cross-center transfers.
  - » Retaining program management at headquarters and distributing project management throughout the centers.
- *Create a common body of standards and best practices to eliminate center-to-center variation in technical requirements and promote interoperability between systems.*
- *Conduct a zero-baseline review of NASA regulations to determine which are essential and which need to be filed away, preserving the relevant institutional knowledge in both cases.*
- *Conduct a zero-baseline review of NASA procurement processes to shift focus to mission assurance, cost management and program management while eliminating performance-driven mission creep and reducing problems with cost estimates and cost control.*
- *Improve NASA's program management skills by increasing professional development opportunities for NASA's workforce to include new and innovative initiatives, resulting in wider dissemination and institutionalization of best practices and attraction and retention of top talent.*
- *Retain and strengthen in-house technical capabilities to more effectively promote innovation by:*
  - » Increasing in-house work that helps maintain the technical proficiency needed to effectively manage contractors.
  - » Allocating time for select science, technology and engineering personnel to pursue their own areas of interest and innovation.
  - » Increasing the number and frequency of simpler, lower-cost missions.
  - » Encouraging development of small "skunkworks" teams to address challenges outside the main bureaucratic hierarchy.

### The Way Ahead

The recommendations presented in **PIONEERING: Sustaining U.S. Leadership In Space** can make NASA more successful, which will naturally accrue the benefits of scientific knowledge, inspiring the nation's youth, greater soft power and economic rewards. This is much more effective than setting any of these benefits as the ultimate goal for the U.S. space program, which would distract NASA from leveraging its core strengths.

Plus, it provides a clear and consistent means for measuring progress, while equitably distributing penalties for failure and rewards for success.

Most of all, this framework gives NASA the opportunity to apply its skills and expertise over the long timeframes required to expand the human sphere of influence.

Increased stability will help insulate NASA from shifts in political priorities and reduce the waste that results from the starts, stops, delays and cancellation of programs. NASA will have the confidence that it can pursue a project as long as it is technically viable, without worrying about capricious changes in direction from one election to the next.



