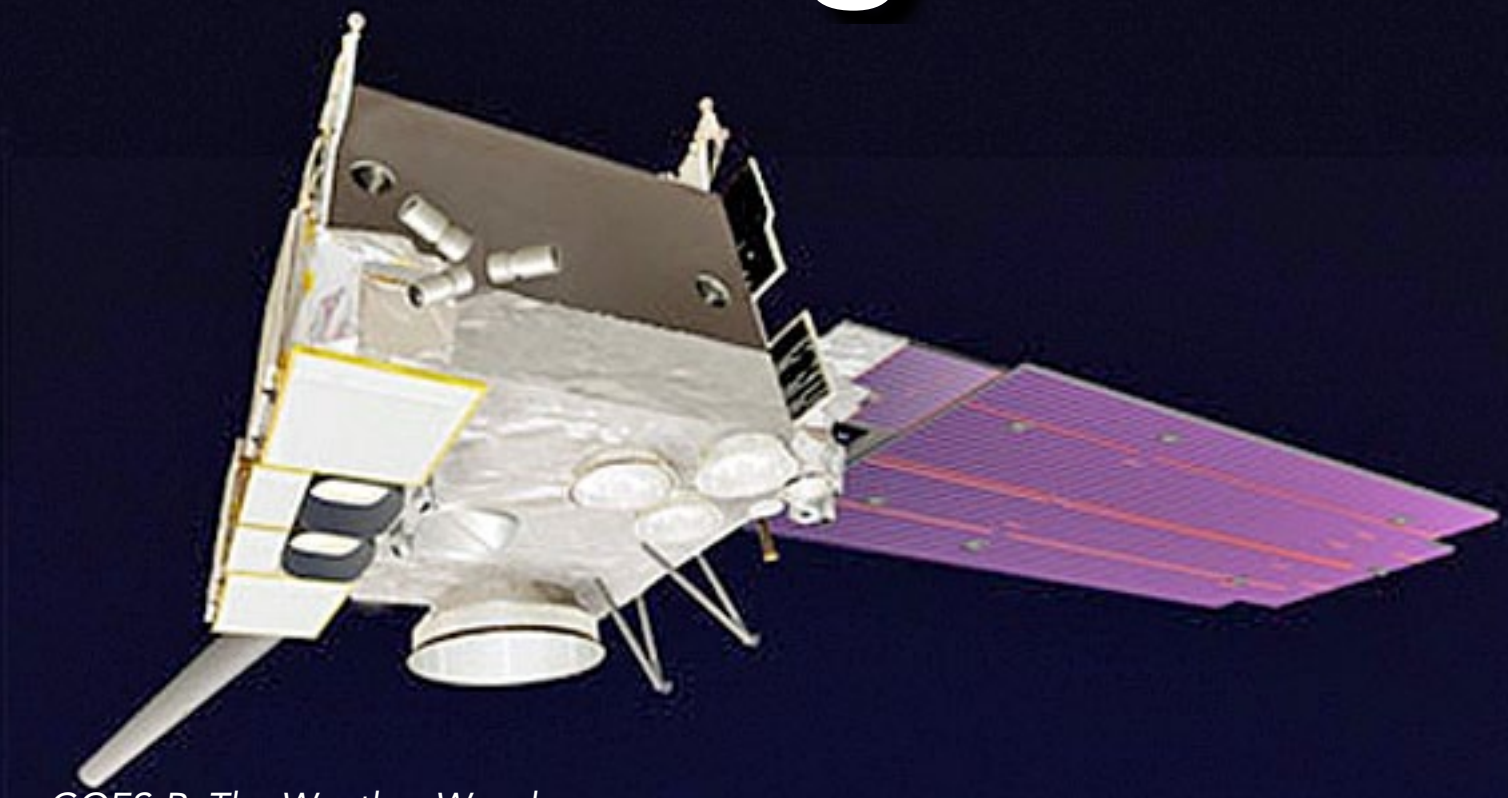
Worldwide Satellite Magazine July/August 2013

SatMagazine



GOES-R, The Weather Wonder
In-depth interview with Greg Mandt, NOAA's GOES-R Program Manager

Also...
Forrester + Sadtler, NSR's Gounari
Flooding Event Response
Teleport Investment
Rocket Science Made Simple
Space-Based OTVs
Demystifying SATCOM
Moving Satellites
HOPE

Cover image of GOES-R is courtesy of Lockheed Martin

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The New Simple
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SkyEdge II-c

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July/August 2013

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Senior Contributors

Tony Bardo, Hughes
Chris Forrester. Broadgate Publications
Karl Fuchs, iDirect Government Services
Bob Gough, Carrick Communications
Jos Heyman, TIROS
David Leichner, Gilat Satellite Systerms
Giles Peeters, Track24 Defence
Mike Antonovich, ATEME
Richard Dutchik
Bert Sadtler, Boxwood Executive Search

This Issue's Authors

Chris Forrester
Nick Flaherty
Stéphane Gounari
William J. Ketchum
Ken Gilliam
Hartley Lesser
Brian Mclane
Elliot Pulham
Bert Sadtler
Pattie Waldt

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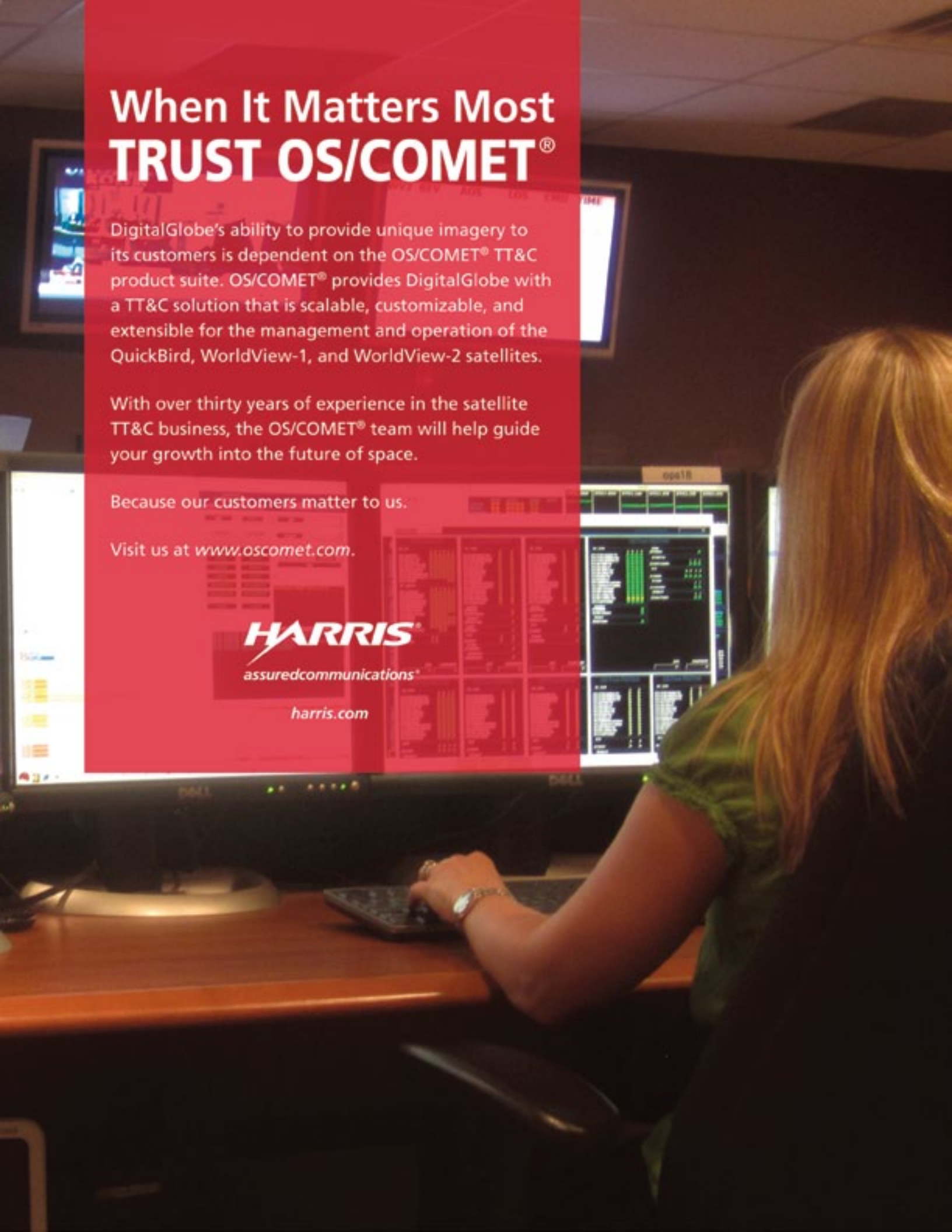

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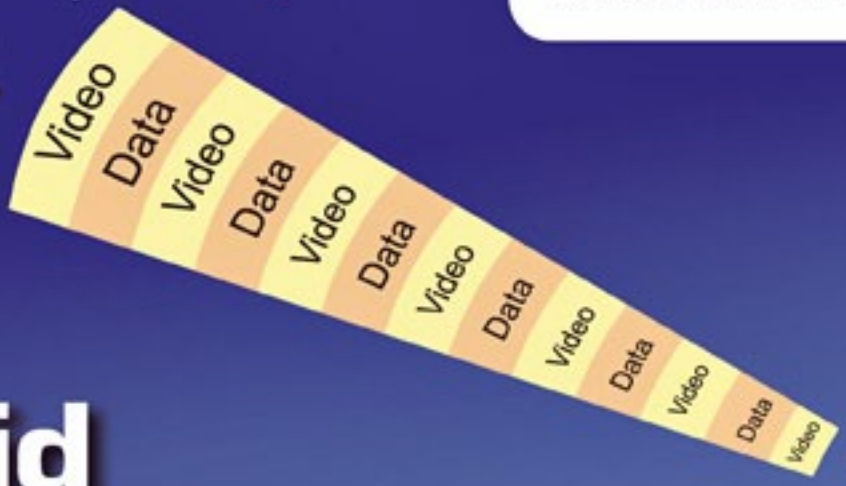
Features

WORK MICROWAVE

Analog & Digital RF-Solutions



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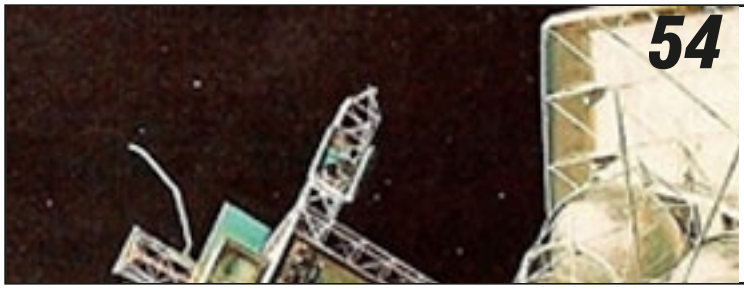

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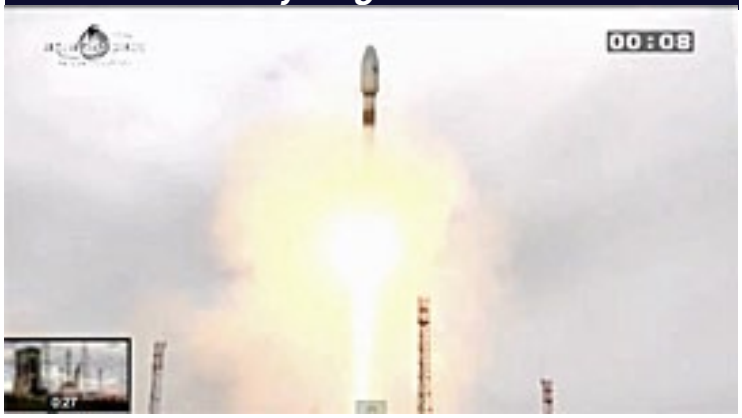
The O3b Journey Begins



A day's delay, and a red hold did not dampen spirits when the successful launch finally occurred on June 25, 2013. An Arianespace Soyuz ST-B rocket successfully launched four O3b satellites from the Kourou Spaceport in French Guiana. The launch, the second Soyuz to lift-off in close succession, was scheduled for 18:54 UTC. However, due to a red hold, the teams opted for a launch 33 minutes later. The mission used a Soyuz-STB/Fregat-MT, a Soyuz-2-1b optimized for commercial launches from the Centre Spatial Guyanais in French Guiana, with a Fregat upper stage.

