Worldwide Satellite Magazine—April 2015

SatMagazine

Featuring...

Galileo FOCs Launch Success

Galileo satellites in FOC formation. Image is courtesy of OHB Systems.

SatMagazine

April 2015

InfoBeam

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SatMagazine is published 11 times a year by SatNews Publishers, 800 Siesta Way, Sonoma, CA 95476 USA, Phone: (707) 939-9306, Fax: (707) 939-9235


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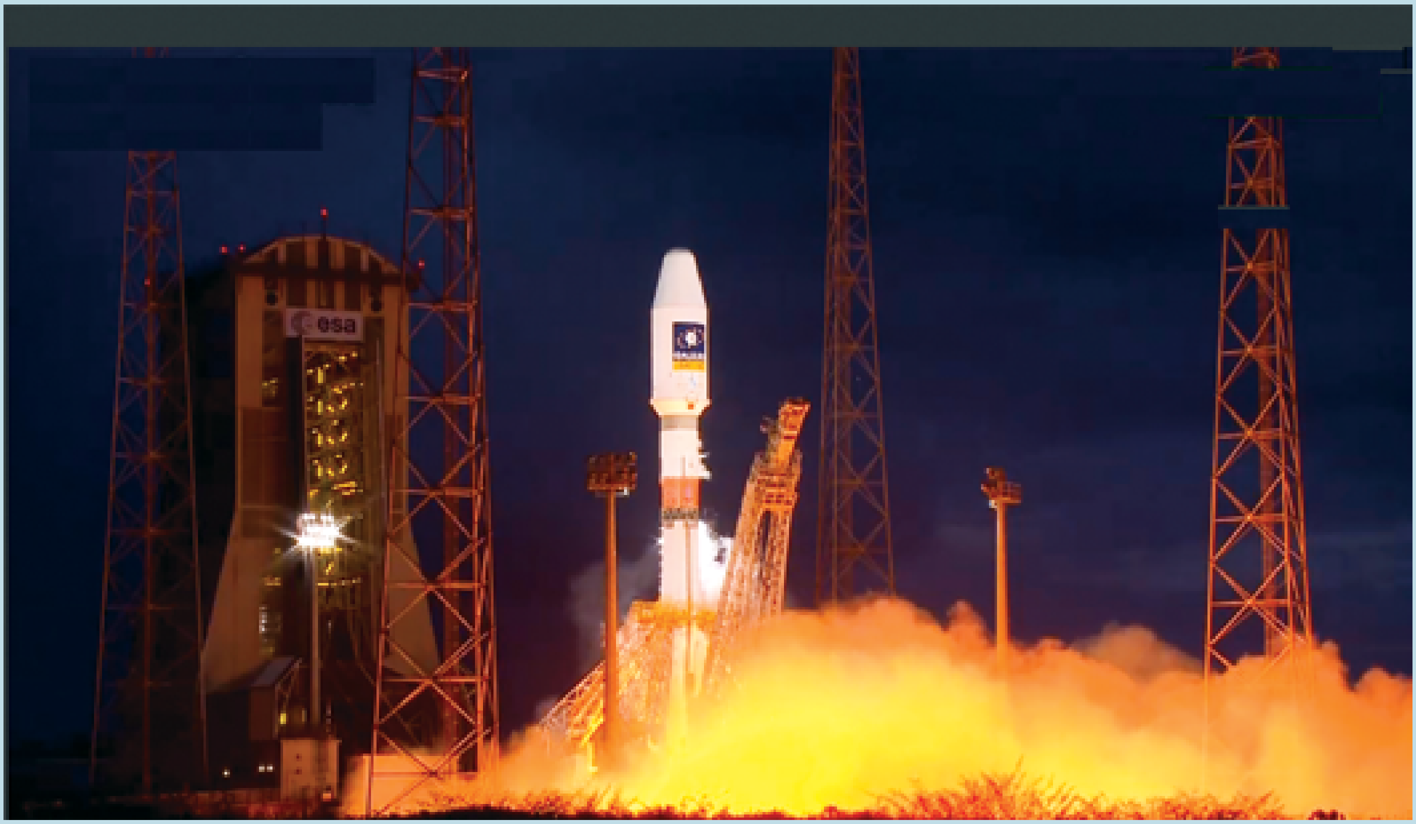
The Rise Of Anastasia + Adam—Galileos Make Their Way To Orbit



Soyuz Flight VS11 refers to Arianespace's current Soyuz launch that occurred on March 27 which successfully carried the two Full Operational Capability (FOC) satellites for Europe's Galileo navigation system to orbit.

Among the many accomplishments of the scientist and astronomer Galileo during his life was the discovery of the four largest satellites of Jupiter (named the Galilean moons in his honor) and now these two satellites, named after him, have been launched.

Soyuz deployed its passengers on a flight that lasted approximately 3 hrs., 47 min. The launcher's Fregat upper stage, which is responsible for carrying out the final orbital maneuvers, performed two burns that were separated by a three-hour-plus ballistic phase to reach the targeted deployment point for the dual-satellite payload.

Galileo's FOC phase is being funded and managed by the European Commission, which has designated the European Space Agency as the system's design and procurement agent. The European Space Agency is delegated as the design and procurement agent on the Commission's behalf.

The prime contractor for these two Galileo FOC satellites, that weigh some 715 kg. each, is OHB System of Germany. The satellite navigation payloads were supplied by Surrey Satellite Technology Ltd. of the UK. This launch was performed from the purpose-built ELS launch facility for Soyuz.

The Galileo navigation system provides highly accurate global positioning services under civilian control.

Flight VS11 is Arianespace's second mission performed this year and follows a lightweight Vega launch in February, as well as the 11th Soyuz liftoff performed from French Guiana since this workhorse vehicle's 2011 introduction at the Spaceport.

The Arianespace French Guiana Soyuz launch site
Photo is courtesy of ESA - S. Corvaja, 2011

The European Space Agency (ESA) infosite offers information regarding the Soyuz launch vehicle that was used to deliver these two Galileo satellites to orbit.

The original decision to develop the launch infrastructure to enable Soyuz to be launched from French Guiana was of mutual interest to Europe and Russia, and benefited from funding from the European Community.

Soyuz is a medium-class launcher whose performance perfectly complements that of the ESA launchers Ariane and Vega, and increases the competitiveness and flexibility of the exploitation of Ariane launchers in the commercial market.

The Soyuz launch vehicle that is used at Europe's Spaceport is the Soyuz-2 version called Soyuz-ST. This includes the Fregat upper stage and the ST fairing.

According to the European Commission (EC), Galileo will offer greater precision, thanks to a greater number of Galileo signals, the new satellite clock design, and improved corrections of ionospheric effects—positions computed with Galileo satellites will be more accurate.

When combined with GPS, the higher number of satellites available will also offer higher precision. From most locations, six to eight Galileo satellites will be visible, and in combination with GPS signals, this will allow positioning to within a few centimeters, depending on the service used.

Additionally, the high number of satellites will improve the availability of signals in cities where tall buildings can obstruct signals from satellites that are low on the horizon.

Independent studies show, according to the EC infosite, that Galileo will deliver around 90 billion euros to the EU economy over the first 20 years of operations. This includes direct revenues for the space, receivers, and applications industries, and indirect revenues for society such as more effective transport systems, more effective rescue operations, and so on.

The goal of the EU's satellite navigation programs (Galileo and EGNOS) is to:

- *Achieve technological independence with respect to other global navigation satellite systems*
- *Mobilize the economic and strategic advantages of having European control over the continuous availability of satellite navigation services*
- *Facilitate the development of new products and services based on satellite signals*
- *Generate related technological benefits for research, development, and innovation*

Soyuz-2 is the most recent version of the renowned family of Russian launchers that began the space race more than 50 years ago by launching Sputnik, the first satellite placed in orbit, and then sending the first man into space.

Soyuz-2 has improved performance and is able to carry up to 3 tons into geostationary transfer orbit, compared to the 1.7 tons that can be launched from Baikonur, in Kazakhstan.

Arianespace infosite: ***www.arianespace.com***
The EC infosite: ***ec.europa.eu/***
The ESA infosite: ***www.esa.int/***

Galileo FOC formation. Image courtesy of OHB Systems.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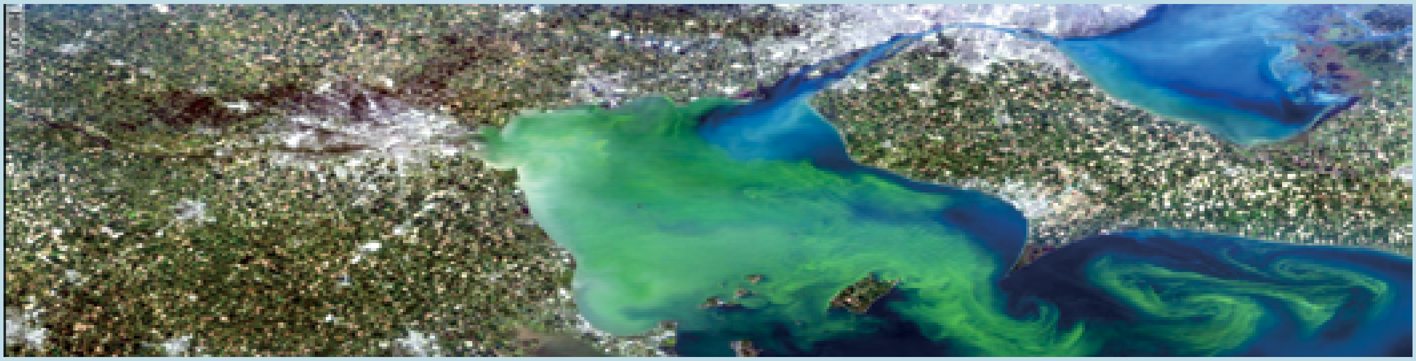
Sensing A Fifth Year Of Hyperspectral Imaging Accomplishments For The Naval Research Laboratory



The Hyperspectral Imager for the Coastal Ocean (HICO) took this image of Lake Erie, Ohio on September 3, 2011. Said Dr. Mary Kappus, the U.S. Naval Research Laboratory lead, "Hyperspectral means it takes a picture, but for each spot it separates the light into over 100 separate wavelengths." Photo is courtesy of the U.S. Naval Research Laboratory.

In October of 2014, the fifth-year anniversary for two sensors that the U.S. Naval Research Laboratory (NRL) has been operating aboard the International Space Station (ISS) was celebrated. With the continued and growing interest in hyperspectral imaging from space, a look at the work being done by the NRL is certainly in order.

Two U.S. Naval Research Laboratory (NRL) sensors, known as HICO-RAIDS, have been docked on the International Space Station for five years. "We have the distinction of being the first U.S. payload that was attached [there]," says Dr. Scott Budzien, the lead NRL scientist for RAIDS. "We were strongly focused on understanding the temperature of the atmosphere between about 100 km above the surface up to about 150 km above the surface."
Photo is courtesy of NASA.

The Hyperspectral Imager for the Coastal Ocean (HICO) took this image of Christchurch, New Zealand on August 7, 2011. "HICO's definitely been a really successful transition," says Dr. Mary Kappus, the U.S. Naval Research Laboratory (NRL) lead. "There's a lot of overlap in the things we need to understand about the ocean."
Photo is courtesy of U.S. Naval Research Laboratory/Jamie Hartman.

The Hyperspectral Imager for the Coastal Ocean (HICO) takes images of oceans in many different wavelengths to help scientists see what's in the water, be it sediment or chlorophyll or runoff.

The Remote Atmospheric and Ionospheric Detection System (RAIDS) also measures light in various wavelengths, but looking at the upper atmosphere and ionosphere.

HICO-RAIDS launched to the ISS as one payload in 2009. Once docked, Dr. Scott Budzien, the Principal Investigator for RAIDS, said, "They took us out and attached us to the 'porch' of the Japanese Experiment Module. We have the distinction of being the first U.S. payload that was attached [there]."

HICO and RAIDS were both designed as one-year missions. Said Budzien, "Just about a week ago, we fired up our UV [ultraviolet] instrument again and we're collecting data as we speak. So, still chugging along—an Energizer Bunny."

For the first three years, HICO operated with funding from the Office of Naval Research (ONR). NRL partnered with Oregon State University to host a website for the images and to field proposals from outside scientists who want to task HICO to capture certain images.

Today, the National Aeronautics and Space Administration (NASA) sustains HICO. "Now the data also goes to NASA's ocean color website, where they've had open ocean data for years," said Dr. Mary Kappus, who leads HICO. As of the five-year anniversary, HICO has collected nearly 10,000 images.

Said Kappus, "HICO's definitely been a really successful transition. It shows the synergy between NASA and NRL and academia. There's a lot of overlap in the things we need to understand about the ocean. If you work together to do some of these things, you can get a lot of information and share it commonly."

HICO-RAIDS was integrated and flown under the direction of the Department of Defense Space Test Program. RAIDS was built jointly by NRL and The Aerospace Corporation, with additional support from the Office of Naval Research.

RAIDS accurately measures very fine changes in shades of color from the Earth's airglow.

"RAIDS is a suite of eight different spectrographs, spectrometers, and photometers," said Budzien. "We cover a really wide wavelength range—from 50 nanometers in the extreme ultraviolet, all the way out to the near infrared—so we have this unusual, very broad spectral coverage."

The instrument scans the atmosphere up and down—or, it did. "We scanned from basically the space station altitude all the way to the Earth's surface, looking down below the horizon." Then, in December 2010, the scan drive electrically malfunctioned and RAIDS got stuck "pointed down on the atmosphere looking at a slant." (Electrical malfunctions aren't unusual for hardware operating in the harsh environment of space.) Even so, Budzien says, "It was a one year mission, and the scan platform worked for 15 months, so we were pleased with that."

While RAIDS was fully operational, it led to three important scientific discoveries.

First, "We were strongly focused on understanding the temperature of the atmosphere between about 100 kilometers (km) [60 miles] above the surface up to about 150 km [90 miles] above the surface," says Budzien. "That's a really difficult altitude range to measure." By targeting near-infrared wavelengths, Budzien's team—and partners at The Aerospace Corporation in El Segundo, California—"produced some of the first global measurements of temperature through that altitude range."

NRL's breakthrough came from understanding the processes that affect the different energy levels of oxygen molecules as they collide and temperature. "There are many different energy levels in the oxygen molecule," says Budzien. "Depending on temperature and how these molecules are getting knocked around, that affects the population of the energy states, and so the spectrum changes shape." He concludes, "Depending on the fine shade of color at the near infrared wavelengths, we can figure out what the temperature is."

The second discovery had to do with measuring the electron density of the ionosphere. Dr. Andrew Stephan, an NRL scientist also on the project, "devised a technique by looking at two different extreme ultraviolet bands to make a more precise measurement of the daytime ionosphere." He and partners at Boston University validated the technique against ground-based radar.

Finally, scientists at Virginia Polytechnic Institute and the New Mexico Institute of Mining and Technology used RAIDS to study nitric oxide (NO). "It's a thermally important molecule high up in the atmosphere," said Budzien. "They're trying to understand how the chemistry of nitric oxide changes through the course of the day and night, and so they used RAIDS data to help refine their model." While RAIDS now collects much less scientific data, it's still useful for understanding how these types of instruments hold up in space. As an example, Budzien's team learned that RAIDS' sensitive optical sensors still perform well aboard the ISS.

"People were afraid that because of the manned presence and vehicles that come and go all the time, that the environment would be too dirty to collect extreme ultraviolet science data as we do," he said. "So our experiment contributes to lifetime studies for sensors on the ISS."

However, Budzien hasn't given up yet on repairing RAIDS. He's proposed to build a jack that one of the robotic arms already on ISS could use to "point [RAIDS] at a new altitude that would be more scientifically interesting. And then we could collect more data and do world class science all over again."

When light shines through water, it reflects and absorbs differently depending on what else is in the water. Said Kappus, "If there's a lot of chlorophyll it'll absorb at certain wavelengths, if it's very clear it won't absorb at those wavelengths, and so forth. If there's a lot of sediment, it'll scatter more at some of the redder wavelengths, which is what makes the water look brown."

HICO (pronounced "HIGH-co") captures these variations in light and color with spectra for each point in a picture. Kappus explained, "Hyperspectral means it takes a picture, but for each spot it separates the light into over 100 separate wavelengths." While more detailed than necessary for open ocean, which Kappus describes as mostly blue, the coast is more complicated. "You've got runoff from rivers, you got more turbulence, you've got more organic things in the water, and more sediments in the water—and it changes on smaller spatial scales," she said.

Every day, NRL sends up commands tasking HICO where to take pictures. "We can only take one image on each orbit," says Kappus, "which gives you about 15 a day maximum." Some of the tasking supports other NRL projects, NASA sometimes tasks for pictures from a natural disaster area, and many of the tasks come from academia.

"[HICO's] on the space station, which orbits in a strange orbit," said Kappus. "You're at different places, different times—sometimes they're at angles that are not what you would sensibly choose for imaging."

NRL looks at how ISS will orbit in the coming week, and "puts out the list of all the opportunities for the coming week, and people say, 'Oh I want that and that, and that and that.' And then we have a teleconference once a week to deconflict."

Kappus mentioned some of the science HICO's supported, including measuring water flow or velocities remotely. "We have a good [algorithm] in our branch, and so they used HICO data to study a really large area, the whole English channel." Another NRL scientist worked with colleagues in Russia to measure run-off in the Sea of Azov.

Additionally, she said, "We've done a lot of stuff actually just understanding the sensor and signal-to-noise characteristics and changes to radiometric calibration—so really more technical, esoteric things." She describes remote sensing as a cycle: "We're interested in the exploitation of the data, but we're also interested in improving the next sensor."

Kappus is delighted that, given all the design trade-offs the team made to get HICO built quickly and cheaply (not using space-hardened hardware, for example), that it's still such a good program. "It's a great team, not a very big team, which is what works," she says. "Maybe not a lot of money, not a lot of time. You focus, you work hard, and get stuff out."

The U.S. Naval Research Laboratory is the Navy's full-spectrum corporate laboratory, conducting a broadly based multidisciplinary program of scientific research and advanced technological development.

The Laboratory, with a total complement of approximately 2,500 personnel, is located in southwest Washington, D.C., with other major sites at the Stennis Space Center, Mississippi, and Monterey, California.

For more information, visit the NRL infosite at
www.nrl.navy.mil/

Story by Kyra Wiens, Naval Research Laboratory

The U.S. Naval Research Laboratory (NRL) researchers who support two sensors, called HICO-RAIDS, aboard the International Space Station celebrated five years of operations in October 2014. "It's a great team," says Dr. Mary Kappus, who leads HICO. "Maybe not a lot of money, not a lot of time. You focus, you work hard, and get stuff out." Photo is courtesy of the U.S. Naval Research Laboratory/Jamie Hartman.

InfoBeam

Arabsat's Dirab Earth Station Gets CID + Monitoring

Arabsat and Siemens Convergence Creators have signed a contract for the installation of a new Communication System Monitoring (CSM) at Dirab Earth Station near Riyadh, Saudi Arabia.

The system will monitor all traffic within the Arabsat satellite fleet and is intended to provide a 24/7 monitoring cycle for the RF & QoS measurements, the characterization, decoding & analyzing of all carriers within the payload. With SIECAMS®, Arabsat will take a major step into a new dimension of satellite monitoring and interference detection and thus improve the quality of their satellite services Thanks to its flexible architecture, the system not only meets the present needs of Arabsat, but is also designed and ready for future requirements.

Furthermore, SIECAMS® was one of the first satellite monitoring solutions available on the market to support Carrier-ID detection, a new technology which enables the identification of the owner of a satellite signal. Both Arabsat and Siemens Convergence Creators are members of sIRG -the Satellite Interference Reduction Group. This new project will combine the strengths of both companies and will lead to a close cooperation for combating and mitigating satellite interference to improve the overall quality of satellite services.

Khalid Balkheyour, President & CEO of Arabsat, said, "Carrier ID is a global, industry-wide initiative aimed at speeding up the resolution of interference and improving the quality of service for all users of satellite communications. ARABSAT is actively involved in the global Interference Mitigation intiatives through its leading role in SIRG & GVF and always strives to use state-of the-art technology to ensure the highest quality services to its customers with current and future satellites."