Arianespace played its crucial role in improving the world's connectivity with a successful medium-lift Soyuz launch that orbited O3b Networks' initial four satellites.

The cluster of spacecraft lifted off on Arianespace's maiden Soyuz mission for O3b Networks, creating the way for the establishment of telecommunications and Internet services over Asia, Africa, South America, Australia and the Middle East that combine the global reach of satellite coverage with the speed of a fiber-optic network.

The statement from Thales Alenia Space: The first four satellites in the O3b medium Earth orbit constellation were successfully launched today by Arianespace for operator O3b Networks, using a Soyuz rocket from the Guiana Space Center in French Guiana. The second batch of four satellites will also be launched this year, and the third batch in the first half of 2014.

Positioned at an altitude of 8,062 kilometers along the Equator, about four times closer to the Earth than geostationary satellites, these Ka-band satellites will provide telecommunications services and Internet connectivity combining high speed, low cost and reduced latency for emerging markets in Asia, Africa and the Middle East. O3b Networks will provide telecom operators with trunking capacity and connectivity for mobile networks, at broadband speeds comparable to those offered by fiber-optic networks.

"We are very pleased with the success of this first launch, alongside O3b Networks and Arianespace," said Nathalie Smirnov, Director of Telecommunications at Thales Alenia Space. "It marks a major step forward in the development of O3b Networks, and is also a very concrete initiative to reduce the digital divide. Everybody at our company is obviously fully mobilized to prepare for the two remaining launches."

O3b satellites are located in a so-called "repeating" Equatorial orbit, enabling a given ground station to see the same satellite every six hours, which considerably

simplifies satellite architecture. Weighing 700kg. at launch, each O3b satellite is based on a platform offering 1.5kW of power. The payload comprises 12 mobile antennas and 10 Ka-band transponders.

Thales Alenia Space has received orders for a total of 117 satellites in constellations (12 for O3b, 81 for Iridium NEXT and 24 for Globalstar's Second Generation satellites). Thales Alenia Space is now marketing the new EliteBus platform, already validated in orbit. EliteBus is designed for enhanced cost competitiveness, based on efficient volume production and supply chain management. In addition to telecommunications applications, EliteBus can meet requirements for Earth observation, navigation and other civil and defense missions.

The O3b Networks strategy is to provide millions of consumers and businesses in nearly 180 countries with low-cost, high-speed, low latency Internet and mobile connectivity.

The just-launched payload is for the first four communications satellites for the company. These will be the first satellites of Jersey, a small island in the English Channel, which is a British Crown Dependency, but is not part of the United Kingdom.

The spacecraft have a trapezoidal-shaped main body, which helped facilitate their integration on the payload system, which is a tube-shaped dispenser system, with the satellites mated to the upper and lower attach points.

The launch was designated VS05 in Arianespace's launcher family numbering system and this mission involved a flight duration of 2 hours and 22 minutes.

After the powered phases for the Soyuz ST-B vehicle's first three stages, the Fregat-MT upper stage performed four burns, allowing deployment of the O3b spacecraft.

The O3b Networks' slogan for this crucial launch was: "The Journey Begins," with these words even emblazoned on a charter aircraft that brought its executives, as well as personnel from Arianespace, satellite manufacturer Thales Alenia Space and other guests, to French Guiana from Paris.

"Definitely, we can now say that 'the O3b journey has begun,'" said Arianespace Chairman & CEO Stéphane Israël in comments from the mission control center after confirmation of the Soyuz mission success. "Let me tell you that there is no better reward for Arianespace than seeing the happy faces of our customer in the front row. In this very moment, pride and gratitude are the two words coming naturally to my mind."

Israël noted that O3b Networks is the 33rd new entrant in the satellite telecommunications business to select Arianespace for launches that have started their operations.

A total of 12 O3b Networks' satellites are to be orbited by Arianespace in groups of four, with the next mission planned for later this year, and another in 2014. Thales Alenia Space produced the Ka-band relay platforms.

Total payload lift performance for this mission, was 3,204kg. This flight was the third since Stéphane Israël became Arianespace's new Chairman & CEO, which he noted in post-launch comments, acknowledging that the company's worldwide reputation is more than deserved.

"Arianespace's key success factors are the commitment of its institutional and industrial partners, the complementarity, reliability and availability of its launch vehicle family, as well as the dedication and competency of its teams," Israël said. "Indeed, I wanted tonight to pay a tribute to the women and men who make Arianespace what it is on a daily basis, wherever they are located, in Evry, Kourou, or in our commercial offices abroad."

The next Arianespace mission is scheduled for July 25, using a heavy-lift Ariane 5 to orbit the Alphasat and INSAT-3D satellites.

Despite both the Soyuz for this mission, and the Soyuz carrying Resurs-R launching around two hours apart, (a coincidence caused by a 24 hour scrub due to weather constraints for the O3B mission), Tuesday's launches did not set a record for the shortest gap between two launches of the same family of rocket.

The record that was broken was one that occurred on August 18, 1960, when the U.S. Air Force conducted two launches less than two minutes apart. The launch vehicles were a Thor DM-18 Agena-A that lifted off from Vandenberg Air Force Base, which was then followed by a Thor DM-21 AbleStar from Cape Canaveral, which failed to orbit.

The next Soyuz launch after the O3b mission is expected to occur on July 27th, with a Soyuz-U orbiting Progress M-20M, a cargo spacecraft bound for the International Space Station.

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It's All About Correct Positioning

CSR plc has debuted their SiRFstarV™ 5e, a Global Navigation Satellite System (GNSS) engine optimized to enable highly accurate location positioning for devices including mobile phones, cameras, and health and fitness products.

By supporting fully concurrent GLONASS, GPS, QZSS and SBAS from ROM, the highest accuracy and fastest time-to-first-fix (TTFF) are ensured.

Wireless solutions specialist Telit Communications plc will be using the solution for its Jupiter SE868-V2 module, which was launched at CTIA Wireless 2013 in Las Vegas. The 11x11mm QFN packaged receiver module integrates 5e, TCXO, SAW and RTC oscillator into a small convenient package, accelerating time-to-market and reducing product development risks.

CSR believes its advanced power saving modes make it extremely battery-power friendly and ideal for wearable and personal navigation applications. SiRFstarV 5e offers a range of features to increase accuracy, improve time to first fix and preserve battery power to enable a better user experience. These include:

»InstantFixTM Extended Ephemeris (EE)—Devices without wireless connectivity, such as cameras, are able to overcome slow TTFF, a common annoyance for the end user. 5e is capable of autonomously forward predicting EE for three days locally, and for connected devices the solution supports server based EE for up to 31 day for GPS and up to 14 day GLONASS EE

»Direct to battery capability—The GNSS chip can connect directly to a Lithium battery supply, enabling system cost reduction and increased power efficiency. This is implemented by an integrated switched PMU, reducing system level power and eBOM costs

»Design flexibility for optimal solution cost—With clear attention to solution implementation, 5e is designed for small size and low power. For example, UART and SPI Flash drive levels are drivable from 1.8v to 3.3v, eliminating the need for level shifters and increasing implementation flexibility

»Intelligent design—The 5e is designed to be optimised for low power battery operated devices. For instance, in asset tracking applications, the 5e engine will intelligently decide how long to try to acquire satellite signal based around its environment, saving a significant amount of battery power

SiRFstarV 5e is offered in a size optimal 0.4mm pitch Wafer Level Chip Scale Package (WLCSP) and a 0.5mm pitch Ball Grid Array (BGA) for low cost PCB applications.

Additional information is available at **http://www.csr.com/**

4K Coming Of Age

Intelsat's Galaxy 13 satellite, artistic rendition

Intelsat S.A. (and Ericsson have announced the successful demonstration of a true 4K Ultra High Definition (UHD), end-to-end video transmission over satellite to Turner Broadcasting's facilities in Atlanta, Georgia.

This was the first transmission of a UHD signal over satellite in North America, and the demonstration proves that the satellite delivery chain can accommodate the next-generation signals as soon as broadcasters are ready to offer them.

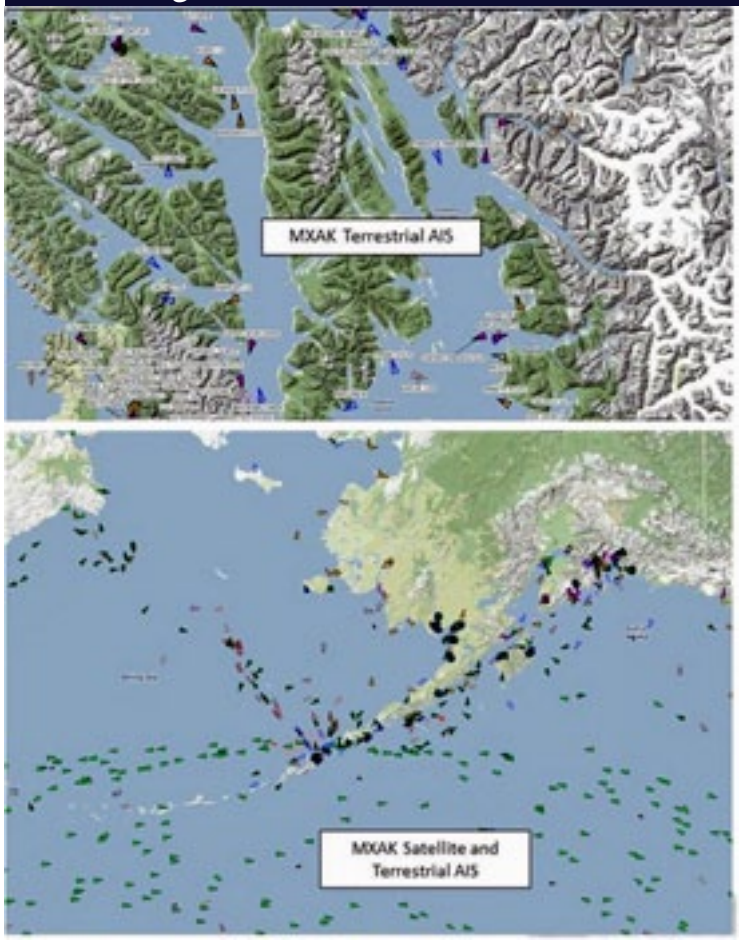
During the demonstration, Intelsat's Galaxy 13 satellite delivered a 4:2:2 10-bit, 4K UHD signal at 60 frames per second, which resulted in an immersive viewing experience. The 100Mbps video feed was encoded and decoded in real time by Ericsson, using its AVP 2000 contribution encoders and RX8200 receivers, capable of 4K UHD operations as well as HD and SD contribution at the highest quality. Newtec provided the modulation and demodulation hardware, featuring Clean Channel Technology®, and the satellite downlink antenna was provided by Turner Broadcasting.

An earlier test between Newtec and satellite transmission provider PSSI Global Services, which was conducted in preparation for the UHD demonstration, achieved 140Mbps over a 36MHz transponder on Galaxy 13 to a 4.6-meter antenna.

"4K UHD is the next evolutionary step for television broadcasting—we will be ready to support the transition to full-time distribution in this new format," said Peter Ostapiuk, Intelsat's vice president of media product management.

"We are tremendously pleased with the outcome of today's demonstration," said Giles Wilson, head of TV compression business, Ericsson. "It shows what is feasible in terms of meeting consumer demand for the highest quality possible."

A Tracking Alliance



exactEarth has teamed up with the Marine Exchange of Alaska (MXAK) to form the Alaska vessel tracking alliance which is built on the MXAK PacTracs product offering. PacTracs is a vessel tracking display system that uses the MXAK's 100 coastal Automatic Identification System (AIS) receivers throughout Alaska.

Users are now able to upgrade their PacTracs service to include the exactAIS® satellite feed from exactEarth. This upgrade will expand coverage from the coastal waters around Alaska to include the entire North Pacific and the Arctic. Coverage will now extend from 45 degrees north latitude all the way to the North Pole.

Vessel tracking is the cornerstone of MXAK's services. This new hybrid AIS and satellite tracking system will address all aspects of the organization's mission of providing services that aid safe, secure, efficient and environmentally responsible maritime operations.

"The Marine Exchange of Alaska provides the Alaska maritime community with many valuable services, which now will include exactEarth's satellite coverage of vessel movements on the open ocean. We are excited to support the PacTracs vessel tracking application for the Alaska maritime community," said Mr. Chandler Smith of exactEarth-USA.

InfoBeam

Hot Zone Initiations In Africa

Q-KON has launched a HotZone Internet access and distribution solution in Africa.

The offering is primarily aimed at entrepreneurs who want to leverage off connectivity for their businesses as well as establishments that want to provide this service to patrons and guests.

The StarLight HotZone consists of a VSAT terminal, wireless access controller with a printer and a keypad. It comes pre-configured with 4Mbps downlink speed and 512Kbps uplink speed and works on a franchise basis. In addition to being straightforward in terms of implementation and setup, Q-KON points out the solution's flexibility and adaptability to user requirements.

Logistically, a would-be investor or franchisee in Internet services needs to install a VSAT antenna with a satellite modem, access controller, voucher printer and keypad at their premises. Once the site is activated by the Q-KON Networks Operating Centre (NOC), the franchisee engages Q-KON to purchase the pre-paid data bundle using the online user portal.

The site is now ready to distribute Internet to patrons and guests. A guest can buy a voucher in any of the designated denominations. The desk assistant will issue the guest with a voucher by selecting the option on a keypad. The voucher will be printed with an access code and PIN which needs to be typed into the portal page when accessing the HotZone. The guest will be allowed access to the Internet and the access controller will manage the usage until the purchased bundle is finished. The purchased voucher will expire if not used within the same calendar month that it was purchased.

Algorithmic Advances

Astrium and CNES, have achieved a major improvement in Pléiades image quality, including sharper products and enhanced geometry.

A new algorithm, developed by the French Space Agency, provides images with better-drawn, neater contours, with a better understanding of the surface texture.

These improvements greatly facilitate the analysis of the image (photo-interpretation) and also improve the accuracy of 3D models resulting from stereo taken images. These gains encompass:

- *Better pan-sharpening*
- *More accurate RPCs (Rational Polynomial Coefficient) improving ortho-rectification and stereoscopic quality*
- *An almost perfect focal plane characterization*

All Pléiades 1A and 1B images processed now will be of better quality including archived data that is reprocessed. Astrium Services and CNES work in a continuous partnership to improve the quality of images available.

The Ins + Outs Of A Buy Out

CPI International, Inc. and its wholly owned subsidiary Communications & Power Industries LLC (CPI) have acquired MCL, Inc., a manufacturer of power amplifier products and systems for the satellite communications market, and a wholly owned subsidiary of MITEQ, Inc.

CPI is a leading provider of microwave, radio frequency (RF), power and control solutions for critical defense, communications, medical and other applications. MITEQ manufactures RF microwave components and satellite communications (SATCOM) products.

Under the terms of the agreement, CPI acquired the assets of MCL using cash on hand. The acquisition will be integrated into CPI's Satcom Division.

CPI will honor MCL's current sales commitments, and will continue to operate MCL's manufacturing facility in Bolingbrook, Illinois, for the period necessary to fulfill these backlog commitments. Following the completion of these backlog commitments, CPI will address customers' needs with products from its Satcom Division in Georgetown, Ontario, Canada and Palo Alto, California.

CPI will continue to support MCL's installed base of products and customers worldwide. CPI will maintain a service center for MCL products in the Chicago area and expects to retain MCL's existing global network of authorized service providers. Several of M C L's key managers and employees will transition into roles at CPI supporting MCL products.

Suite Security Solution—Cytelics(sm)

Globecomm Systems Inc., a communications solutions provider, has launched Cytelics®, an end–to-end cyber security solutions service.

Cytelics will be offered through Comsource, a Globecomm company specializing in engineering, software development and interoperability testing.

Cytelics is included with many industry specific systems and solutions and is designed for commercial and industrial organizations that focus on manufacturing, transportation, power/energy utilities, and other heavy industry. These companies are dependent on Industrial Controls Systems (ICS), and can utilize Cytelics to secure their manufacturing business line.

Cyber Security solutions also cover sectors using complex production networks such as broadcast networks, telecomm operators, and educational institutions. Cytelics offers a comprehensive and customizable suite of network security services and technologies.

Cytelics cyber security solutions are custom-designed for target industries by encompassing ICS, automation systems, SCADA, information security, IT systems, and physical security into a complete lifecycle offering. This include:

- *Risk Assessment of networks to determine vulnerabilities and business exposure.*
- *Remediation solutions that correct network and systems vulnerabilities.*
- *Risk mitigation solutions harden the network and ensure industry best practices.*
- *Vigilance that continually detects, deters, and defends against threats.*
- *Custom network design and implementation to secure networks and ICS*

Byron Parker, Comsource President, said: "The launch of Cytelics will uniquely position Globecomm in the Cyber Security market. Through Comsource's accredited security laboratories and network testing facilities and Globecomm's ability to deliver custom secure communications networks, we provide the flexibility to develop customized solutions for any type of cyber threat.

InfoBeam

Voice Power

Alianza, a leader in cloud voice platforms, has announced that ViaSat Inc. has selected the company's VoIP solution to power ViaSat's newly launched Exede® Voice service.

ViaSat turned to Alianza's turnkey wholesale solution to successfully address market timing, product and cost requirements. Alianza's software-as-a-service (SaaS) model applied to wholesale voice helps enable service providers to maximize voice profitability and minimize risk.

ViaSat selected Alianza's cloud voice platform after an extensive evaluation of voice delivery options. Alianza provided a superior time to market, voice quality, operational control and business case for ViaSat's new voice service.

ViaSat made extensive use of Alianza's application programming interface (API) to integrate the service administration, customer care and reporting functions into its back-office systems, resulting in significantly less time and resources required to manage and scale Exede Voice.

"At ViaSat, our engineers and technical team focused on optimizing every point in the Exede network to deliver superior call quality," said Lisa Scalpone, vice president, Satellite Services. "Alianza will enable us to effectively manage and scale our back-office functions. Together, these capabilities are the foundation of an end-to-end customer experience that delivers quality, value and convenience."

Powered by the ViaSat-1 satellite, ViaSat's high-speed Exede Internet serves approximately 300,000 subscribers and covers about 80 percent of the U.S. population. Launched June 17, Exede Voice is the first satellite VoIP residential telephone service introduced in the U.S.

"With an offer including Exede Voice, Internet and satellite television, ViaSat is delivering a triple-play communications and entertainment service bundle for consumers," said Brian Beutler, CEO and co-founder of Alianza. "Our cloud voice platform provides ViaSat with the right capabilities at a cost that makes clear business sense."

Space Solar Power: Key To A Liveable Planet

Kalam and Hopkins discuss joint statement at the 2013 International Space Development Conference (ISDC).

The National Space Society (NSS) has announced a new space solar power international initiative.

NSS will work to forge an international organization involving America, India and other nations to develop space solar power. This has the potential of solving humanity's energy needs and greatly mitigating climate change. The following is a joint statement by Dr. A. P. J. Abdul Kalam, Former President of the Republic of India and Mr. Mark Hopkins, Executive Committee Chairman, National Space Society.

We, Dr. Kalam and Mr. Hopkins, have long shared humanity's dream of all nations living together in prosperity and peace and moving forwards through global collaboration in space to meet the challenges that now face our Planet Earth. We are conscious that all nations have to strive to make our planet livable again, after centuries of devastation of its environment and ecosystems and rapid depletion of its precious mineral resources, including fossil fuels and fresh water.

Over these last three years many of our colleagues, in NSS and in India, have come together and made progress towards this international collaborative mission by sustained dialogue with mutual respect, understanding, and trust.

It is essentially this process that has helped us to decide that the time has arrived for us to together attempt to give a direction and momentum to this movement to realize space solar power and its enabling technologies through international collaboration that can help rebuild our environmentally vulnerable planet.

Today, we begin working together in a well organized and well supported manner to realize such a 21st Century

global collaboration; and together help to lay the structural foundation for an international collaboration to develop and deploy space solar power systems. We are aware that coalitions and collaborations work best if there is a shared mission and common goals, and effective leadership.

We need to build strong, trusting relationships across nations through a participatory process with the active involvement of member nations and their institutions and organizations. We will work to develop an effective mission governance process and hope to evolve, jointly and together in international teams, clear operating procedures regarding decision-making, communications, and accountability. We shall be working together to develop a shared vision, to build strong relationships within the leadership team, and to rotate leadership roles.

A shared vision shall include specific mechanisms such as the Global Space Knowledge Platform, the International Virtual Laboratory, and the International Advisory Committee that Dr. Kalam has elaborated through discussion papers with Mr. Hopkins and his Address to the 2013 National Space Society's International Space Development Conference (ISDC 2013).

We hope our international collaborative mission will act as a catalyst for a livable planet which will promote prosperity and peaceful relations within and between nations. Unveiled," Aviation Week, June 3, 2013.

About Dr. Abdul Kalam: Despite coming from a poor background, which required him to work at an early age to supplement his parents' income, Dr. Kalam obtained degrees in Physics and Aeronautical Engineering. He was project director of India's first indigenous satellite launch vehicle. Dr. Kalam was subsequently responsible for the evolution of ISRO's (India's equivalent of NASA) launch vehicle program. From 1992 to 1999, he was the Scientific Adviser to Defense Minister of India and Secretary, Department of Defense Research & Development. Dr. Kalam was President of India from 2002 to 2007. He is known for his work with students. His 79th birthday was recognized as "World Student's Day" by the United Nations. According to a 2010 Readers Digest poll, he is one of the two most trusted men in India.

About The National Space Society (NSS): NSS is an independent, educational, membership, non-profit organization dedicated to the creation of a spacefaring civilization. NSS is widely acknowledged as the preeminent citizen's voice on space, with over 50 chapters in the United States and around the world. The Society publishes Ad Astra magazine, an award-winning periodical chronicling the most important developments in space. To learn more, visit **www.nss.org**.

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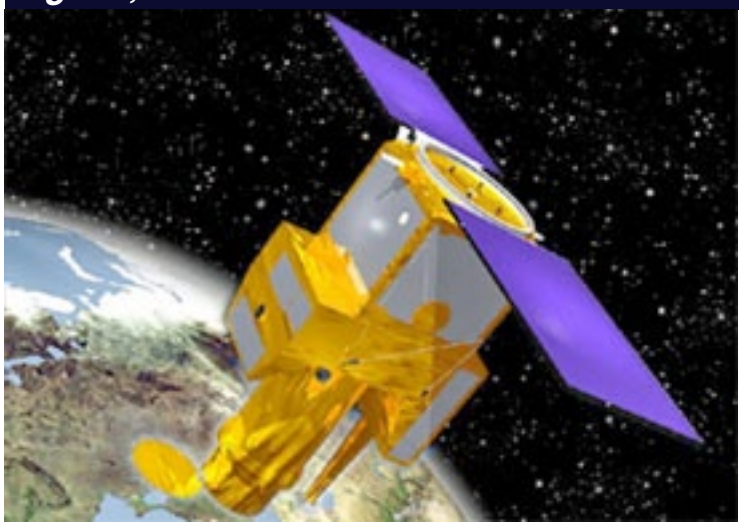


Artistic rendition of the Turkish Göktürk-1 satellite

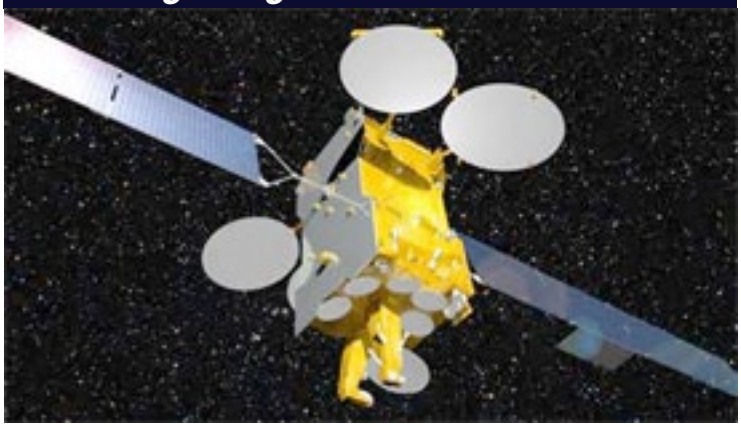
Arianespace has announced a launch contract with Telespazio to launch the Göktürk-1 satellite for the Turkish government.