Siemens Convergence Creators:
www.convergence-creators.siemens.com/

Arabsat: ***www.arabsat.com/***

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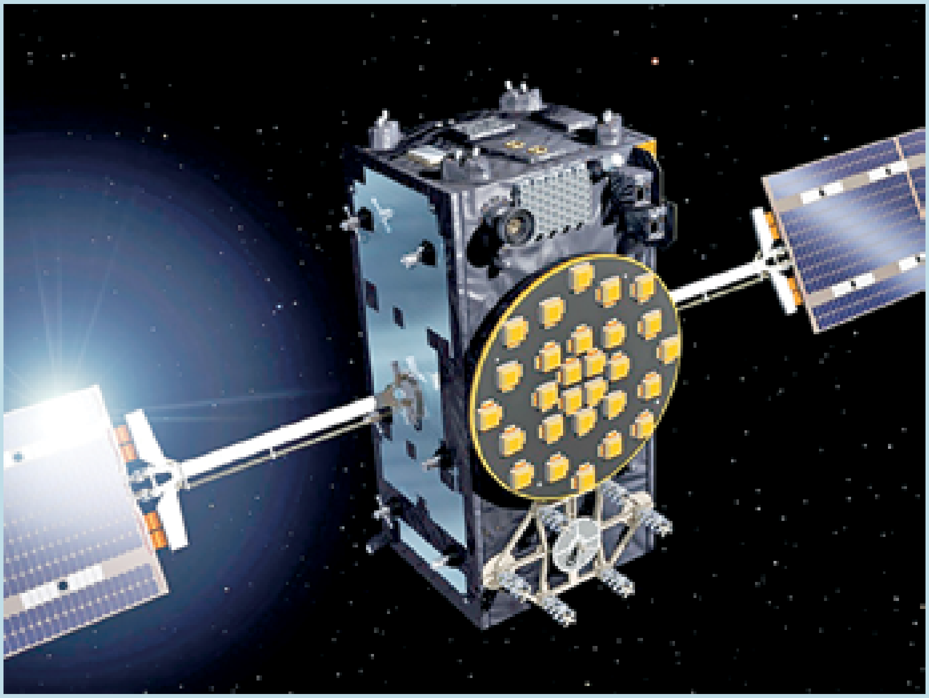
Moog's Propulsion Systems Have Galileo's Orbital Interests In Mind



Artistic rendition of a Galileo Full Operational Capability satellite, with platforms manufactured by OHB in Bremen, Germany, and navigation payloads coming from Surrey Satellite Technology Ltd in Guildford, UK.
Image Credit: ESA / J. Huart

Moog Inc. Space and Defense Group are enabling the second set of Galileo Full Operational Capability (FOC) Satellites to maintain their orbit 23,222 km above Earth.

The satellites, Adam and Anastasia (FM3 and FM4, respectively), launched atop a Soyuz-STB Fregat-MT rocket from Europe's spaceport in Kourou, French Guiana.

The satellites, manufactured by OHB System AG in Bremen, Germany, are an integral part of Europe's program for a global navigation satellite system, providing accurate, guaranteed global positioning service, interoperable with the US GPS and Russian GLONASS systems.

The complete satellite system consists of 30 satellites in three planes of Medium Earth Orbit (MEO) and a ground infrastructure.

Moog built the entire Galileo Propulsion System, which includes monopropellant engines, fill and drain valves, latch valves and pressure transducers including the complete thermal control system installation and harnessing.

The propulsion system is a critical subsystem to the satellite, providing orbit maintenance and control capability, support of spacecraft de-tumbling, as well as attitude control in contingency cases (Ultimate Safe Mode).

Moog leveraged the experience gained from the unique Fermi Gamma-ray Space Telescope (formerly GLAST) and critical Landsat Data Continuity Mission (LDCM) propulsion systems with successful launches in 2008 and 2013, respectively, and the high production volume experience from the ORBCOMM Generation 2 (OG2) constellation.

Moog delivered all 14 propulsion systems for the first portion of the constellation, the second batch of eight is currently in the process of delivery.

The complete system design, analysis, qualification, fabrication, test, and delivery of this new system was performed by Moog with sites in both the United States and Europe. The design incorporates Moog-built components with robust designs and heritage such as fill and drain valves from the United Kingdom; latch valves from East Aurora, New York; pressure transducers from The Netherlands; and thrusters from Niagara Falls, New York.

Final assembly and test is performed at the Niagara Falls facility that has been delivering spacecraft and missile propulsion systems for critical national assets for over four decades.

The Galileo satellites also include fine and cosine sun sensors supplied by Moog. Sun sensors are designed to deliver exact information about the position of the sun. This vital information is used for yaw steering of the spacecraft and therefore applied in earth pointing, solar array orientation and orbit control maneuvers.

The first two Galileo FOC satellites were launched in August of 2014 to an erroneous orbit, due to a launch vehicle anomaly.

The first of the two satellites began maneuvering into its corrected orbit in early November and in its revised orbit after more than a dozen maneuvers using the Moog-provided propulsion system.

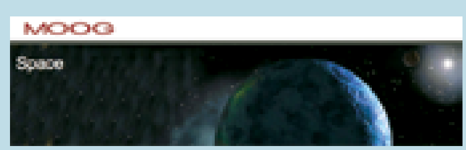
The first satellite, although not in the intended orbit, was placed in an orbit that is reduces the damaging radiation from the Van Allen Belts. Once this orbit correction maneuver was verified successful, the same adjustment was made with the second satellite.

The second satellite started making its journey into the corrected orbit in mid-January, performing 14 total maneuvers over six weeks.

The Full Operational Capability phase of the Galileo program is managed and fully funded by the European Union.

The Commission and ESA have signed a delegation agreement by which ESA acts as design and procurement agent on behalf of the Commission.

Moog: ***http://www.moog.com/***



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Boeing's GPS IIF-9 Confirms Its On Orbit Health

Boeing Global Positioning System (GPS) IIF satellites are steadily replenishing the orbiting constellation, continuing to improve reliability and accuracy for users around the world.

The ninth GPS IIF reached orbit about three hours, 20 minutes after launching aboard a United Launch Alliance (ULA) Delta IV rocket from Cape Canaveral Air Force Station, Florida, and sent signals confirming its health.

"Boeing, ULA and the Air Force successfully launched four GPS IIFs last year, the highest operations tempo in over 20 years, and today's mission marks the first of three launches planned in 2015," said Dan Hart, vice president, Boeing Government Space Systems.

"As they enter service, the IIFs are advancing and modernizing the GPS constellation by improving accuracy, signal strength and anti-jamming capability. We are also introducing the L-5 civilian 'safety-of-life' signal intended mainly for aviation and transportation," he added.

The GPS IIF-9, designated as SVN-71, will undergo on-orbit testing and checkout before beginning full operation.

Boeing has served as a prime contractor on GPS since the program's inception, contributing multiple generations of GPS satellites and accruing more than 525 years of on-orbit operation.

Boeing's GPS IIF infosite:
www.boeing.com/boeing/defense-space/space/gps/index.page

World Teleport Association (WTA) Announces 2015 Teleport Awards For Excellence

The World Teleport Association has revealed the winners of the 20th annual Teleport Awards for Excellence during an exclusive luncheon in DC.

The awards are presented each year to organizations and individuals in the teleport industry whose achievements have been deemed exceptional by the international trade association and its awards committees, made up of industry members from across the globe.

The 2015 recipients are:

» ***Independent Teleport Operator of the Year: Online****. Online brings together the solid technical expertise of CET Teleport in Germany with the extensive developing world experience of the Limeline Group to lead the way in high-quality, secure and reliable business communications for enterprise customers across the globe. The teleport, operational since 1987, provides access to over 200 geostationary satellites. Its extensive coverage across Europe, Africa, the Middle East, Central Asia through the Caribbean and South America is supplemented by dedicated access to a growing network of international fiber cables.*

»

» ***Teleport Technology of the Year: Newtec Dialog® with Mx-DMA™****. The Newtec Dialog® platform is a scalable and flexible multiservice satellite communications platform that allows satellite service providers to build and adapt their network easily as their business grows. Its advantages include supporting a wide range of applications and services on a single platform, 15 percent efficiency improvement with Newtec's Clean Channel technology, 50 percent bandwidth saving with Newtec Mx-DMA return link technology, and more.*

»

The winners were selected by an independent committee of industry experts based on nominations submitted during the first quarter of 2015.

In addition to the above honorees, WTA presented the previously announced ***Teleport Executive of the Year Award*** to Jorge Luis Villarreal Schutz, CEO of Elara Comunicaciones.

Head over to **www.worldteleport.org/news/217404/WTA-Names-Elaras-Jorge-Luis-Villarreal-Schutz-2015-Teleport-Executive-of-the-Year.htm** to read more about the 2015 Teleport Executive of the Year.

The 2015 Luncheon and Awards Ceremony, sponsored by SES, hosted many of the world's leading teleport operators and previous winners of WTA's Teleport Awards for Excellence.

Keith Buckley, President and CEO of ASC Signal, delivered the champagne toast to past recipients and presented the Teleport Technology of the Year award to Newtec.

NewSat provided attendees of the DC event with a guest gift. WTA's Director of Development Louis Zacharilla was the emcee of the event, and was joined by WTA's Chairman M. Brett Belinsky and Mark Rathert, General Manager, Ground Operations for SES to announce Online as the winner of the Independent Teleport of the Year.

Commenting on the 2015 Awards, Zacharilla said, "WTA is proud to honor Online, Newtec, and Jorge Luis Villarreal Schutz at the 20th annual Teleport Awards. As have the winners in each of the previous nineteen years that WTA has presented these awards, those honored today represent an admirable level of excellence we aim to achieve in an industry that continues to, year after year, achieve excellence globally."

Since 1985, the World Teleport Association has focused on improving the business of satellite communications from the ground up.

At the core of its membership are the world's most innovative operators of teleports, from independents to multinationals, niche service providers to global carriers.

WTA is dedicated to advocating for the interests of teleport operators in the global telecommunications market and promoting excellence in teleport business practice, technology and operations.

The WTA infosite:
www.worldteleport.org/

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Avanti Supports Pan-African Aviation Project

Avanti Communications has been appointed by the UK Space Agency to deliver a crucial air navigation project in Africa, SBAS-AFRICA, powered by satellite technology.

The contract has been awarded under the agency's International Partnership Space Program (IPSP), which exists to open up opportunities for the UK space sector to share expertise in real-world satellite technology and services overseas.

Africa has just 3 percent of global air traffic, and yet air accidents in Africa account for roughly 20 percent of the worldwide total. By demonstrating potential improvements in flight safety via SBAS technologies, the project can provide socio-economic benefits to the continent.

Based on prior cost-benefit modelling[3] which identified a 1.7 billion euros potential economic benefit to the African aviation sector from the deployment of SBAS services, SBAS-AFRICA will help accelerate the adoption of GNSS-based flight operations, positively influence the evolution of aviation safety in Africa and encourage development in the wider African economy.

SBAS-AFRICA will deliver a satellite based augmentation system for GNSS-based operations in the aviation sector, serving significant parts of Africa in partnership with a number of local stakeholders.[4] The project will use a unique asset, Avanti's ARTEMIS L1 Navigation transponder, to provide a navigation data broadcast service.

Matthew O'Connor, Chief Operating Officer at Avanti Communications, said, "SBAS-AFRICA brings an innovative and pragmatic approach to deploying SBAS services in Africa. It establishes crucial collaboration between the UK and a number of African countries, including South Africa and Ghana. Participating countries will benefit hugely from expertise gained, placing them at the forefront of navigation services across the continent and, crucially, helping to improve aviation safety for a major generator of economic benefit in Africa. The Artemis satellite will play an integral role in this project. We expect that such a showcase for its performance, accuracy and quality will provide further evidence of what can be achieved with this technology and lead to significant commercial opportunities."

Dr. David Parker, Chief Executive of the UK Space Agency, said, "The UK Space Agency is delighted to play a role in fostering new international partnerships that not only enable innovative UK space companies like Avanti to provide more high-tech exports that can boost our space sector but also allow the UK to widely share the considerable social and economic benefits that space technology and infrastructure can provide."

Avanti Communications: ***www.avantiplc.com/***

UK Space Agency:
www.gov.uk/government/organisations/uk-space-agency

InfoBeam

Moving On Up @ SSPI's Board Of Directors—Stott To Chair, McGuirk To President


Chris Stott

The Society of Satellite Professionals International (SSPI) has announced the appointment of Chris Stott, Chairman & CEO of ManSat, as the new Chairman, and Bryan McGuirk, COO of ViviSat, as President of its Board of Directors—their one-year terms started on March 19.

SSPI also announced the election by the membership of two new directors. David Kagan, President, ITC Global, and Carmen González-Sanfeliu, Regional Vice President, Latin America & Caribbean, Intelsat. They were elected to serve three-year terms beginning March 19.

Ms. González is filling the seat vacated by Dianne VanBeber, Vice President of Investor Relations and Communications for Intelsat, who stepped down at the end of her second term. She has served SSPI as President and Chairman of the Board for the past two years and oversaw a significant expansion of the Society's programs.

SSPI's Board of Directors represents a cross-section of the commercial satellite business, from manufacturing to launch to services. Continuing their service on the Board are:

- *Dawn Harms, Vice President of Business Development, Boeing Space Systems International (Treasurer)*
- *Tony Rayner, Chief Operating Officer, Eutelsat America (Secretary)*
- *Michael Aloisi, Vice President, Distribution Technology, Satellite & Affiliate Services, Viacom Media Networks*
- *Christine Erhenbard, Director, Broadcast Distribution, CBS*
- *Ed Giovannini, Vice President, Sales, CBL RNAM, Ericsson*
- *Erwin Hudson, Program Manager, ViaSat*
- *David Myers, President & CEO, Datapath*
- *Dave Rehbehn, Senior Marketing Director, Hughes Network Systems*
- *Thomas Van den Driessche, Chief Commercial Officer, Newtec*
- *Bill Weller, Vice President, Marketing & Sales, Space Systems/Loral*
- *Alan Young, Chief Technology Officer, Encompass Digital Media*
- *Elias Zaccack, Senior Vice-President, Commercial, Americas, SES*

Effective with the March 19 Board meeting, SSPI also appointed as its General Council the respected industry attorney John Hane of Pillsbury Winthrop Shaw Pittman. He is taking the place of SSPI's longtime General Counsel, Bruce Jacobs, who now serves as Chief, Spectrum Enforcement Division with the Federal Communications Commission.

More about Chris Stott

Chris Stott has been a member of SSPI for more than 20 years, a Board member for the past five years and also serves as Chairman of the organization's Isle of Man chapter. Chris was one of the forerunners of the Isle of Man's space industry, setting up ManSat in 1998. Since 2000, the company has carried out satellite filings for the Island under a contract with the Isle of Man Government's Communications Commission. He is a longtime supporter of space and STEM education and serves on the Boards of organizations including the International Space University, Challenger Foundation, Conrad Foundation, the United Space School and the International Institute of Space Commerce. He serves in addition as Co-Chair of the Manna Energy Foundation and Geeks Without Frontiers, and on the faculties of the International Space University and Singularity University.

More about Bryan McGuirk

As Chief Operating Officer of ViviSat, Bryan McGuirk leads the commercialization of the company's pioneering satellite life extension services. Before joining ViviSat, Bryan served in various management roles at SES. Hired in 2003 as Senior Vice President, he led the sales and marketing of its 16 US satellites to the Media and Enterprise sectors. He became President of the Media and Enterprise divisions of SES Americom in 2005, and served on the Board of SES Americom from 2009 to 2010. During 2010, Bryan also served as Senior Vice President of newly formed SES WorldSkies, managing teams in Princeton, NJ and the Hague, Netherlands. Prior to his satellite career, Bryan worked in management distribution positions for Open TV, NBC and Turner Broadcasting.

More about David Kagan

David Kagan was appointed as President of ITC Global in August 2014. Prior to joining the company, David built a reputation as an operationally savvy executive, enabling fast growing companies to provide exceptional customer service. Most recently, Mr. Kagan served as President and CEO of Globe Wireless, where he drove substantial growth, efficiencies and profitability improvements through an operational infrastructure that supported over 6,000 ships and vessels worldwide. The company was sold to industry leader Inmarsat in January 2014. Prior to Globe Wireless, Mr. Kagan spent 12 years as President and CEO of MTN, a leading provider of satellite communications to the cruise, oil and gas, super yacht, and military markets, which he joined after 10 years in management with Norwegian Cruise Line.

More about Carmen González-Sanfeliu

Carmen González has over 25 years experience in the satellite industry and is responsible for INTELSAT's sales activities in Latin America and the Caribbean. As Vice President of the region, she leads a sales force with offices located in Miami, Brazil and Mexico that contribute over $500 million in revenues. The customer base extends to broadcasters, carriers, multinationals and government agencies. Born in Venezuela, González's education includes an MBA magna cum laude from George Washington University and a BA from Georgetown University along with Independent Marketing Studies at Oxford University.

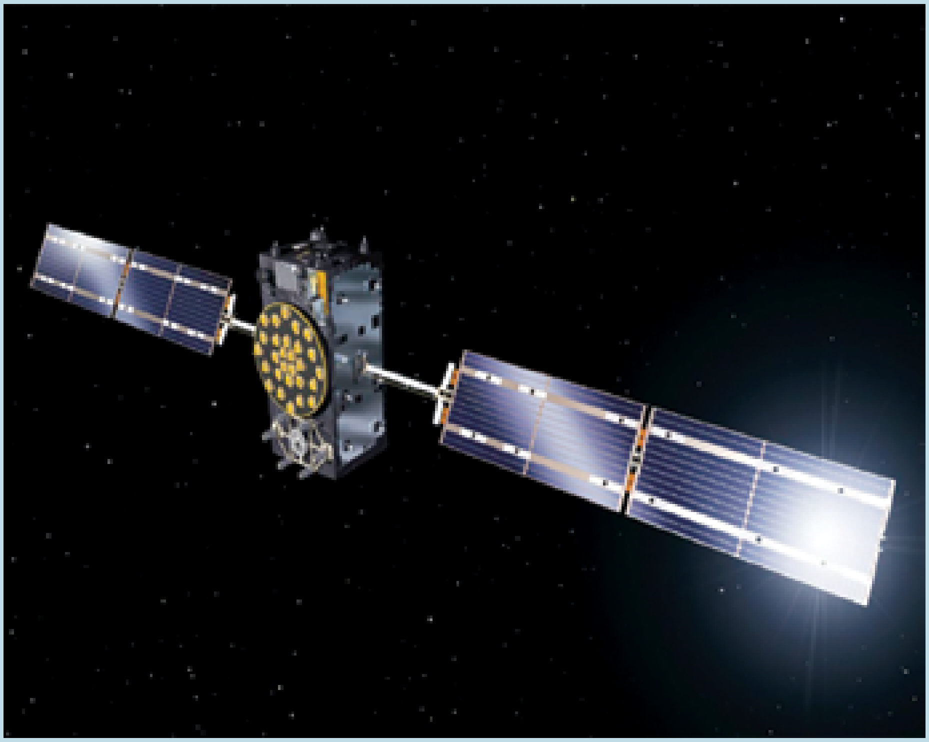
More about John Hane

John Hane is a partner in the Pillsbury Winthrop Shaw Pittman's Communications practice and is located in the Washington, DC office. He concentrates on transactions, spectrum licensing and special projects in electronic media, satellite and wireless communications. He writes and speaks often on broadcast, spectrum and technology issues, and is frequently quoted in communications and technology industry trade press on matters ranging from spectrum allocations to television program carriage. Mr. Hane has been quoted in The Wall Street Journal, the Los Angeles Times, The Washington Post, and other leading newspapers.

The Society of Satellite Professionals International (***www.sspi.org***) promotes the growth of the satellite by educating current and potential end-users and the general public about the indispensable contributions of satellites to business, government and human welfare, and by connecting satellite professionals worldwide through education, knowledge-sharing and fostering professional relationships. Publisher of the only international study of the satellite workforce, SSPI also leads a consortium of industry associations and organizations to promote the ways satellites make a better world. More information on the Better Satellite World campaign is available at...

www.bettersatelliteworld.com/

OHB Builds 'Em So They Can Fly Away... Galileo Success



"Adam" and "Anastasia", the two Galileo FOC* satellites number three and four developed and built by OHB System AG, hav een successfully launched on board a Soyuz rocket, which lifted off from the Kourou space center in French-Guyana on Friday, March 27.