Stéphane Israël, Chairman and CEO of Arianespace, and Luigi Pasquali, Chief Executive Officer of Telespazio, announced they have signed the launch contract for the Göktürk-1 satellite. This is the ninth contract signed since the beginning of the year by Arianespace and the second commercial contract for Vega on the open market.

Telespazio is the prime contractor for the Göktürk-1 high-resolution observation system, while Thales Alenia Space is providing the space segment. Weighing 1100kg. at launch, the Göktürk-1 satellite will be launched by Arianespace's Vega light launcher into a Sun-synchronous orbit at an altitude of about 700km. It will be launched from the Guiana Space Center, French Guiana, in 2015.

The Göktürk-1 system will provide very-high-quality panchromatic and multispectral products for a wide range of applications, including cadastral surveys, management of natural resources, environmental monitoring and homeland surveillance.

A Sending Is Signed



Artistic rendition of the EUTELSAT 3B satellite.

An agreement to launch the EUTELSAT 3B spacecraft in April 2014 using the Sea Launch Zenit-3SL launch system and launching from the ocean-based Odyssey launch platform.

Currently under construction by Astrium, an EADS company, EUTELSAT 3B is based upon the Eurostar-3000 platform. Operating in C, Ku and Ka-bands, the satellite has been designed with high levels of operational flexibility to serve video, data, Internet and telecom customers across Europe, Africa, the Middle East, Central Asia and parts of South America.

The satellite will operate from Eutelsat's orbital slot located at 3 degrees East longitude in geostationary Earth orbit and have a separated launch mass of more than six metric tonnes.

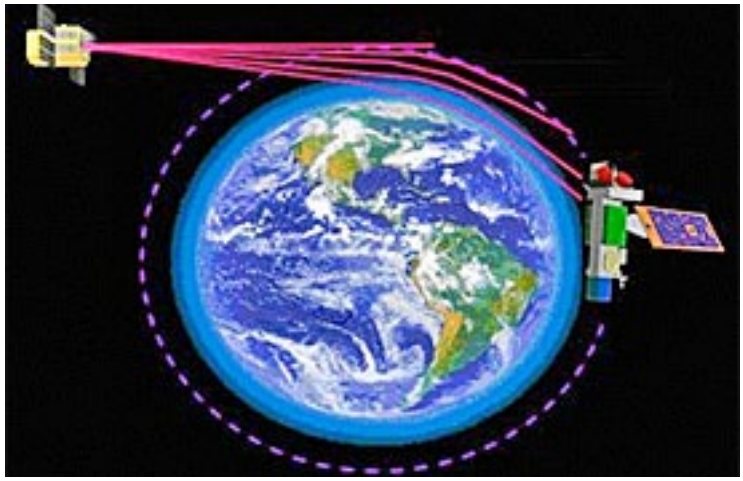
"This agreement represents a significant expression of customer confidence in Sea Launch program, both in our capability demonstrated to date as well as in our future " said Sergey Gugkaev, chief executive officer of Sea Launch.

Kjell Karlsen, president of Sea Launch, said, "We are very pleased with the confidence and trust placed in us by Eutelsat, and look forward to building upon the successful launches of Eutelsat spacecraft in 2011 and 2012."

Michel de Rosen, Eutelsat CEO, added, "We look forward to working once again with the Sea Launch teams on the EUTELSAT 3B mission following the successful launches of EUTELSAT 70B in 2012 and EUTELSAT 7 West A in 2011. This new contract increases the flexibility we need to pursue our in-orbit expansion plan of six new satellites by end 2015 that will diversify our overall resources, increase our operational flexibility and further raise in-orbit security."

Thrusters For FORMOSAT-7

European Space Propulsion, an Aerojet Rocketdyne company, has signed a contract with Surrey Satellite Technology Limited (SSTL) for the delivery of 19 MR-103 thrusters for the FORMOSAT-7 program.



This first award for ESP includes delivery of thrusters for six spacecraft and an option for hardware for an additional six spacecraft. FORMOSAT-7/COSMIC-2 program is a joint constellation metrological satellite mission between Taiwan and the United States for observing and monitoring the global meteorology, climate and ionosphere.

Bill Smith, head of Business Development for ESP and Aerojet Rocketdyne in Europe, said, "We welcome the opportunity to bring high performance in-space propulsion to SSTL and Europe's growing portfolio of satellites."

The MR-103G thruster, a 1N hydrazine monopropellant thruster, was designed and flight proven by Aerojet Rocketdyne. The MR-103 has a long flight heritage for use on a variety of space programs including commercial and civil spacecraft. The MR-103 was originally designed for the Voyager program and the thrusters on that vehicle remain operational today nearly 36 years after launch.

"ESP represents a new competitive force in the European arena," said Aerojet Rocketdyne President, Warren M. Boley, Jr. "It will maintain a strong European identity while leveraging Aerojet Rocketdyne's seven-decade legacy of propulsion performance. International collaboration will lower costs and enhance customer support."

Pictured above right is a SSTL artistic rendition of the FORMOSAT-7/COSMIC-2 program.

InfoBeam

Africa Banks On SATCOM

Financial services via satellite in Africa mean that people can withdraw money from SatADSL cash machines at any time, even in remote and otherwise unconnected places. Pictured is a SATADSL unit in Ghana.

Satellites are making it possible to transfer money between remote locations in sub-Saharan African countries that are otherwise unconnected to the outside world.

An ESA project looking at ways to use satellites for services in developing nations where land networks are simply impossible or non-existent gave rise to the Agency's SatFinAfrica pilot project in 2011.

The project was so successful that a company called SatADSL was established in Belgium early last year to provide SATCOM for financial services to Africa. Microfinance offices in different villages, linked via satellite, allow people to transfer or withdraw money with ease.

The SATCOM service is sold via local African distributors who resell it to the microfinance offices on behalf of SatADSL.

Financial services via satellite in Africa mean that people can withdraw money from SatADSL cash machines at any time, even in remote and otherwise unconnected places. Pictured is a SATADSL unit in Ghana.

Currently, SatADSL serves more than 100 offices and the number is growing. Each branch has its own satellite terminal. SatADSL has just received 1 million euros from a leading Belgian private equity investor to support this growth, with the aim of connecting thousands of branch offices of microfinance companies in sub-Saharan Africa via satellite.

Other services offered by SatADSL include cash machines to withdraw money at any time, even in remote and otherwise unconnected places. The machines operate in the same way as they do in Europe, only in Africa, a satellite terminal sits on the roof.

For those withdrawing cash, the procedure is no different. SATCOM also provides the same level of security as terrestrial networks.

SatFinAfrica uses Sat3Play satellite technology developed by Newtec in Belgium, with assistance from ESA's Advanced Research in Telecommunications Systems, or ARTES, program. The satellite link is provided by SES Astra in Luxembourg using SES Broadband.

This IRIS Can Look @ The Sun + Not Blink

The launch of the IRIS satellite via Orbital's Pegasus Rocket.

The IRIS spacecraft will use an ultraviolet telescope to look at a small area of the sun to answer detailed questions. Photo courtesy of NASA.

Orbital Sciences Corporation's Pegasus® rocket successfully launched the Interface Region Imaging Spectrograph (IRIS) satellite for the National Aeronautics and Space Administration (NASA). The IRIS spacecraft was deployed into its targeted orbit approximately 400 miles above the Earth and early results confirm that the satellite is operating as anticipated at this stage of its mission.

The launch of the Pegasus rocket originated from Vandenberg Air Force Base (VAFB), California when Orbitals' L-1011 "Stargazer" carrier aircraft took off from the airfield at approximately 6:30 p.m. (PDT) on June 27, 2013. Following a one-hour preplanned positioning flight, and a 13-minute powered flight sequence, Pegasus launched the 440-pound IRIS satellite into its polar, sun-synchronous Earth orbit.

"The Pegasus rocket carried out another successful mission for NASA today, extending its record of consecutive successful missions to 28 over a 16-year period," said Mr. Ron Grabe, Orbital's Executive Vice President and General Manager of its Launch Systems Group. "We are proud of our launch team and are

pleased to have contributed to a successful beginning of this important NASA heliophysics science mission."

"We are thrilled to add IRIS to the suite of NASA missions studying the sun," said John Grunsfeld, NASA's associate administrator for science in Washington. "IRIS will help scientists understand the mysterious and energetic interface between the surface and corona of the sun."

"Congratulations to the entire team on the successful development and deployment of the IRIS mission," said IRIS project manager Gary Kushner of the Lockheed Martin Solar and Atmospheric Laboratory in Palo Alto, California. "Now that IRIS is in orbit, we can begin our 30-day engineering checkout followed by a 30-day science checkout and calibration period."

IRIS is expected to start science observations upon completion of its 60-day commissioning phase. During this phase, the team will check image quality and perform calibrations and other tests to ensure a successful mission.

NASA's Explorer Program at Goddard Space Flight Center in Greenbelt, Md., provides overall management of the IRIS mission. The principal investigator institution is Lockheed Martin Space Systems Advanced Technology Center. NASA's Ames Research Center will perform ground commanding and flight operations and receive science data and spacecraft telemetry.

The Smithsonian Astrophysical Observatory designed the IRIS telescope. The Norwegian Space Centre and NASA's Near Earth Network provide the ground stations using antennas at Svalbard, Norway; Fairbanks, Alaska; McMurdo, Antarctica; and Wallops Island, Virgina. NASA's Launch Services Program at the agency's Kennedy Space Center in Florida is responsible for the launch service procurement, including managing the launch and countdown. Orbital Sciences Corporation provided the L-1011 aircraft and Pegasus XL launch system.

IRIS is a NASA Explorer Mission to observe how solar material moves, gathers energy and heats up as it travels in the sun's lower atmosphere. This interface region is where most of the sun's ultraviolet emission is generated. These emissions impact the near-Earth space environment and Earth's climate operations and receive science data and spacecraft telemetry.

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A Spatial Penguin Encounter...

The NASA/ESA Hubble Space Telescope has produced this vivid image of a pair of interacting galaxies known as Arp 142.

When two galaxies stray too close to each other they begin to interact, causing spectacular changes in both objects. In some cases the two can merge—but in others, they are ripped apart.

Just below the center of this image is the blue, twisted form of galaxy NGC 2936, one of the two interacting galaxies that form Arp 142 in the constellation of Hydra. Nicknamed "the Penguin" or "the Porpoise" by amateur astronomers, NGC 2936 used to be a standard spiral galaxy before being torn apart by the gravity of its cosmic companion.

The remnants of its spiral structure can still be seen—the former galactic bulge now forms the "eye" of the penguin, around which it is still possible to see where the galaxy's pinwheeling arms once were. These disrupted arms now shape the cosmic bird's "body" as bright streaks of blue and red across the image. These streaks arch down towards NGC 2936's nearby companion, the elliptical galaxy NGC 2937, visible here as a bright white oval. The pair show an uncanny resemblance to a penguin safeguarding its egg.