They reached their planned orbit at an altitude of around 23,000 kilometers just under four hours later, shortly after they sent their first "sign of life" to the French Space Control Center of CNES in Toulouse. Over the next few days, the two satellites will be undergoing preliminary function testing.

Observing the launch live from Bremen, Marco R. Fuchs, CEO of OHB SE, said, "This was a very emotional moment for all of us who eagerly watched the launch and the activities of the next few hours in Bremen, Toulouse, Kourou and everywhere around the world. I am thrilled to have learned that both satellites have reached their target orbit. My thanks go out to the entire Galileo team for a job well done."

Dr. Ingo Engeln, a member of OHB System AG's Management Board, was present during the launch in Kourou, "The moment in which the launcher lifts off is an indescribable feeling. But with our responsibility for the satellites, the tension did not ease until a few hours after the launch when we knew that the satellites are functional in orbit."

Aliac Jojaghaian, head of the OHB team in charge of the early operation phase at the CNES control center in Toulouse was very satisfied, "We are all very grateful that the launch was completed without a hitch this time. Both satellites are in the right orbit, they have the correct alignment, the solar panels have unfolded properly and we have contact with Adam and Anastasia."

The Galileo control center in Oberpfaffenhofen will be assuming responsibility for Anastacia on April 5, 2015 and for Adam on April 6, 2015 on behalf of ESA and the European Commission. Later, the ground station in Fucino takes over the commissioning of the payload. They will be followed by a further 18 Galileo FOC navigation satellites for which OHB is also the responsible industrial prime contractor.

The first Galileo FOC satellite named Doresa reached its corrected orbit at the end of November 2014. Both the navigation payload and the search and rescue service payload underwent intensive testing in the following weeks, since passing all tests successfully.

The second Galileo FOC satellite has also reached its corrected orbit where the navigation payload can be tested. This involved the gradual lifting of the satellite over a distance of 3,500 km combined with a transition to a more circular orbit for the satellite. This operation commenced in mid-January and was successfully completed six weeks later after a total of 14 individual maneuvers.

The second FOC satellite Milena is currently undergoing the same payload testing as the first one and has so far successfully passed all tests.

The fifth Galileo FOC has already completed all function, performance and environmental impact testing, while number six has passed all function and performance tests and is scheduled for environmental impact testing over the next few weeks.

OHB in Bremen is currently working in parallel on the assembly of the Galileo FOC satellites at a total of seven production islands.

*The FOC (full operational capability) phase of the Galileo program is being funded and executed by the European Union. The European Commission and the European Space Agency ESA have signed a contract under which ESA acts as the development and sourcing agency on behalf of the Commission.

OHB Systems:
https://www.ohb-system.de/

InfoBeam

TS2 Satellite Brings Services To Iraq, Syria + Armenia

TS2 Satellite recently launched new KA-SAT satellite services using the HYLAS 2 spacecraft, providing high-speed data services to Iraq, Syria and Armenia.

The HYLAS 2 satellite carries 24 active Ka-band user beams and six gateway beams. The Ka-band spot beams are providing two-way communications services to facilitate high-speed delivery of data to end-user applications such as corporate networking, broadband Internet access, business continuity services and video distribution.

HYLAS-2 Iraqi beam.

Artistic rendition of the HYLAS-2 satellite.

The new Ka-band service is based on the field-tested and proven technology provided by iDirect. Ka-band service requires smaller antennas, reducing the equipment and transportation costs and making for an easier installation.

Marcin Frackiewicz, CEO and founder at TS2 Satellite, said, "Our new service to Iraq, Syria and Armenia allows for downlink speeds up to 20Mbps, five times the previous maximum, using a smaller antenna. Higher performance is gained at a much lower cost, which allows up to four times higher connection speed at the same cost, if compared to previous Ku-band service, without compromising connection reliability and stability."

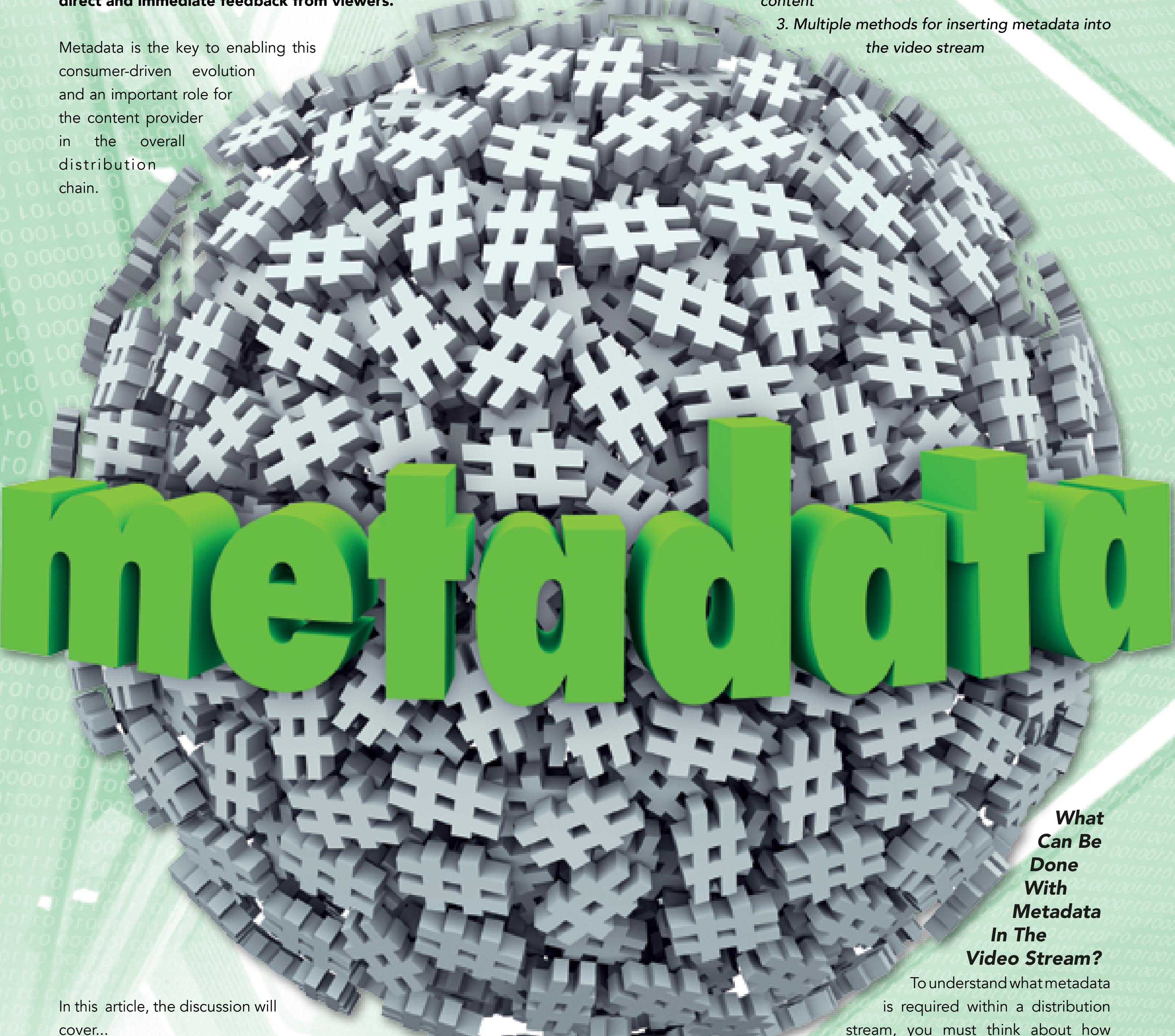
TS2 Satellite: ***www.ts2.pl/***

SatBroadcasting™: A Technical Focus On... Making The Most Of Metadata

By Roger Franklin, Chief Executive Officer, Crystal

Video content providers, from traditional broadcasters to Internet streaming platforms, face expanding consumption models and the challenge of responding to direct and immediate feedback from viewers.

Metadata is the key to enabling this consumer-driven evolution and an important role for the content provider in the overall distribution chain.



In this article, the discussion will cover...

1. What can be accomplished using metadata formatted to the SCTE-35 standard, or equivalent for non-MPEG streams

2. How specific metadata messages are used to describe content

3. Multiple methods for inserting metadata into the video stream

What Can Be Done With Metadata In The Video Stream?

To understand what metadata is required within a distribution stream, you must think about how the video content can be enhanced for the viewer. The context and mode by which the video is consumed plays a crucial role in determining what metadata is important. Viewing of live versus recorded content dictate different metadata approaches

Metadata in a Live Stream

For production of live linear content, metadata is created and inserted as the event unfolds requiring systems and processes that can react in real-time.

An important aspect of live streams is the concept of "social viewing." No matter the changes in consumer behavior, social viewing of live sporting and news events will continue to be an important activity. The specific content to be delivered can, and should, vary based on where people are gathered to watch those events—their context.

Live events, especially sports events, impose video distribution restrictions, or blackouts, based on the attendance, or lack of, at the actual event. Each league defines unique restrictions and enforcement is complicated when viewing occurs on a mobile device that may or not be with in a geographic blackout zone. Metadata within the stream is used to ensure the rules are followed for the given viewing context. While this context driven metadata approach places an increasing burden on the content distribution networks it also opens up multiple ways to monetize the content.

Metadata in Prerecorded Content

For non-live content, video on demand is the norm. People catch up on their favorite shows after being on vacation, or they binge watch an entire season during a weekend.

The sales or promotions that accompanied the initial linearly distributed video stream may be expired by the time the video content is viewed on demand or the offers may have changed. To fully support the new consumption paradigm and maximize revenue opportunities, metadata can be included in this pre-recorded video to build an on-the-fly playlist of offers and advertising that is relevant to the viewer at the time they view on-demand content.

With viewer specific information and the correct metadata, video content providers and their advertisers can deliver relevant content targeted to the viewer that would not have received in any other way.

What SCTE-35 Metadata Is Required

Understanding the required metadata is currently the greatest challenge for the industry as it seeks to keep up with the changed and evolving video distribution models.

Each segment of an MPEG video program can be marked up with SCTE-35 metadata to describe the entire program. The programmer must decide what constitutes a "segment." Traditionally, a video program is categorized into one of three segment types:

- *The main program—video associated with the show being distributed. This includes some advertisements inserted by the programmer that should not be replaced by cable head-ends or other re-distributors.*
- *National Spots—advertising segments where re-distributors, such as national cable super-head-ends and Direct-To-Home satellite service providers, can insert advertisement or promotional content for their entire subscriber base.*
- *Optional Local Spots—advertising segments where local re-distributors, such as local cable head-ends or DTH regional channels, can insert advertisement or promotional content they want to deliver only to local subscribers.*

However, these three categories are not enough to completely solve the challenges of modern video distribution.

When a video program is made available for web streaming subscribers or Video-On-Demand consumers, much of the original promotions and advertising may not be applicable or appropriate to the viewer at the time and place they view the program. To facilitate the replacement of content with something more relevant during the live streaming process or during future viewing events, the initial program must have more segment types than just these three. Each of these new segments may be as short as 10 seconds or as long as 60 minutes.

The amount descriptive metadata required is significant and since there are more points where content substitution occurs, the precision of splice point timing must improve over today's current standards.

Defining Metadata

Two primary pieces of metadata are required within the video stream to successfully define segments so that content replacement is possible. The first identifies "where" in the stream a segment starts and ends; the second identifies "what" content is present in that segment.

The rules defining the conditions under which content replacement can occur are defined outside of the video stream and to be successful, content providers should follow the Event Scheduling and Notification Interface (ESNI) standard to communicate those rules to their distribution partners. The standards for an Event Signaling and Management (ESAM) API provide suggestions for SCTE-35 messages for in-stream signaling.

The "where" to replace content in an MPEG video stream is determined with SCTE-35 splice messages. Splice points must be identified in the stream at the beginning of a content segment and at the end of the same content segment. Because every splice point must begin with an encoder-created IDR frame, the encoder should also insert the SCTE-35 splice message.

The IDR frame is not only a full frame of video content without references to other frames, it instructs receivers to clear their buffer of accumulated reference frames. As no additional B, or P frames can reference any frames before the IDR frame, the encoder must be know where the splice point it so it can properly create the compressed stream that contains the I, B, and P frames.

There are two types of SCTE-35 splice commands that are used to mark a splice point. These two splice commands are contained within a Splice Information Section SCTE-35 message:

- *The first, called splice immediate, as the name suggests, instructs receiving equipment to splice in new content at the first available opportunity, which is the closest IDR frame*

- *The second type of SCTE-35 splice message specifies a specific future time in the stream when a splice point is to occur. The scheduling of a splice point can be conveyed either shortly before a splice point should occur, using a splice insert message, or multiple splice points can be conveyed throughout a program using splice schedule messages*

Considerations for Supporting SCTE 35

Historically, systems handled content replacement using cue tones. A specific cue tone defined the start of a segment, they type of segment that followed, and often the duration of a segment.

If a programmer wanted to change the duration of a segment from 60 seconds to 90 seconds, they would have to work with their cable head-end affiliates and agree on a new 3-digit cue tone code that would be used to mark the beginning of a 90 second segment. Traditionally, the type and duration of a segment that followed a cue tone was inflexible and defined using a written agreement.

In contrast, the SCTE-35 standard provides for more flexibility and makes it possible to fully describe a segment within a program. SCTE-35 messages can define not only the start and stop points of a segment, but also the duration, and the content within the segment. In fact, because the duration can be defined at the beginning of a segment, the message defining the end of a segment is optional.

It is good practice to include the duration and the end-segment messages, but only one is required. The cable head-end affiliates that receive the program should be prepared to receive either the duration information, or the end segment splice point, or both.

Another method available to mark splice points for the beginning and end of segments uses the splice schedule SCTE-35 messages. These messages define future splice points for a program. The receiving splicers must remember the schedule splice events and alter those splice events as new splice schedule messages are delivered.

SCTE-35 messages are also used to define "what" content is in each segment. Splice descriptors can be added to a Splice Information Section messages. These descriptors identify the content in each program segment.

The SCTE-35 standard predefines three types of descriptors, but it is possible to define additional proprietary descriptors as well.

- *The first predefined descriptor is an Avail descriptor that can be added to the splice insert command and this descriptor is designed to function like a cue tone. It is interpreted by receiving equipment a splice point for substituting local advertising into the program stream.*

- *The second predefined descriptor is a DTMF descriptor that is designed to instruct a receiver to initiate the specified DTMF tone. The result of this descriptor is the same as the Avail, but it accomplishes this by signaling older splicing equipment that still require the audible DTMF tones.*

- *The third predefined descriptor is a segmentation descriptor that is used to define the content of a program segment. This descriptor has fields that can be used to turn web distribution on or off or mark whether a segment should or should not be blacked out. It can also be used to add content identification codes that are issued by industry organizations like Ad-ID, EIDR, ISO 15706, and more. These descriptors should be added to splice null, splice insert, or time signal commands before and during a program segment.*

According to the specification, if the segmentation descriptor is added to a splice insert command or used to identify the content of a new segment coming up, then the splice command should be delivered at least 4 seconds before the beginning of the segment.

Due to the vast possibilities of potential replacement content and the algorithms necessary to decide which new content segment will be inserted, many content re-distributors ask that these commands be sent eight or even 12 seconds before the beginning of a new segment.

Proprietary descriptors can be used to command devices other than receivers and splicers. For example, near the end of a basketball game, commands can be sent to cable head-ends addressing and instructing each head-end, independently, from where they will be receiving their next programming source—either a different program in the same transport stream or a different satellite transponder and program number.

As you can see, the SCTE-35 standard for metadata has moved the industry far past the traditional program segments, and the variability for determining distribution requires planning and systems that know how to take full advantage of this standard to create metadata-rich streams. The metadata-rich streams are required to enable additional advertising revenue as consumers' viewing habits change. This new advertising revenue is needed to offset the loss in revenue from traditional advertising resulting from fewer people watching traditional TV.

How Is The Metadata Inserted?

Once you know how the video program should be marked up with SCTE-35 metadata, you have to explore how those SCTE-35 messages get inserted into a program.

The easy answer is… there is no easy answer. Today, the information about the content in each program segment is contained in the play-out automation system. In the future, there will be even more information about the content that is generated at the cameras. This additional metadata will describe which players are on the field, where the ball is, who is in the field of view of each camera, and more.

As you can see, managing and distributing this growing world of metadata will become increasingly challenging. Today's challenge involves moving the information about each program segment from the automation system into the compressed transport stream that is distributed to cable head-ends, direct-to-home provides, and web streaming contend delivery networks (CDNs). To discuss the methods by which you should insert metadata, let's use the contexts of live stream and pre-recorded as was discussed earlier in this article when explaining the value of metadata.

Inserting Metadata Into Prerecorded Content

For non-live programs, the automation playlist can be parsed, if accessible, and the program segment descriptive information that must be inserted can be known, but that's not as easy as it sounds. The programmer must decide on whether to build a splice schedule that delineates the beginning and end of each segment, and deliver that schedule using splice schedule SCTE-35 messages. Or mark the end points to program segments using slice immediate or splice insert messages. Regardless of which method is chosen, the programmer will still need to use splice insert messages to embed splice descriptors for each segment.

Inserting Metadata Into Live Events

The splice schedule method simply doesn't work well for adding metadata to mark up program segments for live events. Live events make it impossible to precisely predict where segments will start or end. For live events it is for the play-out automation system to send out triggers that can be used to insert the correct metadata. These triggers are used to initiate the insertion of metadata that makes the splice points at the beginning and end of each segment as well as the segment descriptors.

To meet the standard, there should be a splice descriptor message at least four seconds before a segment starts, which is still possible for live events. If an encoder cannot properly translate splice descriptor SCTE-104 into SCTE-35 messages then the descriptors and the splice immediate messages may need to be inserted through different methods (described below). In that situation, the exact splice point can then be identified with a splice immediate message that is inserted after the splice descriptor, but before the splice point.

The other challenge many programmers must overcome is the fact that some distribution streams need more or different metadata than others. A programmer's traditional distribution transport stream that is sent via satellite to cable head-ends may not need all the metadata to describe all the details of each program segment. But a new transport stream that is sent to two other super head-ends may. By having the automation play out system send triggers to an external insertion system, the programmer gain flexibility on how and where that metadata is inserted.

The external insertion system can generate SCTE-104 splice immediate messages for insertion into one pre-encoder stream, but not another. And the insertion system can also generate SCTE-35 splice insert with segment descriptors into another post-encoder stream. This type of external insertion system has also proven to be effective with older play-out automation systems that don't support generating SCTE-104 messages.

Even though the SCTE-35 and SCTE-104 standards have been available for a number of years, most video distributors have not had the requirement to implement them fully. The pace at which video distribution is evolving and the need to take advantage of these new standard has increased significantly in the past two years.

The industry is challenged with leveraging older equipment and systems that are not fully compliant with all the standards making it difficult to implement new standards quickly and many of the new video distribution channels that are demanding the standards be used aren't generating significant revenue…yet. They will, but until then it simply is not economically feasible to upgrade play-out automation systems and encoding systems to meet today's requirements knowing that tomorrow's requirements and newer standards are en route. Flexible solutions that can evolve as the industry evolves are required.

In the meantime, additional testing and validation equipment is needed to make sure that the standards are adhered to and the customer requirements are contractually met. This can be challenging, to find test equipment that can monitor and validate the SCTE-104 metadata in the uncompressed domain as well as the SCTE-35 metadata in the compressed domain and the metadata contained in the streaming manifest files.

Even with these challenges, the way forward is clear. The future for content distributors is in the value added to the content distributed. Companies that plan today to manage content smartly will reap the rewards of participating in new revenue streams wherever their content flows.

Want to learn more about the importance of Metadata? Crystal will host a live educational webinar on April 23rd at 2:00 p.m. EST with partner *SatMagazine*, discussing "***Metadata Matters: What You Need to Know About SCTE-35***".This webinar will provide an overview of the importance and use of metadata within the broadcast ecosystem and a primer on the mechanics of incorporating metadata into the content stream.

Click here to register for this informative webinar, or go to http://crystalcc.com/metadata-matters/

About the webinar
Metadata Matters—What You Need to Know About SCTE 35

Video content providers, from traditional broadcasters to Internet streaming platforms, face expanding consumption models and the challenge of responding to direct and immediate feedback from viewers. Metadata is the key to enabling this consumer-driven evolution and an important role for the content provider in the overall distribution chain. The webinar will provide an overview of the importance and use of metadata within the broadcast ecosystem and a primer on the mechanics of incorporating metadata into the content stream.

Join Silvano Payne (Publisher, SatNews Publishers), Hartley Lesser (Editorial Director, SatNews Publishers), Paul Woidke (Industry Veteran and Award-Winning SCTE Expert) and Roger Franklin (President and CEO, Crystal) for an insightful webinar that includes:

- *Overview, history and importance of metadata (SCTE-35)*
- *The mechanics of implementing metadata into the content stream*
- *Q&A*

Register at the link above for the live webinar live and participate in our accompanying tweetchat ***#SMlive***.

Poachers Without Borders... A DigitalGlobe Satellite Sentinel Project Report

Poachers are killing the elephants of Garamba National Park in the Democratic Republic of the Congo at an unprecedentedly rapid pace.

Since mid-April of 2014, park rangers have found the carcasses of 131 elephants[1], slaughtered for their tusks. Unlike in the past, when criminal gangs carried out most of the poaching, the main actors appear to be heavily armed groups using professional techniques. Some of the poachers have been involved in Central Africa's many conflicts and have carried out multiple atrocities against civilians, creating much misery and suffering over the past decade.

The Lord's Resistance Army (LRA), renegade elements of the Congolese national army (the FARDC), and armed poachers from South Sudan and Sudan, have led this recent upsurge in poaching.[2] These groups, in contrast to the criminal gangs, use their revenues from poaching in part to fund their continuing military activities through purchases or food, weapons, ammunition and other supplies.

This increase in poaching is both qualitatively and quantitatively different from previous experience at Garamba. In the past, poachers have relied on relatively low technology tools and have tended to kill one or two elephants at a time. According to African Parks, which manages Garamba on behalf of the Congolese government, the recent attacks have resulted in three to eight elephants being killed at a time, with the tusks often being removed by chainsaws. There is evidence of at least nine elephants being shot from helicopters.[3]

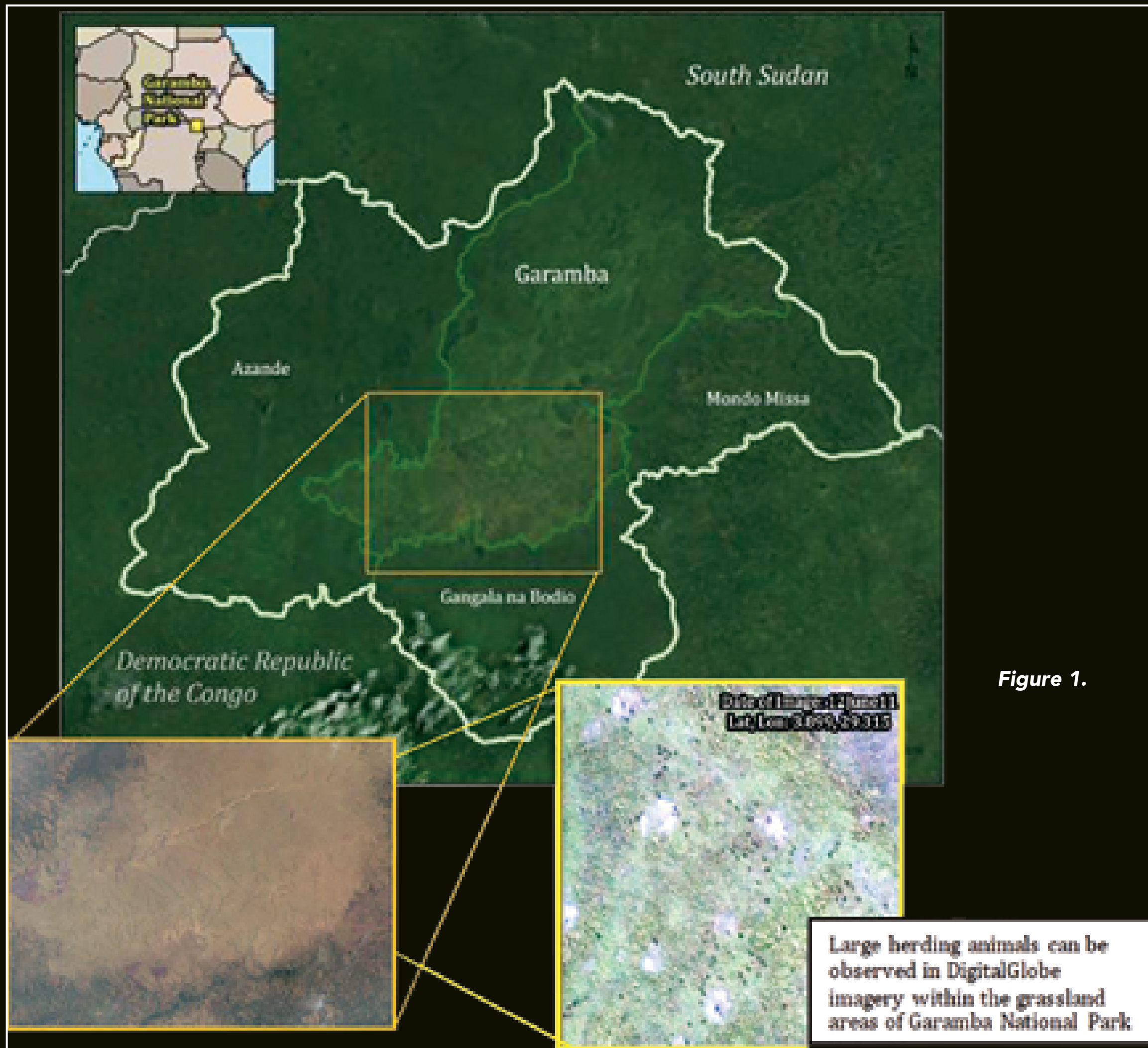


Figure 1.

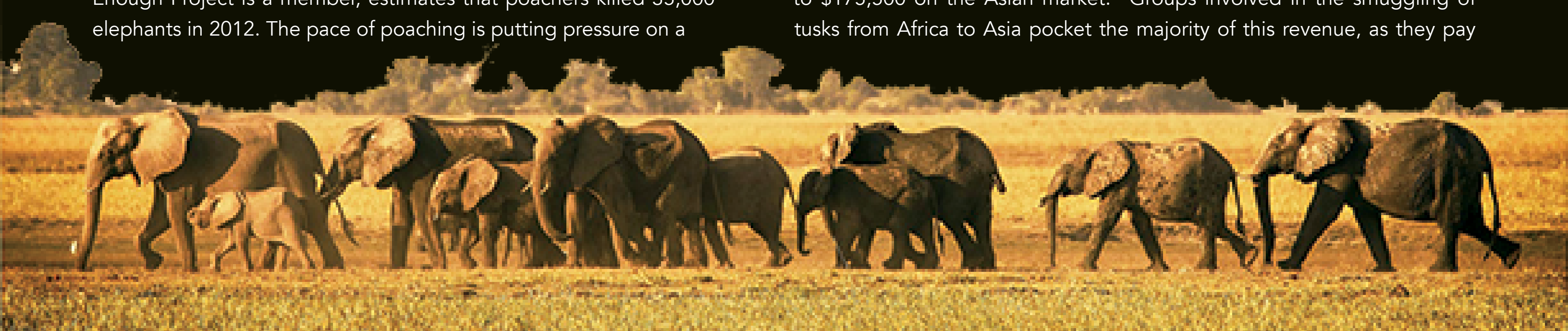
This information being presented in *SatMagazine* is a follow-up to a report produced in 2013 by the ***Enough Project, The Resolve, Invisible Children, and the Satellite Sentinel Project***, with DigitalGlobe's assistance, that described how the LRA poaches elephants in the Democratic Republic of the Congo's Garamba National Park. The project seeks to use satellite imagery and predictive analytics to assist the park's rangers to level the playing field with the poachers and better protect the dwindling elephant population.[4]

Since the 1980s, the Garamba elephant population has fallen to about 2,400 from approximately 20,000, largely due to poaching. This effort to use the latest technology to better equip rangers to protect elephants is currently being tested in Garamba—if the partnership with the park's rangers is successful, the technology can be replicated in other parks across Africa.

The slaughter of African elephants for their valuable ivory has reached the point that according to the World Conservation Society (WCS), 96 elephants are killed each day. WCS' 96 Elephants coalition, of which the Enough Project is a member, estimates that poachers killed 35,000 elephants in 2012. The pace of poaching is putting pressure on a continental elephant population that has declined by more than 50 percent in the past 30 years.

Ivory prices have reached a record high because of high demand in east and southeast Asia, especially China. On the black market in Asia, elephant tusks are valued at $1,000 to $1,300 per pound.[5]

With adult male elephant tusks weighing roughly 135 pounds, and adult female tusks weighing 20 pounds, a single elephant tusk can sell for $20,000 to $175,500 on the Asian market.[6] Groups involved in the smuggling of tusks from Africa to Asia pocket the majority of this revenue, as they pay



regional poachers around $23 per pound (or $50 per kilo) and then sell the same tusk to middlemen for roughly $200 per kilo.[7]

Garamba National Park Overview

For Garamba's rangers, tracking poachers through the vast park is daunting and dangerous. The Park itself spans an area of about 4,920 square kilometers. This includes the three hunting reserves on its borders, and the complex covers more than 12,000 square kilometers, an area the size of the U.S. state of Connecticut and slightly larger than the Gambia. Park rangers must track migratory elephant herds through savanna grasslands and deep forests and they must stop elusive groups of poachers who use their intimate knowledge of the terrain to escape detection. (*Please see Figure 1 on the previous page.*)

Key Findings + Recommendations

In an effort to help park rangers focus their patrol efforts on the areas with the greatest probability of a poaching incident, DigitalGlobe analysts were given the geospatial locations and dates of elephant remains discovered between 2011 and 2013. Analysts also received elephant collar data, ranger patrol routes, and past Lord's Resistance Army (LRA) camp locations.

This data allowed DigitalGlobe analysts to conduct historical geospatial trend analysis, cost surface travel analysis, key terrain analysis, and predictive analysis based on output from the Signature Analyst™ geospatial terrain analysis tool. The following are the team's key findings:

» Collar data from 2011 - 2013 indicates there was no clear seasonal elephant migration but there were four primary areas where elephants tended to cluster. ** Although data from only 19 out of an estimated 2,400 elephants does not represent a statistically relevant sample size, it does represent the best data available on Garamba's elephants and their patterns of movement.*

- Elephants tended to remain in the same primary areas of the park, and very few traveled to the northern portion of the park or into other cluster areas.

- Due to the lack of data in the northern portion of the park, it is difficult to determine if there is a significant poaching threat in that area of the park. Of the three collared elephants that did travel to the northern portion of the park, two returned unharmed, and the GPS collar of one elephant stopped transmitting while it was still in the north.

» From 2011 to 2013, all reported elephant poaching incidents took place within the same 1,818 km² area of the park which can be further divided into four distinct poaching areas of operation (each less than 480 km²).

**It is likely that there were some poaching incidents outside of this area, but because the rangers do not commonly patrol the northern portion of the park, no incidents have been reported north of the Garamba River.*

- 50 percent of all the poaching events that took place in 2013 were within five kilometers of a 2012 event, which indicates that poachers are utilizing the same areas of the park from one year to the next.

- Between 2012 and 2013 there was a significant (55 percent) decrease in the number of poaching events within the park. This was particularly apparent in the eastern portion of the poaching area where a 76 percent decrease in poaching events was observed. Since that time, in 2014, the number of poaching events increased dramatically throughout the park.

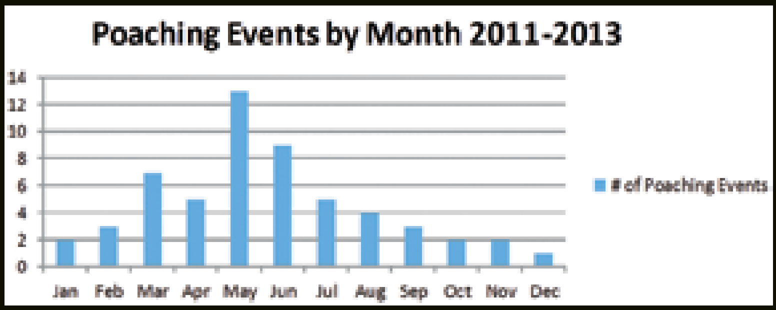
- The Signature Analyst™ tool further reduced the probable poaching area of operations to four areas of less than 32km² (this represents a 98 percent reduction in the overall park and a 95 percent reduction within the historic poaching zone) and one possible new area should poaching in historical areas be disrupted.

In an effort to combat the poaching, rangers have increased both the number of patrols they are conducting and their patrol ranges (from seven kilometers in 2012 to 15 kilometers in 2013). Although these efforts appear to have had an effect in the eastern portion of the poaching areas, they have had a minimal impact in the western areas where the number of poaching events remains consistent.

- *Ranger patrol data for 2013 and for January to March of 2014 indicates that park rangers are primarily sticking to the secondary road network in the western portion of the primary poaching areas of operation. These secondary roads are likely useful to the poachers as a means to reconnect with the primary road network, but poaching events generally take place approximately 3.5 kilometers from a secondary road.*

- *Establishing random checkpoints or inspection stations at key choke points into and out of the poaching areas, particularly during the high poaching months from March to August will likely provide the rangers with a better means of controlling who travels into these areas.*

- *Only 45 percent of all patrols from 2013 to March 2104 have been within five kilometers of a historic poaching event, and only 15 percent have been in an area identified as highly likely to have a poaching incident by the Signature Analyst™ output. Focusing patrols in these areas will likely increase the rangers' odds of disrupting the poachers' areas of operation.*



Elephant Movement

DigitalGlobe analyzed collar data provided by African Parks for 19 different elephants. Although each individual elephant's movements likely represent those of a larger herd, the data is a small sample of the overall number of elephants within Garamba National Park.

The 19 collars transmitted location data for different lengths of time and at different periods of time from 2011 to 2013. Only two of the elephants transmitted locational data for 17 to 20 months, which allowed for wet (June to November) and dry (December to May) seasonal migratory analysis. No clear seasonal migration was detectable in the available collar data. However, in the three-year study period, elephants tended to cluster in four primary areas in the southern portion of the park.

Figure 2 on this page depicts the persistent cluster areas from 2011 to 2013, followed by a temporal depiction of where collared elephant concentrations could be found during the study time frame.

Patrol + Poaching Incidents: Southern Region Of Garamba

Similar to the elephant collar data, park ranger patrol information is most prevalent in the southern portion of the park. Park rangers rarely traveled north of Garamba River from 2011 to 2013. However, recent efforts are being made by the park to patrol northern areas more extensively by utilizing helicopters.[8] (*Please see the graphic on the following page.*)

The number of poaching incidents that have occurred in the northern section is unknown at the time of this report. The available data revealed that there were 56 known poaching incidents resulting in 70 elephant deaths. Since April 2014, there have been at least 131 elephants killed by poachers.[9] (*Please see Figure 3 on the following page.*)

Historical Trend Analysis Within Garamba National Park, 2011 To 2013

From 2011 to 2013, there were 56 elephant kill sites discovered within 56 kilometers of each other in Garamba National Park. Covered by vast grassland, and surrounded by the parks gallery forests to the south, east, and west, the ~1,818 km² area represents the park's primary elephant poaching zone.

Within this zone, there are four distinct poaching areas of operation (AOs), described below. Poachers generally tended to stay away from significant elephant concentrations, and they operates in areas more than seven kilometers from park ranger stations.

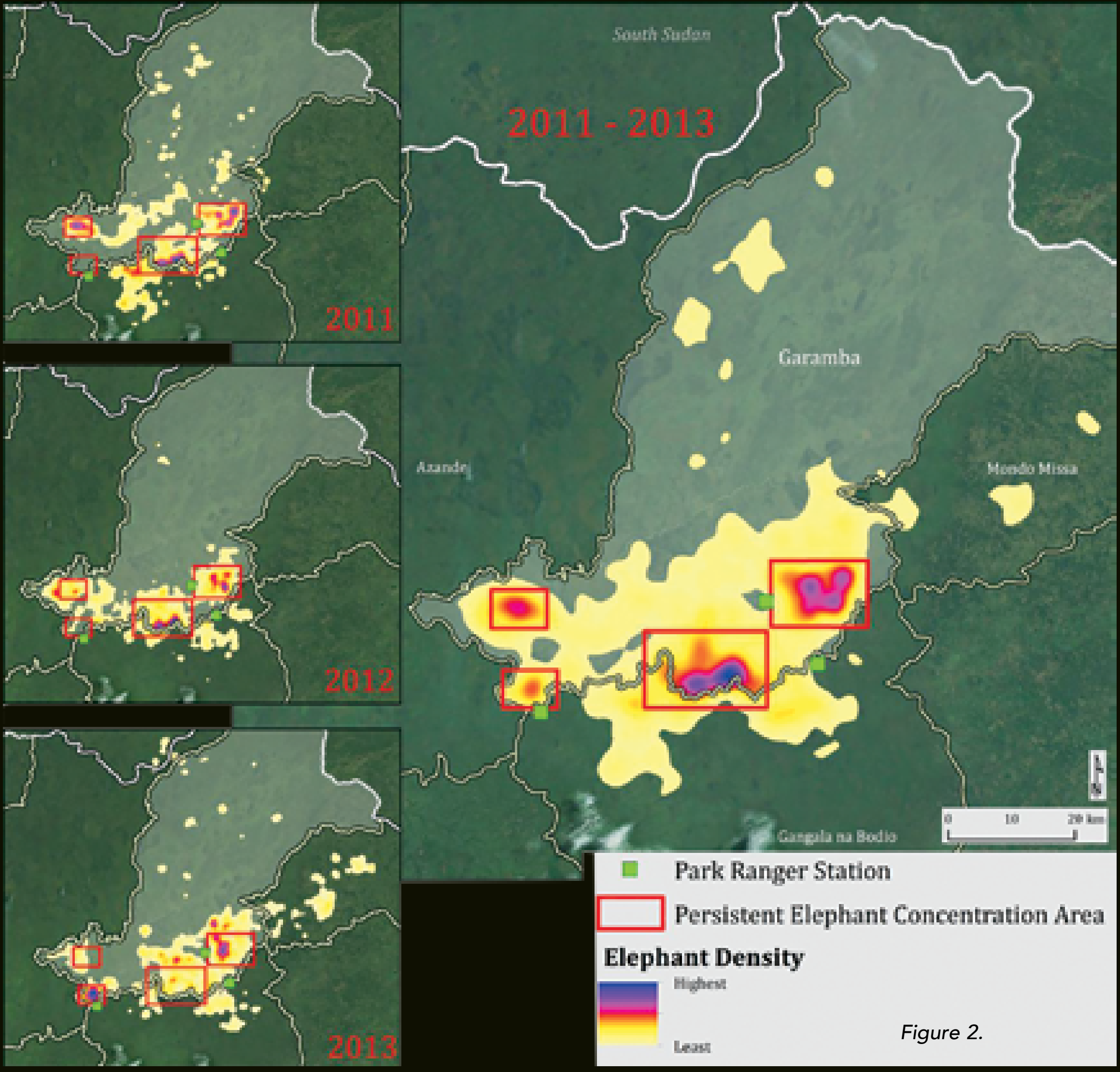


Figure 2.