Artistic rendition of the Hubble Space Telescope. Courtesy of NASA.

The effects of gravitational interaction between galaxies can be devastating. The Arp 142 pair are close enough together to interact violently, exchanging matter and causing havoc.

In the upper part of the image are two bright stars, both of which lie in the foreground of the Arp 142 pair. One of these is surrounded by a trail of sparkling blue material, which is actually another galaxy. This galaxy is thought to be too far away to play a role in the interaction—the same is true of the galaxies peppered around the body of NGC 2936. In the background are the blue and red elongated shapes of many other galaxies, which lie at vast distances from us—but which can all be seen by the sharp eye of Hubble.

This pair of galaxies is named after the American astronomer Halton Arp, the creator of the Atlas of Peculiar Galaxies, a catalogue of weirdly-shaped galaxies that was originally published in 1966. Arp compiled the catalogue in a bid to understand how galaxies evolved and changed shape over time, something he felt to be poorly understood. He chose his targets based on their strange appearances, but astronomers later realized that many of the objects in Arp's catalogue were in fact interacting and merging galaxies [1].

This image is a combination of visible and infrared light, created from data gathered by the NASA/ESA Hubble Space Telescope Wide Field Planetary Camera 3 (WFC3).

Notes

[1] The birth and evolution of various sets of merging galaxies was the subject of the book Cosmic Collisions—The Hubble Atlas of Merging Galaxies, produced by Springer and the European Southern Observatory. The book is illustrated with a range of stunning Hubble Space Telescope images.

The Hubble Space Telescope is a project of international cooperation between ESA and NASA. Image credit: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

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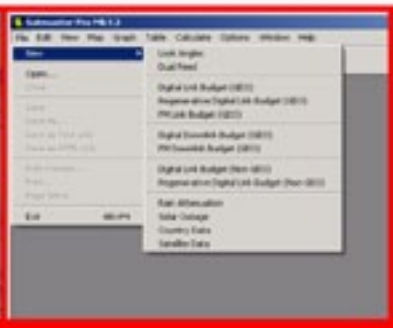

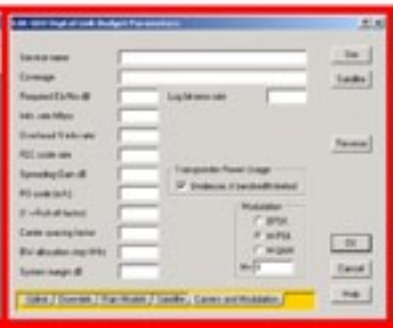

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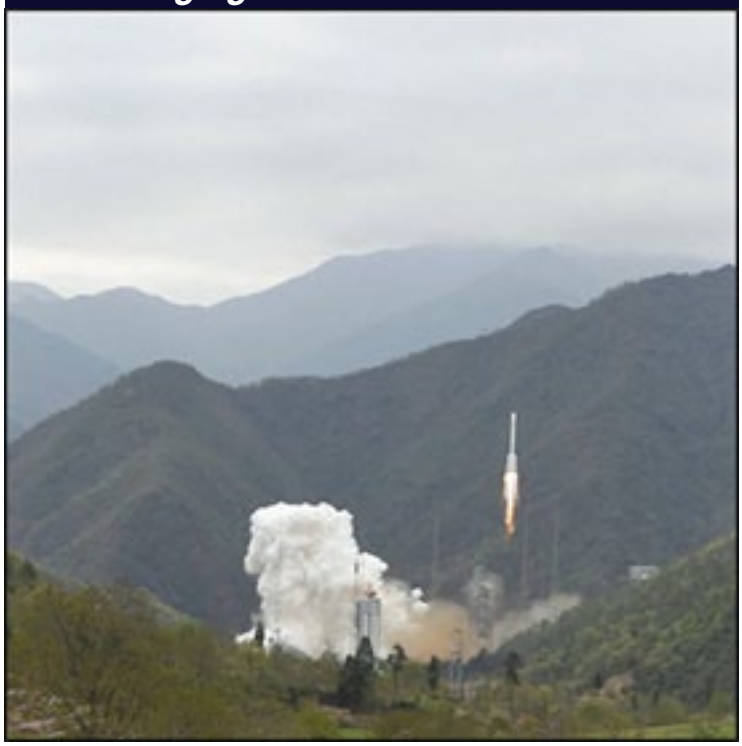
A Challenging State Of Affairs



The APSTAR-7 launch in China.

Artistic rendition of the APSTAR-7 satellite.

China is actively exploring commercial opportunities to boost its share of the global satellite-launching market, in an attempt to challenge U.S. and European dominance of this field, according to a recent infopiece in China Daily.

China Great Wall Industry Corp, a subsidiary of China Aerospace Science and Technology Corp, is using this year's Paris Air Show to showcase its next generation of heavy-lifting rocket, the Long March 5, which is expected to be first launched in 2015.

China Great Wall, the country's sole commercial provider of international launch services and satellite in-orbit delivery, is also using the event to demonstrate its Long March family of rockets, communication satellite platforms, and remote-sensing and meteorological satellites in the hope of attracting more potential international business, said Zhou Yuanying, the deputy general manager of the company's launch service division.

China launched 19 satellites last year, more than the U.S. did for the first time. The country aims to increase its market share in the global satellite-launching business to 15 percent by 2020, according to report of Xinhua News Agency. It currently has about 3 percent market share and its main clients are countries from Asia, Latin American and Africa. Since 2005, China has launched satellites for Nigeria, Venezuela, and Pakistan, and, in April, added Turkey, Argentina and Ecuador to its international roll call of clients, after sending three more satellites into orbit.

Zhou said that China is basing its offering on a combination of high reliability and reasonable cost, but she admitted that it faces major obstacles in entering the U.S. and European markets. The U.S., for instance, has banned the export and transfer of satellites to China as well as the launching of satellites with U.S. components in China, and analysts say the restrictions have helped reinforce the U.S.' dominance of the sector.

The U.S. generated revenue of $1.9 billion from launching services in 2011, accounting for 39 percent of the global market share, according to a report by the Satellite Industry Association. Europe accounted for 25 percent, while Russia had 19 percent of the market.

Zhou said China is looking for ways to compensate for the market restrictions by seeking opportunities in satellite leasing and cooperation with the world's leading satellite operators, such as European companies SES SA and Intelsat SA.

China has already leased its commercial satellite Apstar-7 to the U.S. Defense Department for control of the communications of its Africa command, and the Pentagon recently extended a $10.7 million leasing contract with China.

China Great Wall is also promoting the applications of the Beidou satellite navigation system, an alternative to the US Global Positioning System, to international clients.

China plans to invest 7 billion yuan ($1.13 billion) to further develop the system, which began to provide services for clients in the Asia-Pacific region in December 2012, according to media reports. The system is expected to serve global customers in 2020.

Cover Feature: An In-Depth Look At GOES-R

An Interview With Greg Mandt, NOAA's GOES-R System Program Director

Greg Mandt is responsible for the success of the GOES-R space and ground developments, launch and on-orbit checkout. This $7.6 billion effort is currently in the early development stage with a projected first satellite launch date in 2015.

Previously, Greg served as the Director, Office of Science and Technology and was responsible for science and technology infusion into the National Weather Service including; science and engineering planning; acquisition and refresh of critical technologies; and the scientific developments of the Meteorological Development Laboratory. Previous assignments in the National Weather Service included Director of the Office of Climate, Water, and Weather Services from 2000 to 2005 and Chief of the Science Branch, Office of Meteorology from 1996 to 2000.

Prior to joining the National Weather Service, from 1992 to 1996, he was the Program Manager and Lead Engineer for the Polar-orbiting Operational Environmental Satellite (POES) Program at the National Environmental Satellite and Data Information Service.

During his 14-year tenure in the United States Air Force, Mr. Mandt held management and executive level positions including; Acquisition Manager of the Defense Meteorological Satellite Program (DMSP); Executive Officer for the Space Systems Division; Chief, Spacecraft Engineering Branch, DMSP Program Office; Research Engineer; Flight Dynamics Laboraory; and Flight Test Engineer.

Mr. Mandt holds a Masters of Science degree in Systems Engineering and a Masters of Science degree in Electrical Engineering both from the Air Force Institute of Technology. He earned his Bachelor of Science degree in Engineering Mechanics from the United States Air Force Academy. He is a graduate of the Defense Systems Management College Program Management Course.

An In-Depth Look At GOES-R With Greg Mandt (Cont.)

SatMagazine (SM)
Mr. Mandt, first, and most importantly, what does GOES-R offer that is not already operational in other environmental satellites?

Greg Mandt
The GOES-R series will offer a significant increase in capability above today's geostationary satellites. GOES-R will mark the first major technological advance in geostationary observations since 1994 when it launches in late 2015. GOES-R will feature a 16-channel imager—compared with the five-channel imager available on NOAA's current GOES. This new imager will give us three times more spectral information, four times more spatial coverage, and five times the temporal resolution compared with today's GOES imagers. This instrument will effectively allow forecasters to "zoom-in" on specific storms and watch them evolve/move in real-time.

GOES-R will also feature a Geostationary Lightning Mapper. This instrument will provide a continuous, near real-time surveillance of total lightning activity during both day and night throughout the Americas and adjacent oceans. This holds great promise for observing the development of severe weather and extending warning lead times.

The GOES-R Geostationary Lightning Mapper (GLM). Photo courtesy of NOAA/NASA.

In addition, GOES-R will include a series of improved space weather instruments. There will be two instruments observing the surface of the sun in the extreme ultraviolet and X-ray spectrums, a suite of instruments measuring energetic particles in the vicinity of the satellite, and another instrument measuring the strength of the Earth's magnetic field. All of these instruments will have increased sensitivity and a broader range of coverage.

Data from the GOES-R's advanced instruments will create many different products, helping NOAA meteorologists and other users to better monitor the atmosphere, land, ocean and the sun. This means timelier and more accurate forecasts and warnings.

SM
What is NOAA's role versus NASA's role with GOES-R?

Greg Mandt
NOAA manages the GOES-R Series Program through an integrated NOAA-NASA program office, staffed with personnel from NOAA and NASA, co-located at NASA's Goddard Space Flight Center in Greenbelt, Maryland. NOAA funds, manages and will operate the GOES-R series.

The Program uses NASA Goddard Space Flight Center contracts for the acquisition and development of the GOES-R series spacecraft and instruments and uses NOAA contracts for the acquisition of the ground system and antennas.

SM
What are the satellite's key functions?