Poaching Areas of Operation:

- *AO 1—This (480 km²) area has been the most active overall for poaching, accounting for 33 percent of all 2011- 2013 poaching activity. Ranger patrolling data from 2012 indicates that this area is patrolled far less than the eastern portion of the poaching zone. June to July (37%) and February to March (32%) represent the most active months for poaching in the AO. *Analysis found that elephant G20 passes through this area on a regular basis and is at the greatest risk.*
- *AO 2—This 246 km² area has been frequented by poachers over multiple years, representing 23 percent of all poaching events, with the majority of events (76 percent) taking place from March to June.*

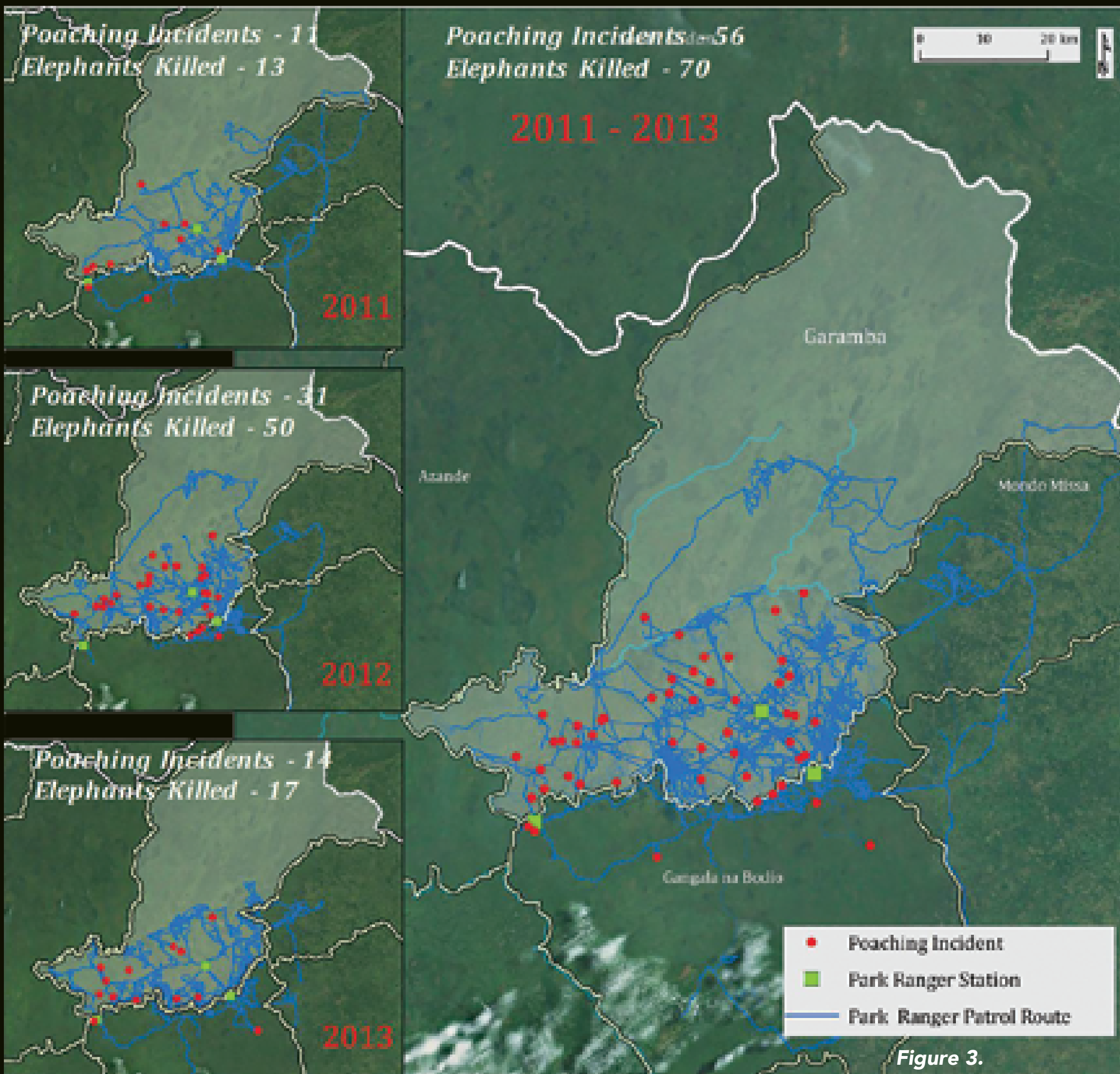


Figure 3.

- *AO 3—Although AO 3 (268 km²) accounts for 21 percent of all poaching activity in the park from 2011 to 2013, only one poaching event took place in 2013, suggesting that increased ranger patrols in this area have pushed the poachers into other areas. Analysis found that the one incident in 2013 took place in the same month and only five kilometers away from an incident a year earlier, which may indicate an annual hunter.*

- __AO 4__—As is the case with AO 3, AO 4 (411 km²) had significantly less activity in 2013 than it had in 2012. The two events that took place in 2013 were shifted further to the west than in previous years. (*Figure 4, next page.*)

Signature Analyst™ Methodology

DigitalGlobe used Signature Analyst™ software to identify geographically suitable terrain for poaching activity. The model measures the relationship between elephant poaching sites and geospatial data, or factors, within the area of investigation to identify other similar terrain in the environment.

Signature Analyst™ Poaching Signature Within Garamba National Park

Using an advanced geospatial terrain analysis tool (Signature Analyst™) DigitalGlobe analysts were able to further refine the most susceptible areas for poaching activity within each of the four poaching area of operations and were able to identify a new area that shares a similar geospatial signature with historic hot spots. (*Please see the image below.*)

The total area reduction represents a 98 percent reduction in the overall park and a 95 percent reduction within the historic poaching zone. In 2013, poaching tended to occur within grasslands, away from elephant concentrations (within AO 1 and 2), on the outskirts of gallery forest areas, above 740 meters of elevation and five kilometers from discovered LRA camps.

There was a significant stand-off distance from park ranger stations in 2013, generally occurring over 12 kilometers away, which is an increase from 2012 when they were generally seven kilometers away. Poaching is also generally 3.5 kilometers from a secondary road network. (*Please see Figure 5 on the following page.*)

** Historical poaching area compared to geospatially reduced area:*

__AO 1__ (480 km²) – 31.6 km² of Signature
__AO 2__ (246 km²) – 26 km² of Signature
__AO 3__ (268 km²) – 2.3 km² of Signature
__AO 4__ (411 km²) – 29 km² of Signature
* Area of interest based off shared signature is 107 km² [9]

Garamba National Park Ranger Patrol Data

In an effort to combat poaching, rangers have increased both the number of patrols they are conducting and their patrol range (from seven kilometers in 2012

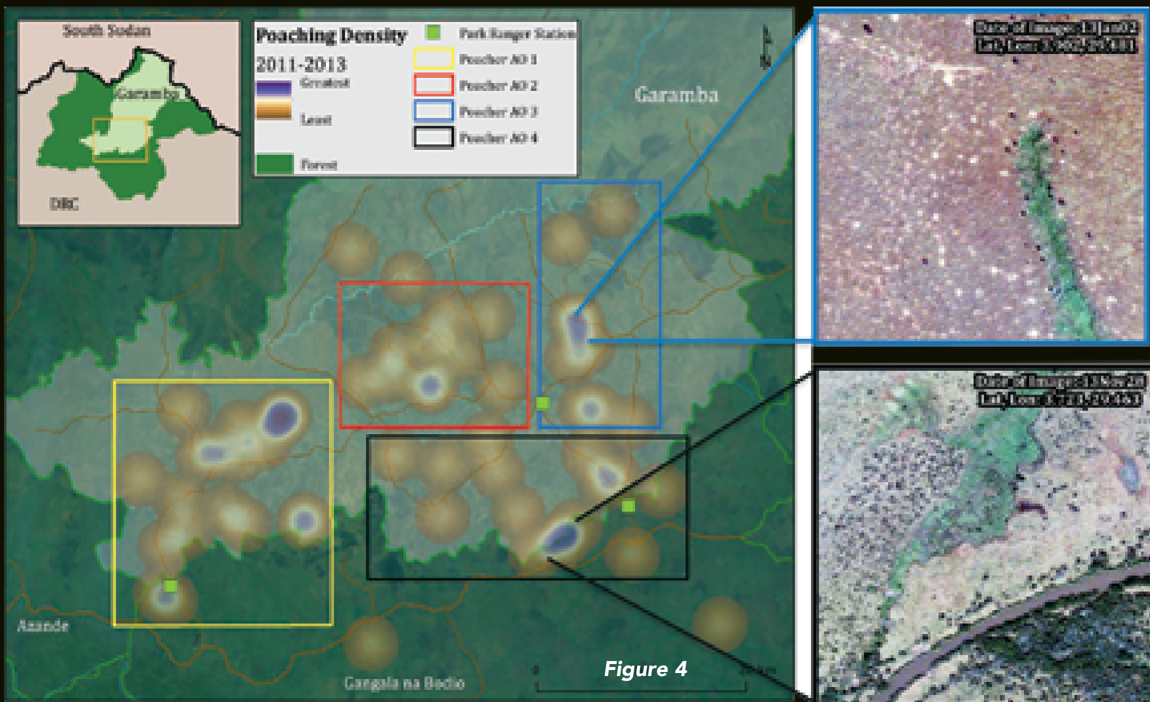


Figure 4

to 15 kilometers in 2013), which appears to have had a positive effect in the eastern portion of the park.

However, in the western portion of the poaching areas, the number of poached elephants remained essentially the same from 2011 to 2013. This is likely due to the fact that the rangers who are patrolling these areas are primarily sticking to the secondary road network, and poaching events are taking place between the road networks and generally at least 3.5 kilometers from a secondary road.

** Throughout all of 2013, only 45 percent of all patrols have been within five kilometers of a historic poaching event, and only 15 percent of the events have been in an area identified as highly likely to have a poaching incident by the Signature Analyst™ output.*

2014 Patrol Data

In January and March of 2014, park rangers had only directly patrolled 5 percent of the 107 km² Signature Analyst™ output. As in 2013, patrols in this area have not often strayed from the secondary road networks. Updated patrol route information since March of 2014 could be used to identify if there have been recent changes in these patrol patterns. (*Please see Figure 6 on the next page.*)

Cost Surface Analysis Of Garamba National Park

The choke points identified represent terrain that poachers may use to move ivory undetected out of Garamba National Park. Establishing random checkpoints or inspection stations at key choke points into and out of the poaching areas will likely provide the rangers with a better means of controlling who travels into these areas.

Cost surface analysis is a rule-based model that represents

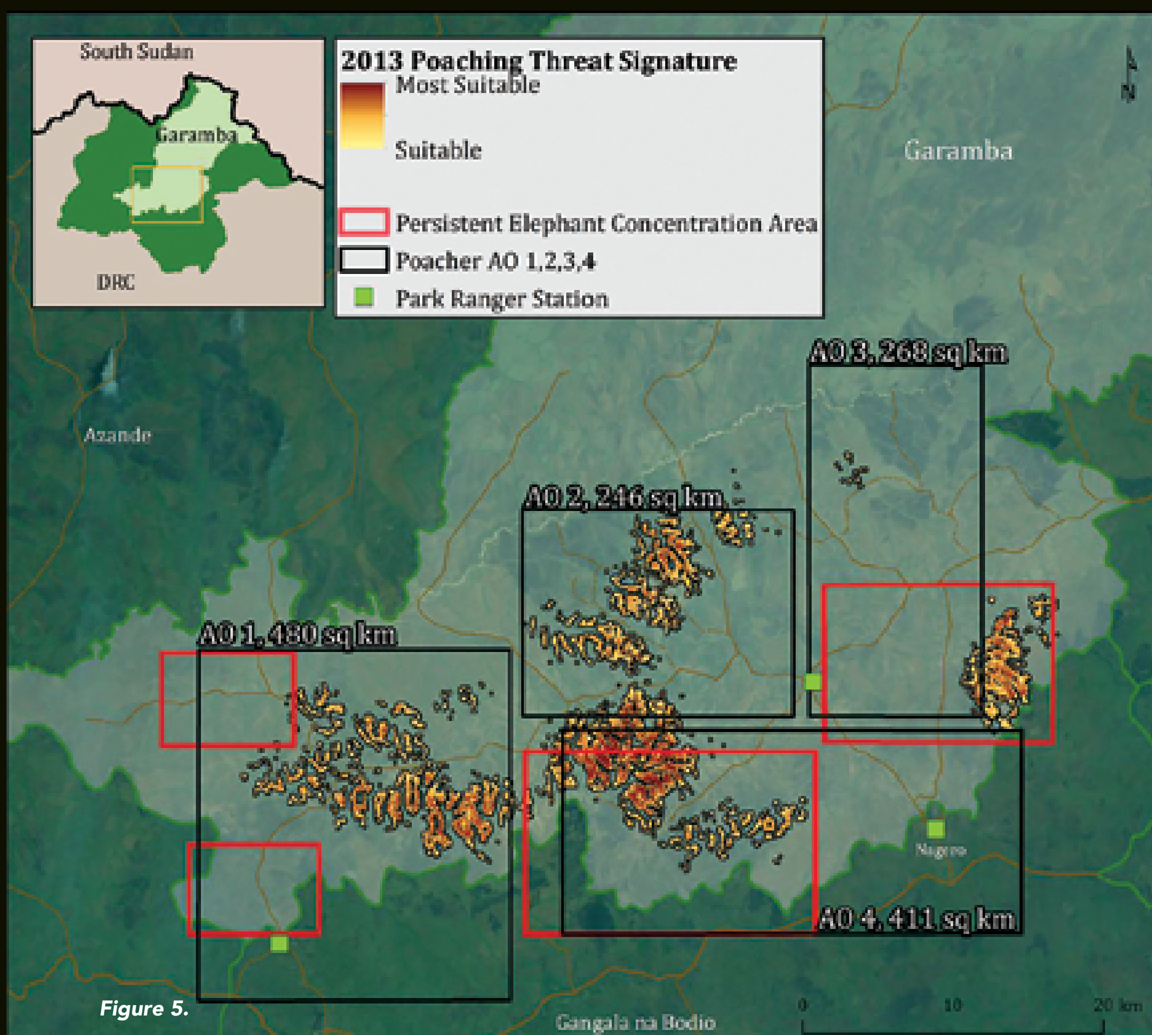


Figure 5.

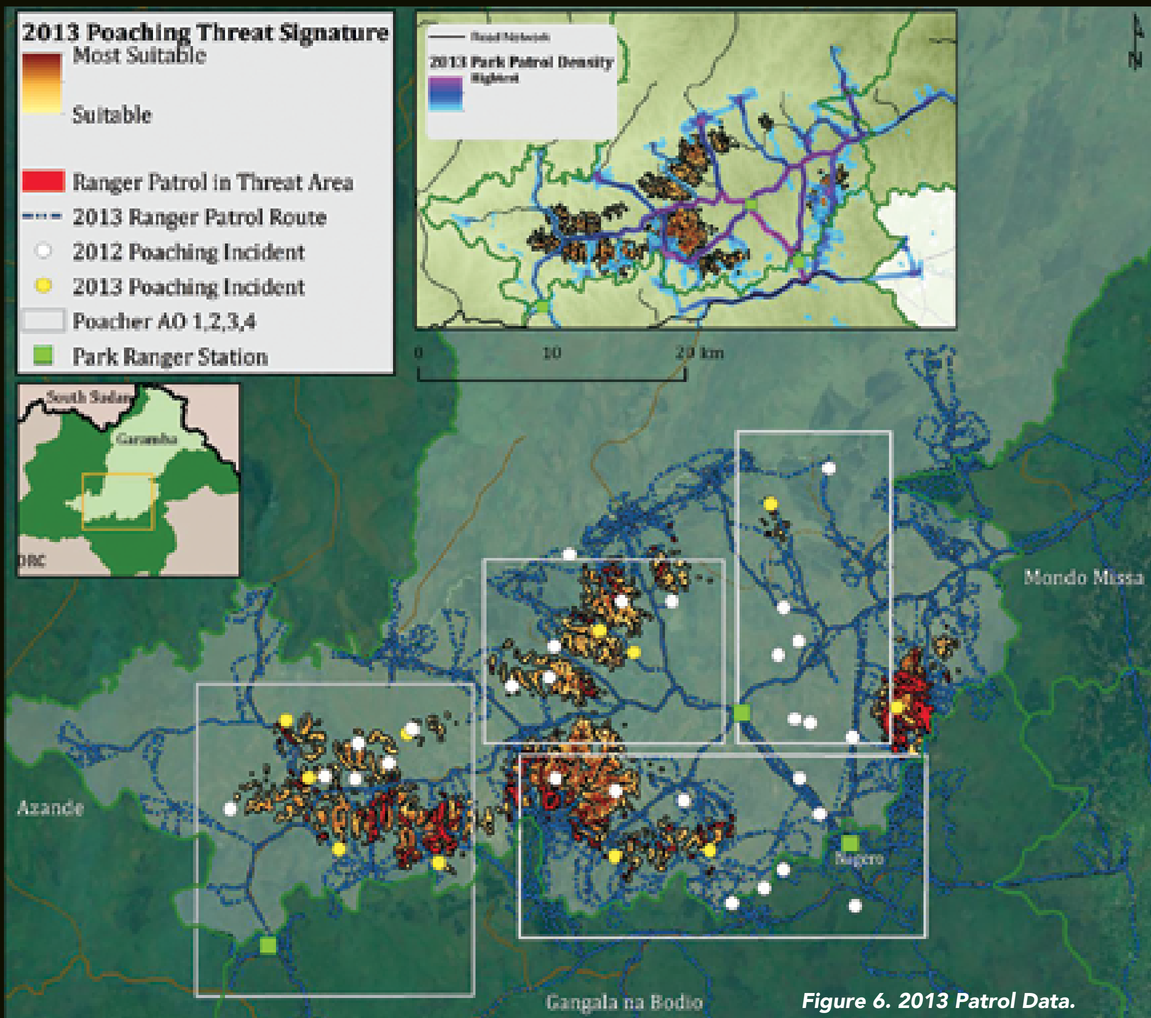


Figure 6. 2013 Patrol Data.

Five choke points were identified using the following assumptions:

- **Land movement**: Poachers will primarily utilize the road network, and then they opt for minimum slope and stand-off distances of 10 kilometers from park ranger stations.

- **Stream/River movement**: Poachers will use waterways when available, and then they opt for minimum slope and keeping (*Please see Figure 8 on Page 34.*)

Key Choke Point Description

The chokepoints identified represent terrain that poachers will likely pass through to reconnect with the primary road networks either, on the way into or out of poaching areas of operation. (AO)

an additional capability DigitalGlobe provides. Further refinement using park ranger input would optimize the model to a higher confidence level and can change results. It is unknown whether the waterways or road networks are utilized by the poachers.

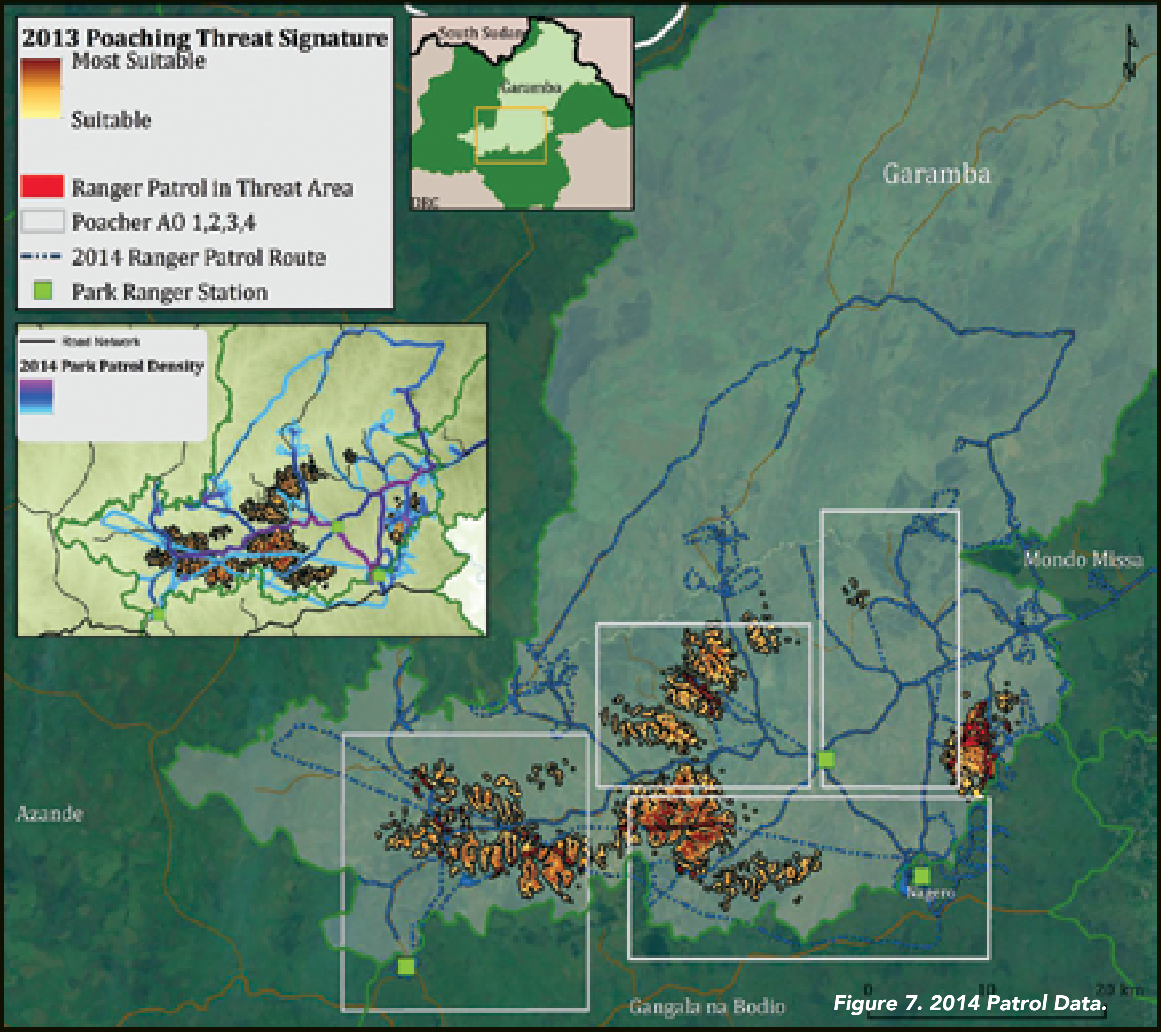


Figure 7. 2014 Patrol Data.

- *Chokepoint 1—This area's close proximity to AO 1 and optimal stand-off distance from the nearest ranger station suggests it is highly likely that this route is commonly used by poachers to return to the improved road network when exiting the park to the west. It is unknown whether this is a river crossing point. However, the availability of flat embankments make this location an ideal staging area for ship-to-land transfers.*

» **Chokepoint 2**—This area is a grassland/waterway for movement throughout the park.

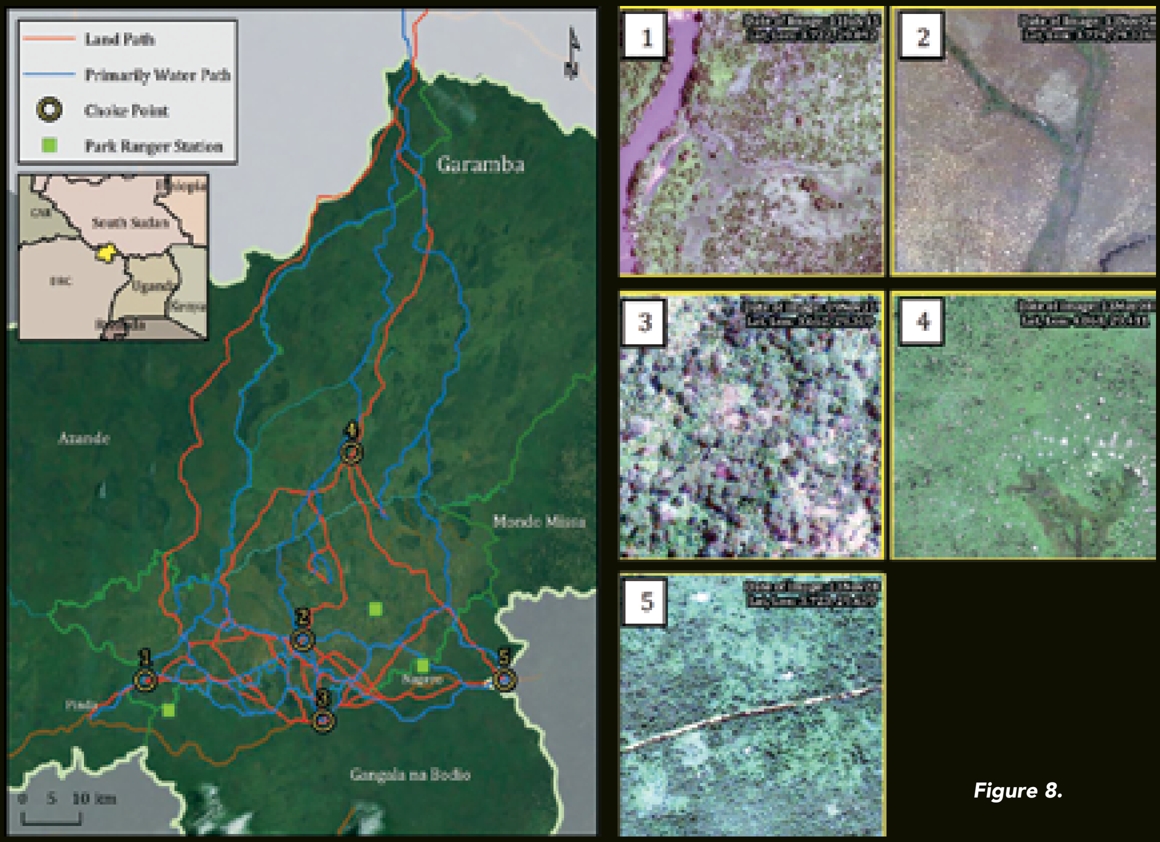
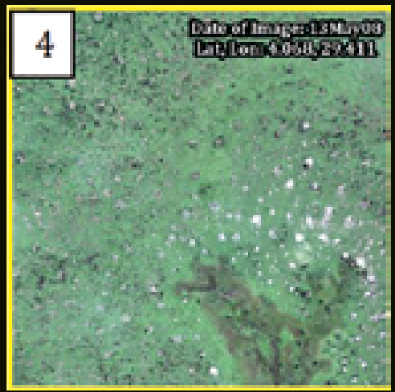


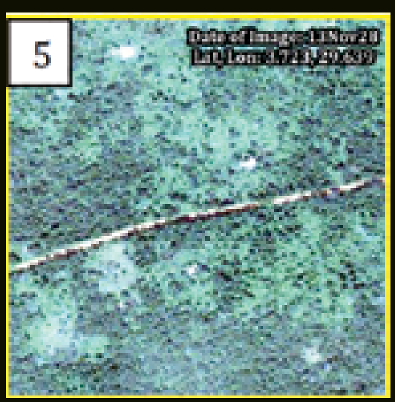
Figure 8.

» **Chokepoint 3**—This area serves as the primary convergent point for multiple avenues of approach. The area serves as the primary southern exit point, is primarily forest-covered, and there is no park ranger station to repel freedom of movement in this area which should be key terrain for park rangers.

» **Chokepoint 4**—This is the intersection of all but one of the 2013 poaching locations for land movement paths heading north. This location is just south of a region of the park that rangers do not patrol, according to 2012 patrol data.



» **Chokepoint 5**—As routes disperse to bypass the Nagero station at a safe distance and head east, this pass through to return to the improved road.



Garamba's park rangers have improved upon the annual number of patrols they are making, and they have significantly increased their patrol distances from the ranger stations (particularly in the eastern areas of the park which saw a dramatic decrease in the number of poaching events between 2012 and 2013).

There are, however, still some focus areas that they have been missing. Rangers could have greater impact in countering poachers operating in the park if rangers gathered data on the northern portion of the park, refocused patrols into the Signature Analyst™ areas where poaching events are more likely to occur, and controlled key access points into and out of the poaching areas.

The findings of this report could assist Garamba's rangers in targeting and timing their patrols to better protect the park's elephants from poachers. If the application of the predictive analysis demonstrated here does help to slow the slaughter of elephants, the analytical method and tools could be used elsewhere in Africa to stem the increasingly rapid slaughter that is taking a heavy toll on the continent's elephant population.

Analytical approaches such as these should be part of a larger multifaceted effort undertaken by governments, African civil society organizations, international bodies, conservation groups, and anti-atrocity organizations to stop poaching. The concerted efforts of many involve halting the poaching in Africa and also ending the demand for ivory.

One example of multinational efforts to counter poaching is the recent deployment of U.S. Marines to Chad to train park rangers to intercept elephant poachers. DigitalGlobe, the Satellite Sentinel Project, and the Enough Project hope that this pilot initiative can make a measurable contribution to that effort.

Update

Since April of 2014, at least 131 elephants have been poached within Garamba National Park. Although DigitalGlobe was not able to obtain the precise locations for every poaching event, results from the modeling of poaching trends allow patrols to focus on the highest likelihood or probability threat areas. This translates to a 95 percent area reduction where the majority of the recent poaching incidents have taken place.

Focusing the park's increased security measures (including use of a charter helicopter, collaboration with U. S. Africa Command, and intensification of the parks surveillance aircraft) in the reduced areas would allow for greater patrol focus on the most likely areas for poaching events.

Editor's note: Our thanks to DigitalGlobe for permission to repurpose their article from their infosite. All imagery is also courtesy of DigitalGlobe.

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NSR Analysis:
A Bump In The Road For Energy

By Brad Grady, Senior Analyst, NSR USA

The talk of the Energy Industry, or more specifically the Oil & Gas Sector, these days is centered on the trickle-down impacts of the near-term instability of crude oil pricing.

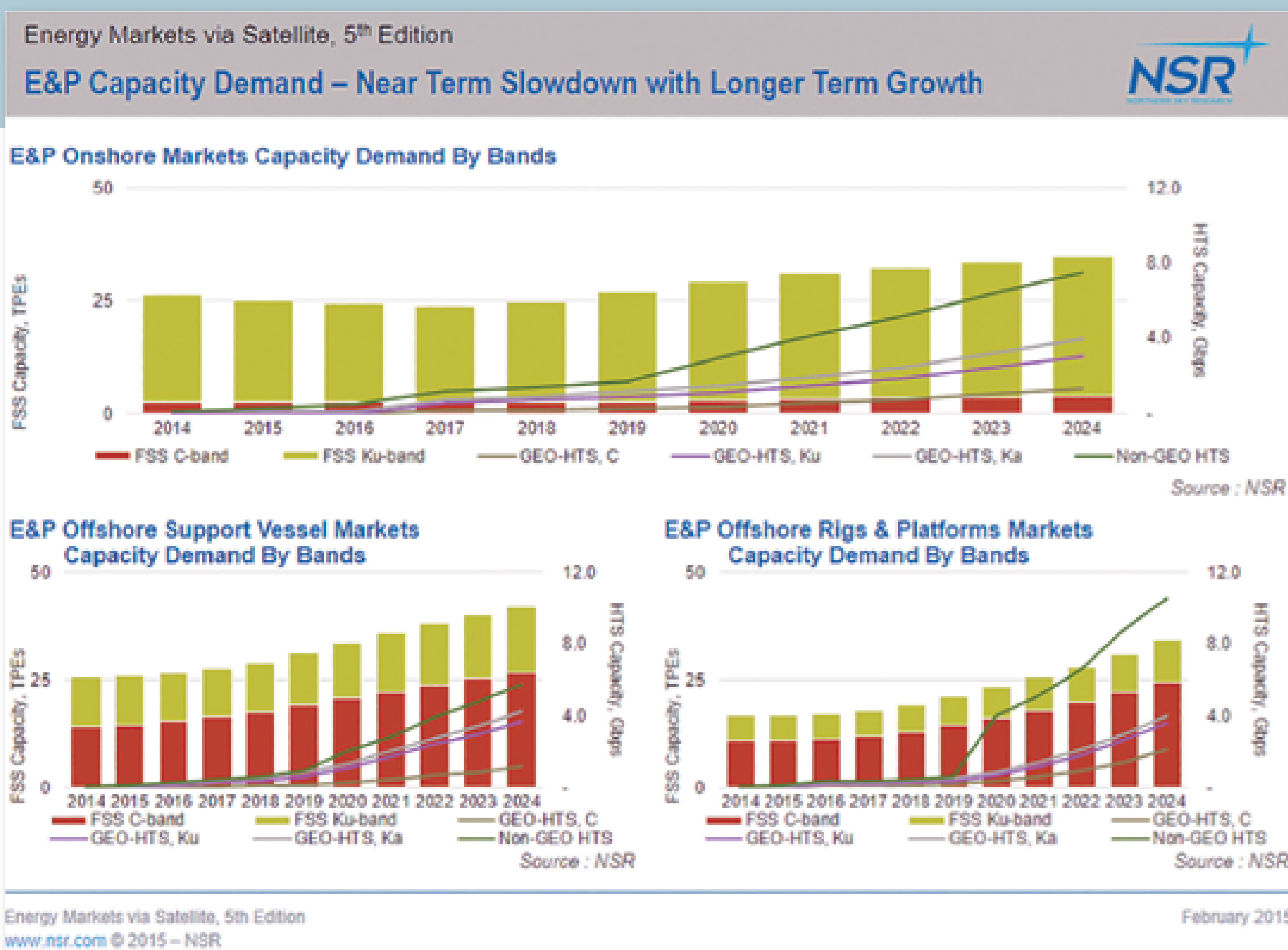
With rig counts continuing to decline compared to previous years, a slowdown across onshore, offshore, conventional and unconventional markets due to lower exploration activity, and budgets across the E&P sector getting slashed for 2015-2016, there is probably good reason to worry, for the near term.

As the E&P sector turns its focus towards the reality of a $60 crude oil barrel hovering around, the overall result is a greater focus towards improving operations across the business—both onshore, and offshore. What does the impact of all this mean for SATCOM in the Energy markets?

As discussed in NSR's *Energy Markets via Satellite, 5th Edition* (***www.nsr.com/research-reports/satellite-communications/energy-markets-via-satellite-5th-edition/***) report, it may be just a bump in the road through 2016-2017, with growth thereafter brought about by HTS.

Onshore will be hit the strongest as crude supply and demand remain disconnected. Without clear pricing stability and an oversupply of crude and natural gas in key markets, satellite service providers should see some consolidation amongst independent producers.

Additionally, as crude pricing favors lower production cost fields in areas such as the Eagle Ford, the market for remote communications into these areas will lean more heavily towards a terrestrial-based primary communications solutions.



Without the quicker drilling tempo of an $80 barrel, and activity concentrating into the more profitable fields, the next 12 to 18 months will see a dip in satcom services demand.

Those rigs that continue to operate through either longer term contracts or more profitable operations will likely see higher demand for data connectivity, but fewer rigs still means less demand.

Offshore E&P is a harder market to find a connection for, with longer term contracts weighing more heavily as well as longer lead-in and shut-down times dampening the link between crude pricing and satellite demand.

For the offshore support vessels (OSV) market, the next few months will be challenging as seismic activity will likely remain lower than normal, and new builds continue to enter the market. However, the core market—vessels on longer term contracts or providing more sophisticated services—will continue to require connectivity. And, once the market stabilizes, more vessels will mean the upward trend will pick up in more places.

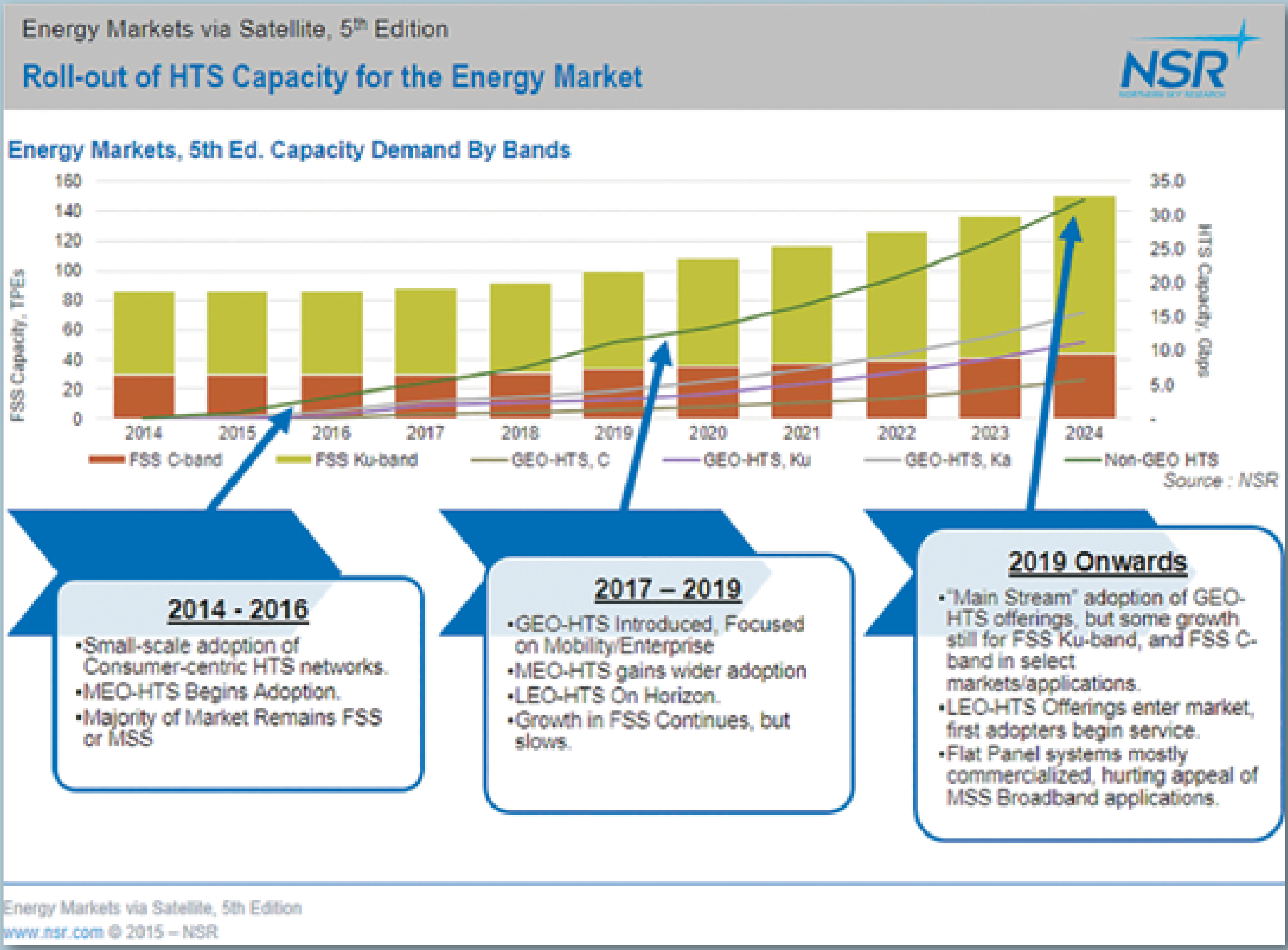
Within the rigs and platforms sector, ultra-deepwater activity will likely feel some impact in the near term as greenfield projects are re-evaluated. Those projects which are still on the drawing boards will likely remain so until markets stabilize, and areas such as the Arctic will slow down as cheaper oil elsewhere remains.

In the core markets of the North Sea and the Gulf of Mexico, terrestrial options will play a larger role as O&G end-users stick to existing fields that have well known quantities of petroleum and are within easy reach of existing assets.

Additionally, with a greater focus on 'improving operations' will also come a greater demand for lower latency, higher throughput connectivity options from stabilized microwave or sub-sea fiber. Yet, the market for SATCOM services will still remain in key markets for the remote projects that are already under development, from near shore operations in Southeast Asia to deep water locations in Brazil.

There will be no getting around the impact of rigs being idled, especially for onshore operations in the shale/unconventional plays. For the rigs and vessels without longer term contracts, the market will remain exceedingly difficult and end-users will need to either reduce the number of active equipment, or significantly cut day-rates.

Those sites and vessels which remain active will need to become leaner, more efficient operations, a process which typically involves more data at more stages of the well lifecycle. Any conversation within the Energy sector that involves "improving operational efficiencies" implicitly means "more data."



Everything from narrowband/M2M data to bandwidth-hungry video conferencing applications will be brought to bear in the name of improving operations. However, budgets will still remain constrained as IT managers are told to do more with the same—or less.

The satellite industry is already in the process of developing a strong solution to the 'do more with less,' with many High Throughput Satellites (HTS) launching over the next 12 to 18 months. Fitting right into the current budget constraints of O&G end-users, the 'more bits per buck' value proposition of HTS will help offset the traditional hesitation across the energy sector of adopting newer technologies.