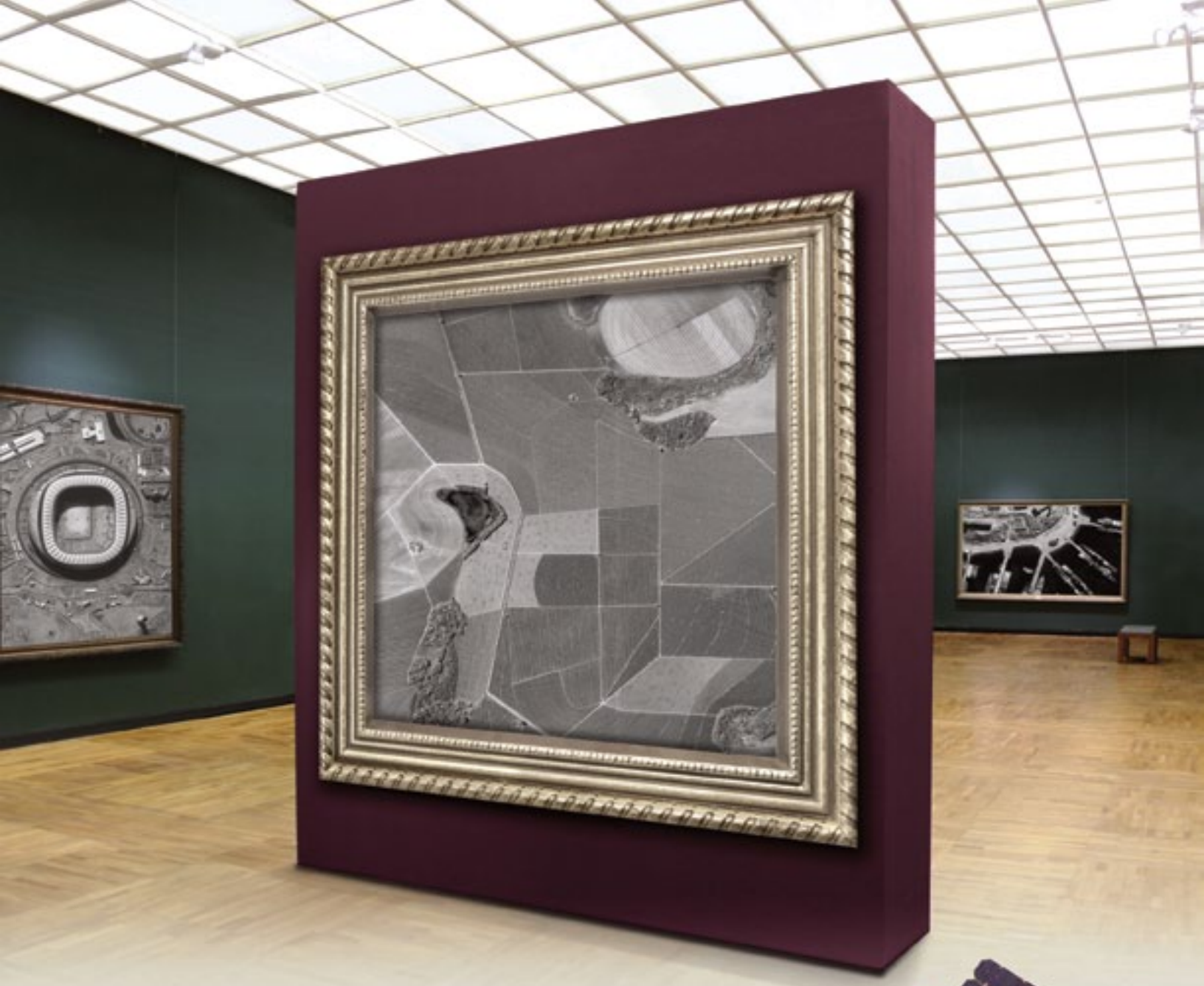
Greg Mandt
Using advanced instruments and sensors, GOES-R's key functions will be improved capability to monitor weather—from better hurricane track and intensity forecasts, increased tornado warning lead times, to safer and more efficient aviation route planning. Another key function of GOES-R will be advanced space weather forecasting, which includes solar flare warnings for communications and navigation disruptions, more accurate monitoring of hazardous energetic particles and better warning of coronal mass ejections.

SM
How are GOES-R and its instruments being tested prior to launch to determine usability and viability?

Greg Mandt
The GOES-R spacecraft and each of the instruments must successfully complete a series of tests designed to demonstrate that they meet all system functional and performance requirements in all expected conditions, both during launch and on-orbit (e.g., vibration, acoustic, electro-magnetic, thermal, and vacuum). The suite of tests is typical for NASA-developed spaceflight systems, detailed for the mission conditions specific to the GOES-R series satellites.

SM
Given the potential hostilities of space, are there any forms of redundancy built into GOES-R operations?

Greg Mandt
Redundancy is built into the geostationary satellite enterprise currently in place. Today, there are three satellites that provide geostationary weather prediction for the U.S. One satellite covers the eastern side of the U.S., the Atlantic Ocean, and the edge of the coast of Africa.



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An In-Depth Look At GOES-R With Greg Mandt (Cont.)

Another satellite covers the western U.S., including Alaska and Hawaii. A third, fully-capable satellite sits in a "storage" orbit between the other two, in the event it is needed should one or any of the other two satellites, or their primary instruments, not work properly.

After GOES-R is launched and has completed its check out, it will go into an on-orbit spare slot. This redundancy ensures two operating satellites are in place at all times. Satellites are launched, tested, and validated in a staggered manner, so as one satellite reaches the end of its useful lifecycle, another is available to take its place.

NOAA also has international agreements and operational procedures in to gain assistance from our partner agencies (EUMETSAT and the Japanese Meteorological Agency—JMA) to provide coverage from their constellations in the event such is needed.

SM

How will GOES-R coordinate its efforts with those of other Earth observation satellites (i.e., NASA's Aqua and Terra satellites)?

Greg Mandt

Earth observation satellites fall mostly into two types—low-Earth orbits and geostationary orbits. The NOAA Joint Polar Satellite System (JPSS) and NASA's Aqua and Terra are examples of the low-Earth orbiting satellites. They collect high spatial and spectral resolution information primarily used to feed numerical forecast systems and support climate research/analysis.

GOES-R is a geostationary orbiting satellite providing high temporal resolution information to primarily support severe weather warning efforts. The two types of systems provide complementary data for the Nation's Earth observation needs.

SM

What launch vehicle was selected to launch GOES-R, given its heavy-weight requirements?

Greg Mandt

GOES-R will launch aboard an Atlas V (541) expendable launch vehicle.

SM

What does the launch schedule look like, as of this writing, and where will the launch occur?

Greg Mandt

The launch of the first satellite in the GOES-R series is currently scheduled for a launch readiness of October 2015. The satellite will lift off from Cape Canaveral Air Force Station, Florida.

SM

Without exceptional ground station support, a satellite is simply another piece of space junk. Would you tell us about NOAA's ground station operations as it relates to GOES-R, and how does Harris fit into this operational segment?

Greg Mandt

The program is developing a state-of -the-art ground system that will receive data from the GOES-R spacecraft and generate real-time GOES-R data products. The increased capabilities of this new generation of geostationary environmental monitoring satellites require a complete upgrade of NOAA's ground infrastructure.

Artistic concept of the Atlas V541 launch vehicle. Courtesy of JPL/NASA.

Additionally, the program is putting in new data receive antennas at the primary downlink site at Wallops Command and Data Acquisition Center, Virginia, and at the backup facility in Fairmont, West Virginia. The program is also putting in new command and control operations capability for GOES-R at the National Satellite Operations Facility (NSOF) in Suitland, Maryland, where it is also developing a new data processing and distribution system at NSOF.

The Harris Corporation, Government Communications Systems Division of Melbourne, Florida, is responsible for developing the hardware and software components of this ground system. The 10-year contract calls for Harris to design, develop, test, and implement the core ground system functional elements.

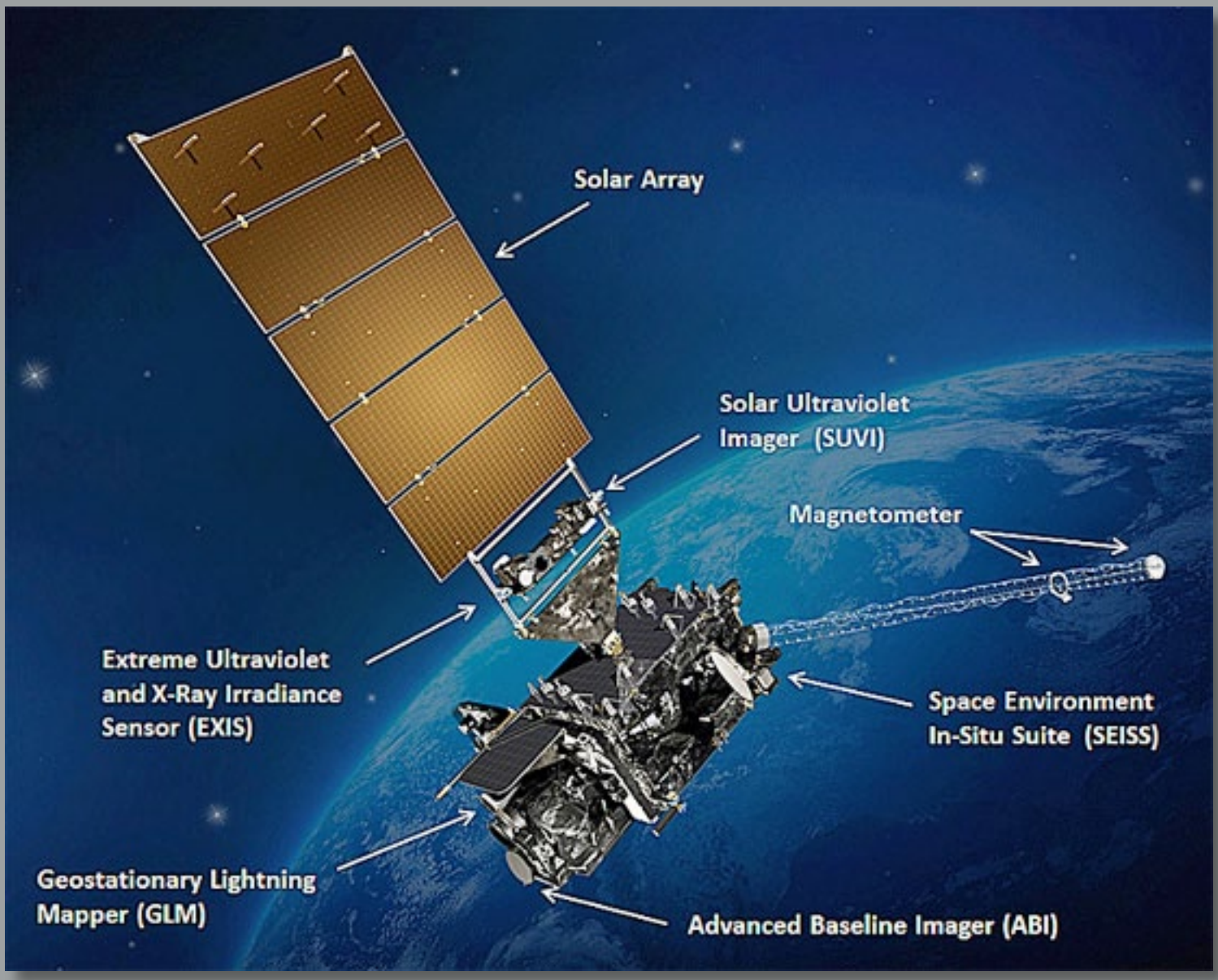
Harris was also awarded a separate 10-year contract to supply the ground antenna system. The contract includes design, manufacturing, and testing of six new antennas and upgrading four existing antennas at the three ground station facilities. Harris, under the core GS contract, will integrate the antenna system into the core GS.

SM

How did NOAA select development partners for satellite instrumentation and who are the partners?

Greg Mandt

GOES-R development partners were contracted through a competitive-bid procurement process. The following partners were selected to develop the GOES-R instruments:



An In-Depth Look At GOES-R With Greg Mandt (Cont.)

- *Advanced Baseline Imager: ITT Exelis, Fort Wayne, Indiana*
- *The Extreme Ultraviolet and X-ray Irradiance Sensors: Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado*
- *Geostationary Lightning Mapper: Lockheed Martin Advanced Technology Corp, Palo Alto, California*
- *Magnetometer: Lockheed Martin Space Systems Company, Newton, Pennsylvania*
- *Space Environment In-Situ Suite: Assurance Technology Corporation, Carlisle, Massachusetts*
- *Solar Ultraviolet Imager: Lockheed Martin Advanced Technology Center, Palo Alto, California*

SM

What instruments are being developed, or have already been developed, for GOES-R? What is each instrument's purpose?

Greg Mandt

GOES-R will carry three classifications of instruments—nadir-pointing (toward the Earth), solar-pointing (toward the sun) and in-situ (in place).

Two of these instruments point toward Earth—the Advanced Baseline Imager (ABI), which is the primary instrument onboard GOES-R for monitoring Earth's weather, climate and environment. The ABI will view the planet with 16 different spectral bands, compared with the five on today's GOES. The ABI channels include: Two visible, four near-infrared and 10 infrared.