The satellite communications sector continues to recognize this, and continues to announce new HTS-enabled satellites across C/Ku/Ka bands in all corners of the globe, with footprints mirroring existing FSS coverage being only a question of 'when', not 'if.'

With more capacity in the sky, and more pressures on the ground to reduce cost and improve operations, HTS-enabled services will become a core component of the remote energy communications puzzle. Although traditional FSS will remain (and grow as activity pick up again), the focus on improving operations and the bottom line will be a strong motivating factor for a quicker than usual adoption which will make the current downturn merely look like a bump in the road for the satellite industry.

NSR: ***http://www.nsr.cm/***

Mr. Grady has been involved in the Satellite Communications industry since 2005, joining NSR in 2010. He is NSR's Energy market subject matter expert, and a core member of NSR's mobility research practice for both civil and government markets. He regularly provides his insights and analysis to NSR's single-client consulting practice, and is also a regular contributor to leading industry publications and forums.

Before joining NSR, Mr. Grady served as the Sustainable Development Projects Coordinator Intern with the Global VSAT Forum where he worked regularly with the GVF Secretariat and the Regulatory Working Group on many of the forum's initiatives. Working with the Regulatory Working Group, Mr. Grady helped develop and implement various RWG initiatives aimed at protecting satellite spectrum, increasing awareness of satellite services, and working to promote regulatory reforms across the globe.

Mr. Grady holds a Bachelor's degree in Economics from the University of Maryland, College Park where his research focused on renewable/alternative energies, Information Communication Technologies and the Satellite Communications Industry. He works in NSR's Washington DC office.

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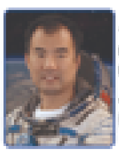
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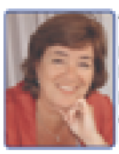
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Meeting The Demand For Crew Welfare + Operational Efficiency

By Rick Driscoll, Vice President, Satellite Products + Services, KVH Industries

The maritime industry is experiencing an exploding demand for broadband connectivity. Data and connectivity enable ship owners to accomplish many goals, from reduced fuel consumption through voyage planning to increased safety through updated training programs delivered to crew while they are onboard. Indeed, many of the maritime industry's most pressing challenges can be addressed with connectivity.

The challenges to be faced include: attracting and retaining quality crew, many of whom are digitally competent and expect access to social media while onboard vessels; meeting increasingly complex regulatory expectations; and running smarter vessels through the use of remote maintenance, advanced weather and route planning, and electronic charts.

Crew Welfare

To improve crew welfare, maritime operators need to provide connections to home. In today's digital world, broadband connectivity is central to social life. Younger seafarers, in particular, are personally dependent on modern communications services, such as social media and email. However, providing Internet access to meet crew members' increasing demand for broadband becomes problematic if bandwidth is not prioritized for operational use, not to mention the budgetary factors that must be considered. In addition, onboard access to movie and TV entertainment and updated news from home has typically been limited in the variety of offerings.

The need to address crew welfare is being driven by maritime operators who want to attract and retain top crew as well as by a new MLC-2006 regulation that requires decent working conditions for seafarers around the world. MLC-2006 recommends that seafarers are given "reasonable access" to ship-to-shore telephone communications, email, and Internet services on the vessel.

Operational Efficiency

To improve operational efficiency, maritime operators need to ensure their vessels have connections to their shore-based offices, as well as the ability to use data-driven applications on the vessel. For example, engine monitoring, remote maintenance, and other applications that involve Machine-to-Machine (M2M) technology and the Internet of Things (IoT), can enhance maritime operations and support the sophisticated systems found onboard modern vessels. However, all rely on broadband connectivity.

Advanced weather and route planning relies on real-time data that include high-resolution weather charts as well as wave and tide information that has typically been too expensive for a ship to receive by satellite connection in a timely manner. At the same time, new regulations that mandate a reduction in fuel emissions are driving the need for ships to engage in more sophisticated voyage planning.

There are also new regulations requiring ships to use electronic charts on the bridge for navigation and safety. For a ship to receive updated chart databases has typically been impractical via broadband, due to the large size of the database files.

Multicasting Technology

As the maritime industry seeks a new approach for receiving the sizable amount of entertainment and operational content needed on vessels, KVH has developed an innovative solution that uses multicasting technology. With multicasting, one transmission sends files to all vessels at once. The content is cached on an onboard server for immediate access by subscribing vessels. This approach stands in stark contrast to other satellite providers' current practice of sending files individually to each user on a receiving vessel and then charging per megabyte for the transmission. By using multicasting technology, the large multimedia, weather, and chart files can be delivered 'over the top' of the satellite network, never affecting the quality of the Internet service onboard the vessel.

Last year, KVH launched its IP-MobileCast™ content delivery service using multicasting technology. Multicasting allows cost-effective delivery of gigabytes of operations data to ships at very low cost. The efficiency is driven by the complete integration of network, content providers, and content delivery. Affordable connectivity opens a new generation of operational services for vessels including charting, voyage optimization, weather, and training.

Training is especially valuable when the programs can be sent via the IP-MobileCast service for the convenience of crew members, who are then able to attain higher levels of certification while onboard the vessel rather than needing to attend land-based training sessions. IP-MobileCast's

TRAININGlink™ channel can multicast entire training courses and time-sensitive updates to ships at sea. Training schedules and crew test scores can also be synchronized and tracked easily.

KVH's Satellite Network

With the commercial maritime industry increasingly reliant on broadband services to enhance crew welfare and improve operational efficiency, KVH Industries is addressing these needs by expanding the capacity of its global VSAT network and supporting the new multicasting services.

KVH recently enhanced its mini-VSAT Broadband(sm) satellite network with additional capacity for the Asia-Pacific region, the Pacific Northwest, and the eastern coast of Canada and the U.S. to support heightened demand from customers engaged in a wide range of commercial maritime activities around the world, including offshore oil and gas, fishing, and shipping.

The mini-VSAT Broadband network utilizes 17 satellites and 24 transponders to provide global coverage, and is the most extensive C/Ku-band maritime VSAT network in the world. In addition, KVH designed the network for rapid expansion; KVH can access abundant commercial satellite capacity by working with leading commercial satellite providers.

KVH and its technology partner, ViaSat, Inc., use ArcLight® spread spectrum technology to deliver fast broadband service, with Internet download speeds up to 4 Mbps. With its enterprise-grade infrastructure, the mini-VSAT Broadband network carried 500 TB of data and 25 million voice minutes in 2014. Designed exclusively for the mini-VSAT Broadband network, KVH's unique TracPhone® V-IP satellite communications antenna systems are built 85 percent smaller than typical VSAT antennas to install more easily on all vessels. Antenna sizes range from the 37 cm (14.5 inch) diameter TracPhone V3-IP, to the 60 cm (24 inch) diameter TracPhone V7-IP, and the 1.1 meter (42.5 inch) diameter TracPhone V11-IP.

Keeping Data Secure

KVH is also enhancing the mini-VSAT Broadband network by ensuring data that travels over the network is extremely secure. To accomplish this necessity, KVH recently implemented a global private MPLS network connecting all of the teleports and satellite beams in the mini-VSAT Broadband network. The MPLS network aggregates all satellite traffic and provides Internet egress at "MegaPOPs" (point-of-presence access points) located in North America, Europe, and Asia. State-of-the-art firewalls and redundant high-speed Internet connections ensure security and reliability of all customer traffic. In addition, a Global Static IP service allows one public IP to be used to securely access a vessel from the Internet, regardless of vessel location.

Cost Savings Through Connectivity

Maritime operators will continue to face many challenges to stay competitive, and broadband connectivity is increasingly being seen as a way to enhance operations and to also save money. Satellite communications costs have typically accounted for a mere 0.3 percent of a vessel's operating cost. However, having an efficient, effective, and managed network can help save 10 percent or more on vessel expenses. These savings are realized through operational efficiency, performance optimization, regulatory compliance, and reduced crew recruitment and retention costs.

KVH is unique in the maritime industry for providing every aspect of a ship's satellite communications needs—onboard hardware, global connectivity, entertainment and operations content, and multicasting content delivery. With KVH, maritime operators can use broadband connectivity to better meet their crew welfare and operational efficiency needs, and can also address the consubstantial need for affordable delivery of entertainment and operational content onboard vessels by utilizing the IP-MobileCast content delivery service. For more information, visit www.ipmobilecast.com.

Rick Driscoll, VP of Satellite Products and Services, joined KVH in 2001 and was instrumental in the development of the mini-VSAT Broadband global satellite communications network. Mr. Driscoll holds bachelor's degrees in Physics and Electrical Engineering and a master's degree in Electrical Engineering.

KVH Oil Field VSAT

On land, the era of the digital oil field as arrived...from exploration to production.

The benefits of broadband connectivity at remote oil field sites include predictive maintenance, real-time invoicing and billing, data security, and an end to guesswork about whether cellular service is going to work.

The value of always-on connectivity comes down to the fact that oil and gas company headquarters can make decisions based on real-time data and information from the remote sites.

With new methods for oil extraction, it's essential that key people are able to analyze and monitor data quickly. KVH's solution for oil field VSAT includes compact and rugged TracPhone V-IP satellite antenna systems designed exclusively for the mini-VSAT Broadband network.

*For more information about oil field VSAT technology from KVH, visit the website, **www.kvh.com/oilandgas**.*

Paving The Way: The Scout Launch Vehicle

By Jos Heyman, Senior Contributor

In the early days of spaceflight, NASA principally used launch vehicles developed from the Atlas, Thor and Titan military missiles for the bulk of its general launch requirements.

However, NASA also had the requirement for a simple, low-cost and reliable vehicle that could be used for sub-orbital and orbital flights. These were envisaged to include Earth and space sciences missions, development of engineering and communications technologies as well as navigational techniques and re-entry experiments.

Development of the Scout launch vehicle by Chance Vought, later LTV, began in May of 1958 to meet this NASA requirement. The vehicle that evolved was built up from a number of existing solid fueled rockets and has been improved over the years. Scout was an acronym for Solid Controlled Orbital Utility. A typical Scout vehicle consisted of four stages.

- *The first stage, with a length of 9.07 meters, was powered by a version of the United Technologies Corp. (UTC) Algol sounding rocket, while the 6.19 meter second stage was powered by a Thiokol Castor version.*
- *The 2.90 meter third stage was based on the Hercules Antares sounding rocket, while the fourth stage, with a length of 1.40 meter, was a development of the UTC Altair or the LPC/Redlands MG-18 solid fueled upper stage.*
- *On top of all this was a heat shield with a length of 1.56 meter. This gave the launch vehicle a total length of 22.90 meter, while the maximum diameter (that of the first stage) was 1.14 meter.*

The first range of Scout vehicles may be considered to be of an experimental nature and can be identified as Scout X, with a number of sub-versions. They were extensively used for sub-orbital as well as orbital missions, including a number of missions specifically for the military services. For this reason, the Scout also carried the military designation SLV-1A. Other known designations include SLV-1B, which was a production version of the Blue Scout Junior derivative, LV-1B (a three stage version of the SLV-1B) and SLV-1C, an uprated version of the SLV-1B. Individual Scout launch vehicles were initially identified by the prefix ST followed by a number. Commencing with the 11th vehicle, the identification was changed to S111, and so on.

Type	Stage 1	Stage 2	Stage 3	Stage 4
X	UTC Algol 1A	dummy	Hercules Antares 1A	dummy
X-1	UTC Algol 1B	Thiokol Castor 1	Hercules Antares 1A	UTC Altair 1A
X-1A	UTC Algol 1C	Thiokol Castor 1	Hercules Antares 1A	UTC Altair 1A
X-2	UTC Algol 1D	Thiokol Castor 1	Hercules Antares 2A	UTC Altair 1A
X-2B	UTC Algol 1D	Thiokol Castor 1	Hercules Antares 2A	UTC Altair 2
X-2M	UTC Algol 1D	Thiokol Castor 1	Hercules Antares 2A	LPC/Redlands MG-18
X-3	UTC Algol 2A	Thiokol Castor 1	Hercules Antares 2A	UTC Altair 1A
X-3A	UTC Algol 2A	Thiokol Castor 1	Hercules Antares 2A	UTC Altair 1A
X-3C	UTC Algol 2B	Thiokol Castor 1	Hercules Antares 2A	UTC Altair 1A
X-3M	UTC Algol 2A	Thiokol Castor 1	Hercules Antares 2A	LPC/Redlands MG-18
X-4	UTC Algol 2B	Thiokol Castor 1	Hercules Antares 2A	UTC Altair 2
X-4A	UTC Algol 2A	Thiokol Castor 1	Hercules Antares 2A	UTC Altair 2
X-5A	UTC Algol 2B	Thiokol Castor 2	Hercules Antares 2A	—

Figure 1. Configuration of Scout X versions.

For the first flight of a Scout vehicle, designated as Scout X and SX-1, the vehicle carried a dummy second and fourth stage. The flight occurred on April 18, 1960, from Wallops Island but the launch was a failure. The Scout X-1 was the first complete four stage vehicle and seven launches were conducted between July 1, 1960, and December 19, 1961. Two of these flights placed satellites into orbit, two failed to place satellites into orbit and the others were sub-orbital. The satellites had a mass of up to 84 kg. into a low orbit.

The Scout launch vehicle. Photo is courtesy of NASA.

The Scout X-1A version had an upgraded first stage and was only used once on March 1, 1962, for a sub-orbital flight. This was followed by the Scout X-2 version, which had a further improved first stage and an upgraded third stage. Only two flights were conducted. One of these, on March 29, 1962, was sub-orbital, while the second flight, on April 26, 1962, failed to place a satellite into orbit.

The Scout X-2B was similar to the Scout X-2 but had an upgraded fourth stage. Only one was launched, on September 27, 1963, but failed to place a 40 kg. satellite into orbit. There is no reference to a Scout X-2A version. The next version, Scout X-2M, used a different upper stage, the MG-18. Three launches were conducted between May 23, 1962, and April 26, 1963, but only one succeeded in placing a satellite into orbit. The Scout X-2M was capable of placing a 90 kg. payload into a low orbit.

Type	Stage 1	Stage 2	Stage 3	Stage 4
A	UTC Algol 2D	Thiokol Castor 2	Hercules Antares 2A	UTC Altair 2
A-1	UTC Algol 2C	Thiokol Castor 2	Hercules Antares 2A	UTC Altair 2
A-2	UTC Algol 2C	Thiokol Castor 2	Hercules Antares 2B	UTC Altair 2
B	UTC Algol 2B	Thiokol Castor 2	Hercules Antares 2A	UTC Altair 3
B-1	UTC Algol 2C	Thiokol Castor 2	Hercules Antares 2A	UTC Altair 3
B-2	UTC Algol 2C	Thiokol Castor 2	Hercules Antares 2B	UTC Altair 3
C	UTC Algol 2C	Thiokol Castor 2	Hercules Antares 2A	UTC Altair 3 + Alcyone 1
D-1	UTC Algol 3A	Thiokol Castor 2	Hercules Antares 2A	UTC Altair 3
E-1	UTC Algol 3A	Thiokol Castor 2	Hercules Antares 2A	UTC Altair 3
F-1	UTC Algol 3A	Thiokol Castor 2	Hercules Antares 2B	UTC Altair 3A
G-1	UTC Algol 3A	Thiokol Castor 2	Hercules Antares 3	UTC Altair 3A

Figure 2. Configuration of operational Scout versions.

The Scout X-3 introduced a new first stage which allowed a payload of up to 87 kg. to be placed into a low orbit. Six launches occurred from December 16, 1962, to March 27, 1964. Of these, one failed and one was sub-orbital. The Scout X-3A tested new equipment on a single sub-orbital flight on August 31, 1962. While there is no reference to a Scout X-3B version, the Scout X-3C used an upgraded first stage on its one and only sub-orbital flight on October 9, 1964. Finally, the Scout X-3M used the MG-18 upper stage. Two flights took place on February 19, 1963 and on July 20, 1963, of which the first placed a 40 kg. payload into orbit.

Thirteen flights were conducted with the Scout X-4 between June 28, 1963, and December 6, 1965. One of these failed, while another one was sub-orbital. The Scout X-4 was capable of placing a 103 kg. payload into low orbit. The Scout X-4A used an upgraded first stage. Three sub-orbital flights to test re-entry vehicles were conducted between August 18, 1964, and June 24, 1968.

The Scout X-5A was the only three stage version of the Scout launcher and one was flown on a sub-orbital mission on April 27, 1968. The sub-orbital flights included seven re-entry tests as well as some scientific/technology tests for the U.S. Air Force. The orbital mission included a number of satellites in NASA's Explorer series as well as some early experimental meteorological and navigational satellites for the U.S. Air Force.

The X series was followed with what could be considered an operational series, comprising a number of different versions that commenced with the Scout A. At this stage, the customers were NASA and the U.S. military as well as for placement of early satellites from other nations into orbit—European Space Research Organization (ESRO) (5), France (2), Germany (3), Great Britain (6), Italy (5) and The Netherlands (1). There were also a number of sub-orbital flights.

The Scout A version was used for launches in the Transit NNSS series, placing two satellites into orbit at the same time. Ten such flights were conducted between December 21, 1965, and August 27, 1970. In addition, one was used to launch a British scientific satellite. The launch capability was 122 kg. into a low orbit.

The Scout A-1 version was only used once on October 30, 1973, to launch a 58 kg. satellite, while the Scout A-2 version was never used. Between August 10, 1965, and November 15, 1971, 25 Scout B flights took place. Of these, five were sub-orbital while two failed. The Scout B had a launch capability of 143 kg. into low orbit. Five Scout B-1s were launched between August 16, 1971, and May 22, 1976, while the Scout B-2 was never used. A Scout C version was supposed to include a fifth stage, Alcyone-1, to increase the payload capacity, but this version was not developed.

Between August 13, 1972, and June 27, 1983, 16 Scout D-1 flights were conducted. One of these was a sub-orbital flight. The improved capacity of the D-1 version gave it an orbiting capability of 185 kg. into a low orbit. The Scout E-1 differed from the Scout D-1 in some of the equipment carried on board. This version was used on only one flight, on June 3, 1974, to place a 27 kg. satellite in orbit. The next version was the Scout F-1 which had an improved fourth stage, increasing the launch capability to 193 kg. into low orbit. The first flight was on May 7, 1975, while a second flight, on December 5, 1975, failed to orbit.

The final version of the Scout launcher was the G-1 version with a capability to place a 210 kg payload into a low orbit. Between 30 October 1979 and 9 May 1994 17 were launched.

Most of the launches occurred at Wallops Island in Virginia and Vandenberg AFB in California, but there were also nine launches from the Italian operated San Marco launch platform in the Indian Ocean off the coast of Kenya. The San Marco facility consists of several converted oil platforms, one being the launch platform San Marco, the other being the Santa Rita control platform.

The facility has been used for sounding rockets as well as orbital launches and was renamed in 2001 as the Luigi Broglio Space Centre (VSC) and continues to be used for tracking of spacecraft and data acquisition. San Marco is the only non-U.S. launch facility that has been used by the United States for satellite launching.

Throughout its life, the payload capacity of the Scout was increased from 55 kg. in the early flights to a maximum of 219 kg. toward the end of the program. This capacity was to be increased further to 520 kg. in a proposed joint development program of SNIA BPD of Italy and LTV Missiles and Electronics Group. This extra capacity was to be achieved by adding two of SNIA BPD's solid-rocket boosters or Nissan SPB 7-35 boosters to the first stage and the upper stage engine by a SNIA BPD Mage 2 solid-rocket motor. To be known as Scout 2, the intention was to launch from the Italian San Marco platform.

When the last Scout flight took place on May 9, 1994, a total 120 Scout launch vehicles had been used for 99 orbital and 21 sub-orbital flights. Of the orbital mission, 11 failed.

Since then, the Pegasus air-launched launch vehicle has, to a certain extent, taken the place of the Scout. However, generally speaking, payloads have become too heavy for a Scout/Pegasus launch vehicle. Smaller payloads are now carried as secondary payloads on other launch vehicles capable of carrying heavier payloads.

Jos Heyman is the Managing Director of Tiros 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 organizations. An accountant by profession, Jos is the editor of the TSI News Bulletin, available at **http://tiros.zarya.info/**.

Simulating Satellite Doppler Shift With COTS Test Equipment

By Donald Vanderwelt, Keysight Technologies, Inc.

When testing satellite communications links, there is often a requirement to use Commercial Off-The-Shelf (COTS) test equipment to simulate one or more link components.

For testing transmitters, a spectrum analyzer or a high-speed oscilloscope with suitable software can be used to receive and analyze transmitted signals. Receiver testing may require a calibrated and repeatable signal source. Other components (e.g., transponders and amplifiers) may require a combination of both sides.

One of the key requirements is to generate test signals that are "realistic" enough to provide an accurate test, such as wideband communications signals, multichannel signals or even wideband chirp signals for ranging systems. A common way to create these complex test signals is to use an Arbitrary Waveform Generator (AWG) upconverted to transmission frequencies by a microwave source. With this hardware, and with software to create the signals for the AWG, it is not difficult to generate signals with bandwidths of several GHz at microwave and millimeter frequencies.

The most common limitation when using an AWG is usually the memory depth. To create wideband signals, a high sample rate must be used. Typical wideband AWG sample rates are frequently above 1 GHz and may be above 10 GHz. These high sample rates use up the AWG's internal memory quickly, and most AWGs cannot play waveforms for more than a second without repeating. This creates a challenge for simulations that require slow variation of the signal over seconds or minutes, such as simulating the Doppler shift of a signal coming from a satellite in Low Earth Orbit (LEO).

Fortunately, recent advances in AWGs and sources now make these simulations possible. Advanced sequencing features allow the user to create long complex scenarios by recalling and repeating smaller waveforms. Digital upconversion (DUC) allows direct manipulation of the carrier frequency of a signal, allowing the same segment to be played at different amplitudes and frequencies without the need to store many unique segments. Advanced sweep capabilities in microwave sources allow for long sweeps over several minutes or hours, simulating the effects of Doppler shift on transmitted signals. How these techniques can be applied to simulating LEO Doppler shift will be examined in this article.

Keysight Technologies' M8190A Arbitrary Waveform Generator

Equipment + Setup

All of the examples in this article use the Keysight M8190A AWG, which provides 14-bit signal depth at sample rates up to 8 GSa/s. The maximum frequency which can be generated by this AWG (staying in the primary 14-bit Nyquist range) is 3.2 GHz, so the Keysight E8267D PSG Microwave Signal Source to upconvert to microwave frequencies will be used.

Upconverting the Signal

There are two commonly used techniques to upconvert the AWG signal to higher frequencies using an external source (*please see Figure 1 below*). The first is to use an external mixer, with the AWG feeding the IF input of the mixer, and the source acting as the Local Oscillator (LO). The key to this method is to use the AWG to produce a signal already at IF, so that sidebands can be filtered off after mixing. This provides the cleanest signal in terms of in-band images, but it is limited in power, and requires the user to find a suitable wideband mixer.

In many applications, such as receiver test, power is not an issue, as the receiver is built to receive very small signals. It is also typically not difficult to

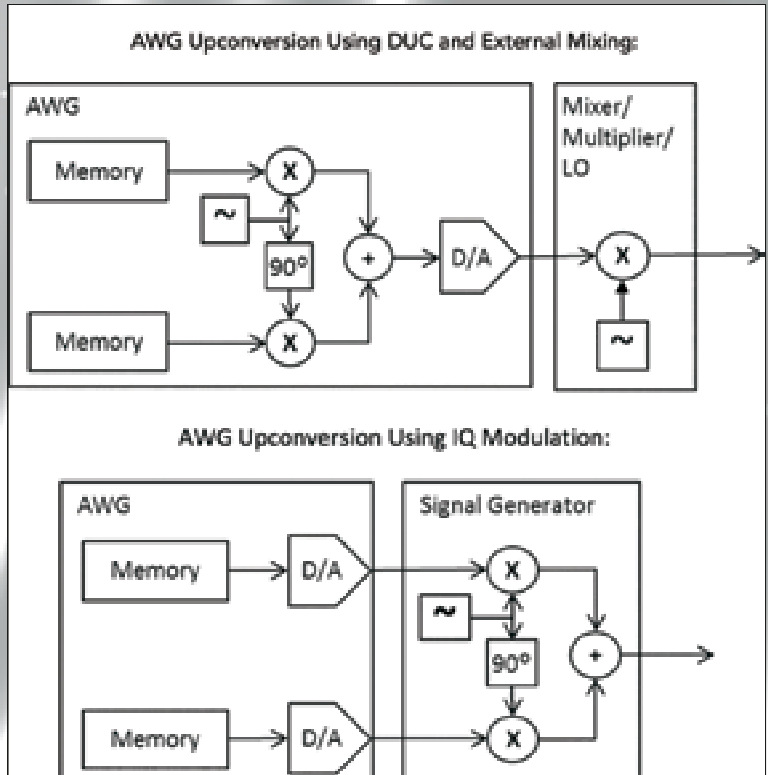

Figure 1.

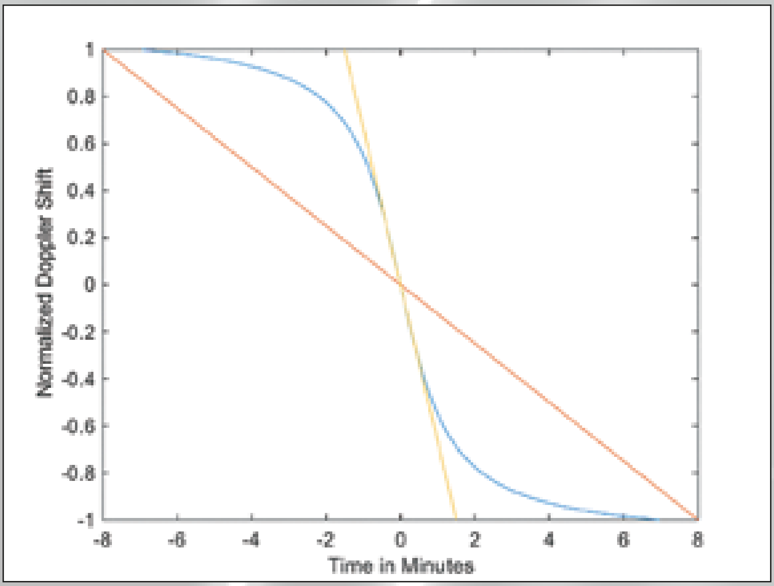

Figure 2. Typical Doppler Shift Profile with Two Linear Test Profiles

find a suitable mixer for given frequency range. It is important that the setup includes a high-pass or low-pass filter to block unwanted mixer images. By setting the IF of the AWG high enough (while still containing the modulated signal within the AWG's range), the two images can be spaced far enough apart to allow for an inexpensive filter.

In generating this signal, there is a significant advantage to using a "Digital Upconverter" (DUC). This DUC is in effect a "virtual" IF carrier independent of the AWG waveform. The upconversion to IF is done mathematically inside the AWG—parameters such as amplitude, frequency and phase can be changed completely separately from the baseband I and Q segments. In this way, long simulations of antenna sweeps, transponder paths, Doppler Shift and so on can be achieved over many minutes or hours without eating up the AWG memory.

Another method for upconverting the AWG signal to microwave frequencies is to use an IQ modulator, which are often available as an option within the microwave signal source. The biggest disadvantage to this method is usually the creation of in-band images: if the IQ modulator and its input signals are not tuned correctly, images and artifacts can show up in-band. Because the IQ modulator is built with less conversion loss than most external mixers, this method has the advantage of higher output power. It also has the advantage of convenience: by using the mixer built into the signal source, the user is free from sourcing and setting up external mixers and filters. This is the method used for the examples in this article.

Simulation Of LEO Doppler Shift

One useful application for the AWG and signal source is the simulation of the Doppler shift of a communications signal from a spacecraft in LEO. Doppler shift is the shift in frequency of a signal as a result of its velocity relative to the receiver. For a spacecraft in LEO, the Doppler shift increases the frequency of the communications signal as the spacecraft comes over the horizon into view. As the spacecraft passes overhead, the frequency

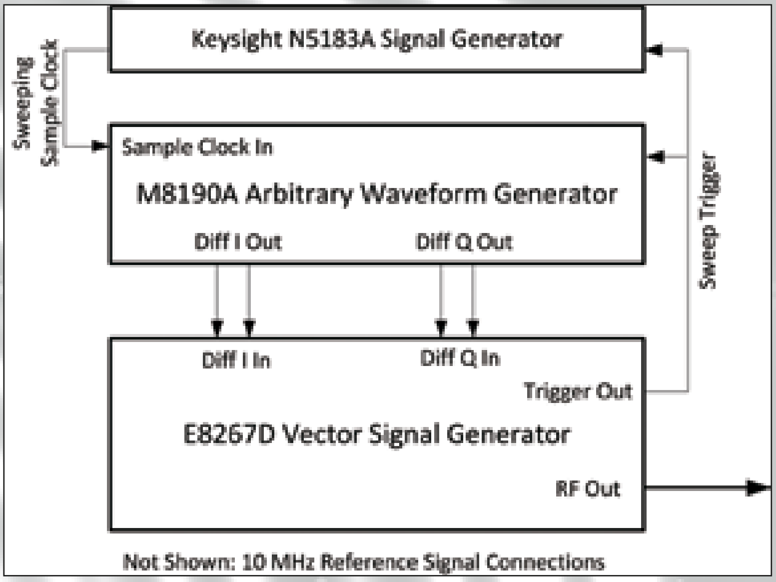

Figure 3. Block Diagram of the Test Setup

rapidly shifts from a higher to a lower value, and as the spacecraft speeds away and over the horizon, the frequency levels out.

The equations for calculating this Doppler shift as a function of time are quite involved, but there are a number of papers available on the subject, one of which is listed in the references.

Calculating the exact profile of the Doppler shift involves the orbit height, the position of the receiver, the orbital path, and many other factors. Fortunately there are many software programs available online to perform these calculations.

For the purposes of component testing it may not be necessary to precisely recreate the Doppler shift of the signal as a function of time. It should be sufficient to find out if the receiver will a) find and receive the signal at the maximum Doppler shift (at the horizon) and b) track and receive the signal while the Doppler shift is going through its fastest change (while the spacecraft passes overhead).

Rather than program the entire S-curve of the frequency shift, it may be enough to program in a linear frequency sweep, with the maximum and minimum points accounting for the highest and lowest frequencies, and the slope equal to or greater than the fastest expected transition (*please see Figure 2 on the previous page*).

As an example, a spacecraft in an 800 km LEO, transmitting at 12 GHz and in a path to travel directly overhead from the receiver would have a maximum Doppler shift of about +/-250 kHz, and a maximum transition slope of about 150 kHz/minute. Although the shift could be programmed as part of the digital upconverter within the arb, for this article, the "sweep" function of the microwave signal source was used to move the carrier frequency.

A simple linear frequency sweep can be used, or more complicated frequency paths can be made by sweeping through a list of frequencies in a linear approximation of the curve. Both the microwave source and the AWG's DUC are capable of list sweeps with more than 10,000 points, allowing for many small frequency transitions per second over the long sweep.

Changing the carrier frequency is only half the job. For wideband signals, the Doppler shift affects the symbol rate in the same proportion as the carrier frequency. Because the AWG's sample clock is proportional to the symbol rate, changing the sample clock frequency will create the desired effect.

This is most easily accomplished by connecting another sweeping external source to the sample clock input of the AWG to adjust the symbol rate simultaneously with the carrier frequency (*please see Figure on this page*). Trigger and marker signals can be used to synchronize the sweeps.

Creating a test signal with simulated Doppler shift involves not only changing the carrier frequency, but also the bandwidth of the signal. Test signals can be created using a wideband AWG and a microwave signal source.

Rather than using up the memory of the AWG on a long sweeping waveform, shorter repeatable segments can be moved around by varying the frequency setting of the signal source and the sample clock of the AWG.

Keysight Technologies:
www.keysight.com/main/home.jspx?cc=US&lc=eng

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The Impact Of The Battle For C-Band On The Satellite Industry

By Zahid Zaheer, Senior Director of GMPCS Affairs, Thuraya

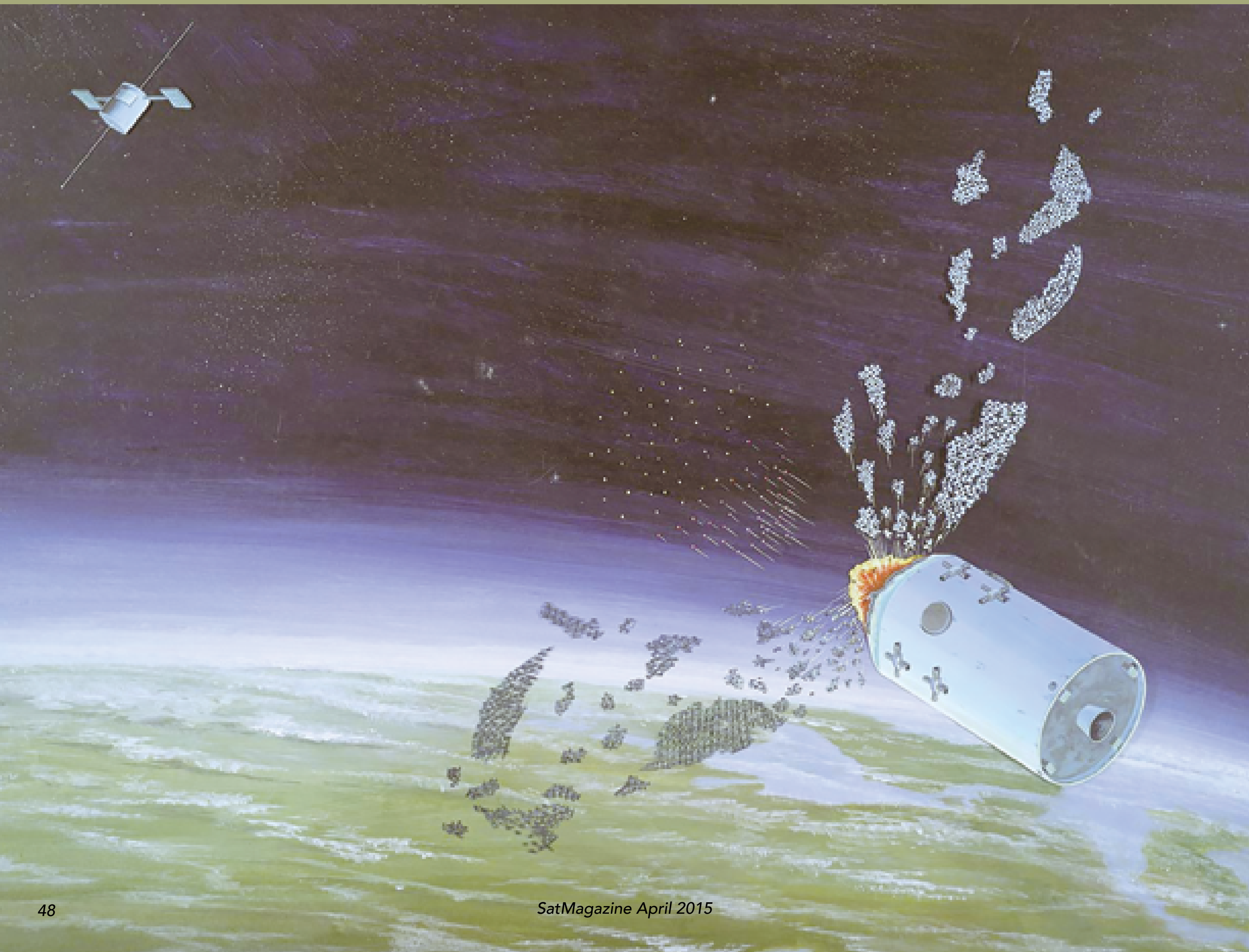
There is a raging debate in the international and regional spectrum regulatory community on the issue of sharing Fixed Satellite Service (FSS) C-band downlink spectrum rights with the International Mobile Telecommunication Advanced (IMT-Advanced) service.

The spectrum is currently being used by satellite operators primarily for telecom and TV broadcasting services, whereas the mobile industry wants to access and use the same band for the IMT-Advanced service.

IMT Advanced is a term coined by the International Telecommunications Union (ITU) to define a terrestrial service that will be an all-IP based mobile broadband solution for smartphones and other mobile devices.

Questions raised on the hotly debated issue include: Should C-band be shared? Would it cannibalize current spectrum allocation? What is the criteria for C-band sharing and how would it impact users, operators and regulators?

Over the last three years, various study groups at ITU have been discussing the topic of sharing criteria between the incumbent satellite service and IMT Advanced. The final decision on whether C-band spectrum can be used by IMT Advanced will be taken at the World Radio-communication Conference (WRC-15) in November this year. The WRC is held every three to four years and is the highest international treaty-level organization that decides on the international radio regulations governing the allocation and use of frequency spectrum.



Studies conducted by ITU study groups have confirmed that the introduction of IMT Advanced in C-band will interfere with satellite signals and severely degrade the quality of service. Other studies have shown that the spectrum requirements for IMT Advanced are over estimated, and the market data provided from the mobile industry is not correct.

As such, the satellite industry and a number of developing countries are rallying against the proposal of IMT Advanced using the C-band spectrum that is currently utilized for satellite communications. A key consideration is that developing and under developed countries are dependent on C-band for their critical connectivity requirements which includes a high reliance on solutions provided by satellite communications.

Worth noting is that WRC, which was held in 2007, also discussed the use of satellite C-band spectrum by IMT eight years prior and, even at that time, the studies conducted by the ITU Study Groups confirmed that it is not feasible for IMT Advanced to share the frequency band with satellite service.

The Significance Of C-Band

C-band was the first frequency band to be allocated for use by the satellite communications industry for Fixed and Broadcasting Satellite Services. C-band frequencies have long been recognized to perform better under adverse weather conditions such as rain and snow fade in comparison with other satellite frequency ranges, such as Ku- and Ka-band.

Although new frequencies have emerged over the years and are being used by the satellite industry, C-band still represents a highly significant portion of the total capacity currently supplied by satellites. Today, both C- and Ku-bands are nearly reaching congestion levels.

In order to meet requirements for reliable and uninterrupted communications for maritime, banking, defense and governments, C-band is often preferred over other higher frequency bands which are prone to raid fade. C-band also easily meets the stringent reliability requirements of service levels of over 99 percent of satellite operators.

Examples of how C-band is used in satellite communications include:

- *Providing connectivity between multiple locations spread around a country*
- *Providing direct and backup international connectivity especially in landlocked countries and island communities. In some cases, satellite communications is the only means of connectivity with the outside world*
- *For use onboard shipping vessels*
- *Providing cellular backhaul services*
- *Broadcasting of TV signals including Direct-To-Home (DTH)*

While the terrestrial mobile community is looking to use C-band for Advanced IMT applications, the same band is used by them for backhauling mobile traffic from their own base stations.

C-band is also used by other types of satellite systems, such as geostationary mobile satellite systems for their feeder link operations as well as for critical telemetry, tracking and command operations. Mobile satellite systems are increasingly used to support disaster and emergency communications because it is easy to use and deploy. Furthermore, it supports various mobility based communication requirements for the media, news gathering, maritime, government and defense sector, among others. Therefore, C-band is the backbone of MSS systems which are the only available means of communication when other channels go down for one reason or another.

To add fuel to the fire, there is an emerging trend among developing countries to launch their own national satellite systems to meet Universal Service Obligation requirements. This trend supports regional and sub-regional connectivity requirements, which will benefit users who will then have access to a wide selection of low-cost mobile devices.

Satellite manufacturers are taking note by innovating and considering the introduction of multi-beam satellites in C-band, similar to those in the Ka-band to support higher speeds and throughputs.

As the debate rages on and new trends come to the forefront, of utmost importance is to protect the C-band spectrum for use by satellite operators in order to continue providing critical connectivity requirements. Also crucial is to ensure that C-band technology continues to evolve and grow to meet the future trends in information-communication technologies.

The Thuraya infosite: ***http://www.thuraya.com/***

Zahid Zaheer is the Senior Director of GMPCS Affairs at Thuraya. Zahid has been with the company for 16 years and is responsible for market access and licensing, regulatory affairs, spectrum management and coordination. Prior to joining Thuraya, Zahid worked with PAKSAT satellite, Pakistan Telecom Authority. Zahid is an engineer by training, who holds an MSc in Electrical Engineering from the University of Southern California and a MBA in Finance & Accounting.

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