With the increased amount of channels, we'll have twice the spatial resolution, allowing NOAA forecasters to characterize storm intensity and track more accurately, and earlier, in each storm's development. The ABI is able to provide a continuous full disk view of the Earth every five to 15 minutes and routine coverage of the United States every five minutes. In the surrounding region of a severe storm or tropical cyclone, the ABI will provide images as often as every 30 seconds.

The second instrument pointing toward Earth is the GOES-R Lightning Mapper, which will be the first-ever operational lightning mapper flown from a geostationary orbit. Having an instrument in orbit such as the GLM is critical. While ground-based sensors provide primarily cloud-to-ground lightning strike coverage, the GLM will provide total lightning activity, including in-cloud and cloud-to-cloud, across the entire Americas and adjacent waters, with near-uniform accuracy day and night. In addition to lightning data, the GLM information will provide early indication of storm intensification and severe weather events, helping improve tornado warning lead time and provide data for long-term climate variability studies.

GOES-R will fly several advanced solar-monitoring and space weather sensors that will provide vital information

A cornerstone of the mission is the 16-channel ABI instrument, shown above. Photo courtesy of NOAA/NASA.

The GOES-R GLM instrument. 1=Sensor Unit Mechancial Support Structure. 2=Metering Tube. 3=Optical Assembly. Photo is courtesy of NOAA/NASA.

Solar X-Ray Imager Testing in the X-Ray Calibration Facility (XRCF). Photo Courtesy of NASA's Marshall Space Flight Center.

to NOAA's Space Weather Prediction Center in Boulder, Colorado. Two instruments—the Solar Ultraviolet Imager (SUVI) and the Extreme Ultraviolet and X-Ray Irradiance Sensors (EXIS)—pointed at the sun will be incorporated into the Solar Pointing Platform. The SUVI is a high-powered telescope that will observe the sun in the extreme ultraviolet wavelength range. The SUVI will observe and characterize complex, active regions of the sun, solar flares, and the eruptions of solar filaments, which may give rise to coronal mass ejections.

The EXIS will detect solar soft X-ray irradiance and solar extreme ultraviolet spectral irradiance. It will monitor solar flares that can disrupt communications and degrade GPS navigational accuracy, affecting satellites, astronauts, airline passengers and power grid performance.

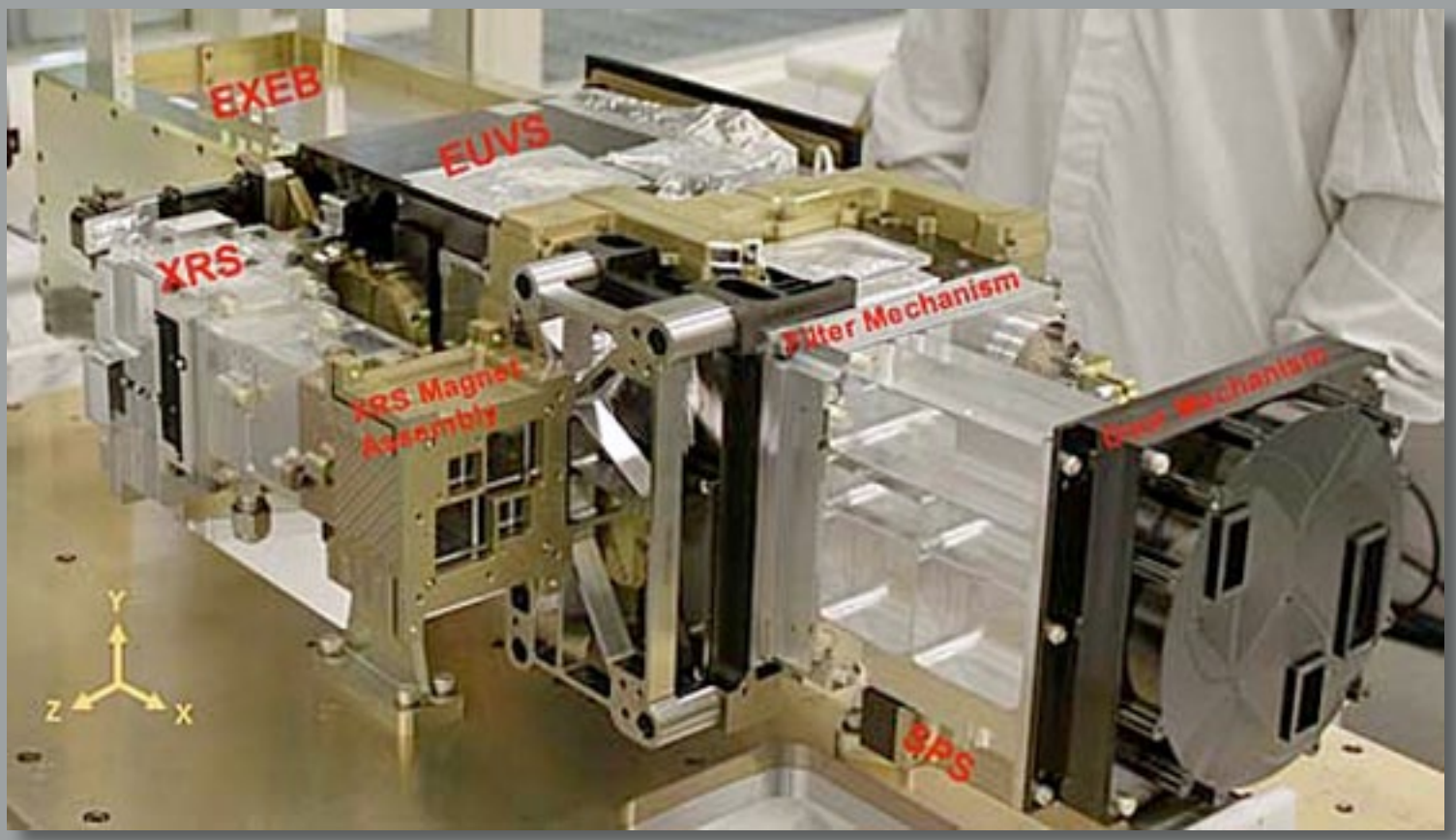
GOES-R also has two in-situ instruments—the Space Environment In-Situ Suite (SEISS) and the GOES-R Magnetometer—that will monitor their own space environment. SEISS will consist of sensors that track the proton, electron and heavy ion fluxes at geosynchronous orbit.

SM

What new types of imagery will be offered by GOES-R? Could you explain the various "products" that will be available for interested parties?

Greg Mandt

GOES-R will make available 34 meteorological, solar, and space weather products. The GOES-R website lists these "Baseline Products" which are those that are funded for operational implementation as part of the ground segment base contract. There's additional information at ***http://www.goes-r.gov/products/baseline.html***



The GOES-R EXIS Engineering Test Unit (EUV + X-Ray Irradiance Senors), which will be mounted in the yoke of the solar array. The subsystems include the Extreme Ultraviolet Sensor (EUVS), the X-Ray Sensor (XRS), EUVS/SRX Electrical Box (EXEB), and the Sun Positioning Sensor (SPS). Photo courtesy of NOAA/NASA.

An In-Depth Look At GOES-R With Greg Mandt (Cont.)

Additional products may be made available as future capabilities for the GOES-R Series.

SM
What are "Cooperative Institutes" and what is their relationship to NOAA? What resources do they provide to your agency?

Greg Mandt
Cooperative Institutes (CIs) are non-federal academic and non-profit research institutions supported by the National Oceanic and Atmospheric Association (NOAA) that provide resources that support NOAA mission goals and strategic plans. Eight NOAA Cooperative Institutes support GOES-R through algorithm and product development and validation, and user readiness education and training. The CIs supporting GOES-R are:

- *Cooperative Institute for Alaska Research (CIFAR) at the University of Alaska, Fairbanks*
- *Cooperative Institute for Mesoscale Meteorological Studies (CIMMS) at the University of Oklahoma in Norman, Oklahoma*
- *Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin in Madison, Wisconsin*
- *Joint Institute for Marine and Atmospheric Research (JIMAR), located at the University of Hawaii at Manoa*
- *Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University in Ft. Collins, Colorado*
- *Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado at Boulder*
- *Cooperative Institute for Oceanographic Satellite Studies (CIOSS) at Oregon State University*
- *Cooperative Institute for Climate and Satellites (CICS)*

Scientists from these organizations work with users to understand their operational needs and then develop/modify products which meet those needs.

SM
How will NOAA tackle the need to train users and developers in the use of GOES-R data?

Greg Mandt
The GOES-R Program is committed to providing extensive training for the operational and educational communities that will address both the end users' and developers' needs, bridging the gap between research and operations. The intended outcomes of user readiness efforts are day one readiness, maximum use of GOES-R products, and an effective transition to operations.

GOES-R is engaging users early in the process through Proving Ground and NOAA testbed activities, simulated data sets, e-learning training modules, scientific and user conferences, documentation, weather event simulations, special case studies, and other communication and outreach efforts. Training will focus on the quantitative and qualitative use of GOES-R data and products, methods for interpreting GOES-R data, new features, capabilities and algorithms, and a better understanding of atmospheric sciences and mesoscale meteorology in preparation for the future GOES-R Series satellites.

The GOES-R Proving Ground is essential to user readiness. The Proving Ground is a collaborative effort between the GOES-R Program Office, NOAA Cooperative Institutes, NASA, the National Weather Service Weather Forecast Offices, National Centers for Environmental Prediction (NCEP) National Centers, and NOAA test beds across the United States.

The Proving Ground provides testing and evaluation of simulated GOES-R products prior to the launch of the satellites. The simulated GOES-R products are generated using combinations of currently available GOES data, along with higher resolution data provided by instruments on polar-orbiting satellites such as Moderate-Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua and Terra satellites as well as model synthetic satellite data.

Many of the GOES-R products will be aimed at monitoring severe weather and helping forecasters issue earlier, more accurate severe weather warnings. In order to create severe weather tools that forecasters have requested, the GOES-R Proving Ground is working with the Experimental Forecast Program and the Experimental Warning Program of the NOAA Hazardous Weather Testbed, developing and utilizing experimental GOES-R products to determine their utility in monitoring and forecasting severe convective weather.

During 2012-2013 GOES-R products have also been demonstrated at the National Hurricane Center, the Ocean Prediction Center, Weather Prediction Center, Aviation Weather Center, Space Weather Prediction Center, and the NWS Operations Proving Ground. The goals of the Proving Ground are:

- *Training forecasters to use new products*
- *Identifying different utilities of each product*
- *Identifying weaknesses or errors with each product*
- *User-feedback development*
- *Day one readiness for GOES-R operations*

The GOES-R Program has also implemented the position of "satellite liaison" to prepare forecasters for the data that will be available with GOES-R and to ease the transition to operations. Satellite liaisons are stationed at a number of the National Centers and the NWS Training Center. Satellite liaisons are tasked with running the various GOES-R demonstrations within these testbed locations. They are essentially research-to-operations liaisons, providing training for testbed participants, and providing participant feedback to the product developers for further improvement.

SM
Did sequestration affect any of the NOAA or partner work needed to complete GOES-R?

Greg Mandt
NOAA cannot comment on specific effects of the FY13 appropriation on the program until spending plans for FY13 are reviewed by Congress. We are still assessing impacts of the FY2013 Appropriation to all of our programs. Programs such as GOES-R that are efficiently managed and approaching their launch date are not able to absorb significant adjustments to funding levels without impact. As soon as FY13 spend plans are finalized, we will provide our stakeholders with detailed impacts.

SM
GOES-R will be able to identify weather hazards for aviation… will such include icing projections?

Greg Mandt
GOES-R's future capabilities include a number of products that can support aviation safety interests including the early identification of rapidly developing clouds, the overshooting tops of maturing intense storms, volcanic ash clouds and sulfur dioxide emitted by volcanic eruptions, as well as regions where icing and turbulence are likely.

SM
What are NOAA's future plans for additional geostationary environmental satellites? What new capabilities are hoped to be ready for such missions?

Greg Mandt
Behind GOES-R's currently planned launch readiness date of October 2015, GOES-S is planned to launch in 2017, GOES-T in 2019 and GOES-U in 2024. The entire GOES-R series will extend the availability of NOAA's operational GOES satellite system through 2036.

GOES-R, The Weather Wonder
More info regarding the program at:
http://www.goes-r.gov/mission/spd-welcome.html.

Staying Ahead Of The Curve
Teleport Infrastructure Investment

By Blake Mclane, President, Emerging Markets Communications

This is a big deal... perhaps one of the most important questions customers pose to their satellite providers surrounds whether or not your infrastructure investment is sufficient enough to handle rapid and exponential growth in big data requirements.

If your provider continuously manages and grows every facet of their infrastructure, from cables to antennas to servers to teleports, then they are one of the few who can answer "yes" to such an inquiry. However, today's "yes" is tomorrow's "no" unless the company continues to refine and upgrade their facility to remain well ahead of the curve—what's next is always bigger than what is, and what you think is coming is probably already here. That's the rule of big data.

Photo courtesy of Emerging Markets Commnincations.

In today's world, billions of devices are connected in real-time to millions of individual networks. The amount of global data and the platforms to manage it continue to grow and grow… and grow. That's because data is always valuable. Data is always moving, always flowing. Yet, data needs to be stored and must be available at any time, and at any point.

Simultaneously, yesterday's complex proprietary systems—formerly the domain of large or well-funded enterprises—or managing, analyzing and transmitting data are now available to virtually all, virtually limitless in scope. So, it seems, are the requirements and investment for those that support and drive big data, those who deploy and manage the technology that make this all happen.

For satellite communication providers, remaining ahead of the curve means connecting the dots, seen and unseen, and investing in tomorrow's technology immediately. Today's protocols may completely transform within the span of a year. Therefore, adapting to technology and making investments to upgrade teleports is critical to meeting the demand of big data. While these investments can be enormous, they are necessary to service customers.

The investment checklist for satellite communications providers includes critical areas such as:

Specialization

Is your provider able to leverage emerging and/or advanced platforms for data delivery? For example, consider the extended C-band Insat for satellite operators. Such requires unique equipment far above the normal cost and is configured on an extended band to provide the teleport with far less interference than the crowded lower bands, where everyone currently resides. The business implications and the dramatic differentiation aren't difficult to comprehend. Those that provide or access this specialized service gain an advantage over those that don't—it's all driven by the increasing volume of big data, and the value of incremental control (with corresponding reductions in interference and traffic) in moving and storing big data when and where required.

Redundancy

Is your provider able to achieve all-encompassing redundancy, including every aspect from incoming feeds through teleport delivery? 2N redundancy should be achieved for each aspect of service, including electrical feeders, converters, power distribution, UPS (uninterrupted power supply), environmental controls (e.g., air conditioning within control and data centers) and cooling towers. Big data doesn't tolerate bottlenecks or breakdowns.

Scope

Is your provider deployed across the globe? Do their transport capabilities permit point-specific transfer and delivery within remote regions? The goal is to achieve maximum or optimal coverage with the least amount of high-performance antenna and satellite equipment. Doing so reduces the volume of control and maintenance, while allowing operations staff to focus and isolate efforts on a few key pieces, rather than many. Big data is everywhere and should be accessible at any point, when required, with optimal efficiency and delivery.

Cost Control

Is your provider effective at leveraging technology to minimize or reduce cost of service? For teleport providers, one particularly expensive area of business is satellite capacity. A small number of providers (including EMC) work to identify and develop platforms that drive reductions in bandwidth, thereby reducing the burden and associated costs of satellite usage. These cost control initiatives are popular within the industry and among customers and prospects. Bandwidth cancellation appliances, such as EMC's NRS, are saving MHz for dozens of satellite links. As big data continues to grow, research and development that leads to more efficient and less burdensome means of transporting data will be of ever-increasing importance.

Staying Ahead Of The Curve (Cont.)

Connectivity

Does your provider's capability extend to fiber deployment? Leading teleport providers invest in optimal connection with fiber optic POP (Point Of Presence) rings to enable robust accessibility and performance for customers via the Internet. These rings typically provide superior POP connectivity for critical business functions (e.g., transactions, monitoring, continuity). Engaging and monitoring fiber optic requirements translates to superior big data delivery and service across the board.

Emerging Markets Communications (EMC) has made a significant investment to its teleport infrastructure in Raisting, Germany, to accommodate the growing data requirements of customers. Aside from the massive size of these teleports with antennas ranging from 11 to 32 meters in size, they are fully redundant and serve as disaster recovery for customers. EMC provides service from a semi-exclusive satellite band (extended band) that is less crowded than the traditional C-band, with far less interference. This strategic decision required an investment in the existing teleport infrastructure that included new fiber, up and down converters, and high powered amplifiers. EMC is dedicated to future-proofing its communications solutions to meet the trending requirements of customers.

About the author

Blake Mclane is the President of Emerging Markets Communications Corp (EMC), a global satellite and terrestrial communications company specializing in delivering mission-critical network services for the global energy industry, mobile network operators, carriers, governments, NGOs and worldwide enterprises with locations in the most remote and/or challenging areas of the world. Blake is responsible for continuing to drive global growth for EMC, particularly in the oil and gas industry, with a focus on maintaining strategic operational excellence and innovation for the company.

With more than 20 years of technology expertise, with a specialization in oil and gas, Blake's proven success in sales, marketing and operations within global, national, regional and start-up companies positions him as strategic leader for EMC. An early trendsetter in professional services, Blake is well known in the corporate community for excellence in service delivery and longstanding client relationships.

For more information, visit ***www.emc-corp.net***.

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NSR Analysis
Manufacturing & Launch Services Diversification: Limited, But Necessary

By Stéphane Gounari, Analyst, NSR Ireland

Both the commercial satellite manufacturing and launch services industries now face a low(er) demand period with increasing supply. Albeit difficult, differentiation is more necessary than ever. In both industries, the competitive intensity is already high and should continue to increase mainly due to the following reasons:

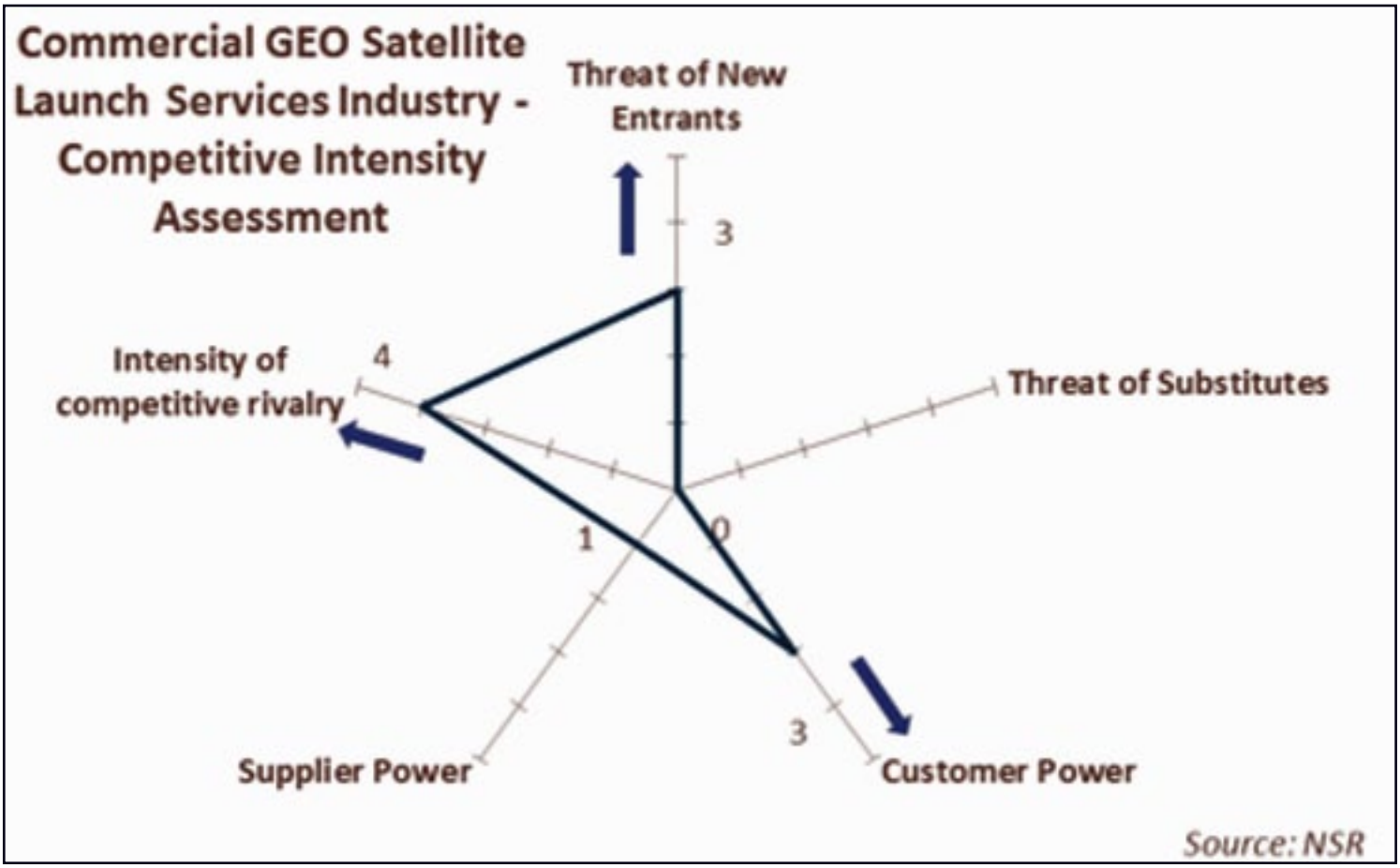
- *Low(er) demand*
- *Significant barriers to exit*
- *New entrants*

In such a context for a player to maintain its revenue, it will require an increase of its market share via two generic strategies: cost leadership and/or differentiation. Cost leadership is always difficult to maintain; in commercial space this seems even more challenging given the lack of volume in the open market, the captive markets that most players enjoy and governments' backing (allowing companies to decrease their prices). Differentiation seems the only way to go, but options are limited.

In the launch services industry, competition mainly rests with reliability and launch cost. The extent to which reliability can evolve is limited as it has a ceiling (100 percent) and a minimum value, given satellite operators won't contract a launch service whose reliability is too low.

In any case, reliability's strength as a differentiator is limited as insurance transfers it into the launch cost. Differentiation must therefore be based on other aspects such as launch capabilities, fairing sizes and additional services.

Making things worse, as satellite operators tend to avoid procuring satellites tying them to one launch services provider, it limits, but does not cancel, the impact of differentiation based on launch capabilities and fairing size.



Arianespace recently announced they were considering the development of a new, longer (19m) payload fairing for Ariane-5, potentially ready by 2015. A fairing of similar length is being developed for Ariane-5ME, potentially ready by 2017. Therefore, this new fairing would be used for a few years only.

The main rational announced for this improvement is to better address electric/hybrid satellites, which are expected to be bigger than chemical satellites. But it may also be a reaction to Proton's new fairing, to be ready in 2016, featuring a diameter similar to Ariane-5's.

Arianespace's urge to develop a longer fairing may therefore be based on a differentiation strategy, to stay one step ahead of its main competitor.

The satellite manufacturing industry features an increasing differentiation potential, mainly platform power, mass and main propulsion capabilities. There are two methods to use power and mass to differentiate: The first one is to focus on a specific segment of the market, without pushing the boundaries but proposing a very efficient product (Orbital Sciences Corporation strategy, albeit changing). The other method is to push the boundaries, to propose platforms with unique payload power/mass. This is SSL's "high-power" strategy (now proposing around 20kW of payload power). This is however limited by the launch services supply (mass capabilities).

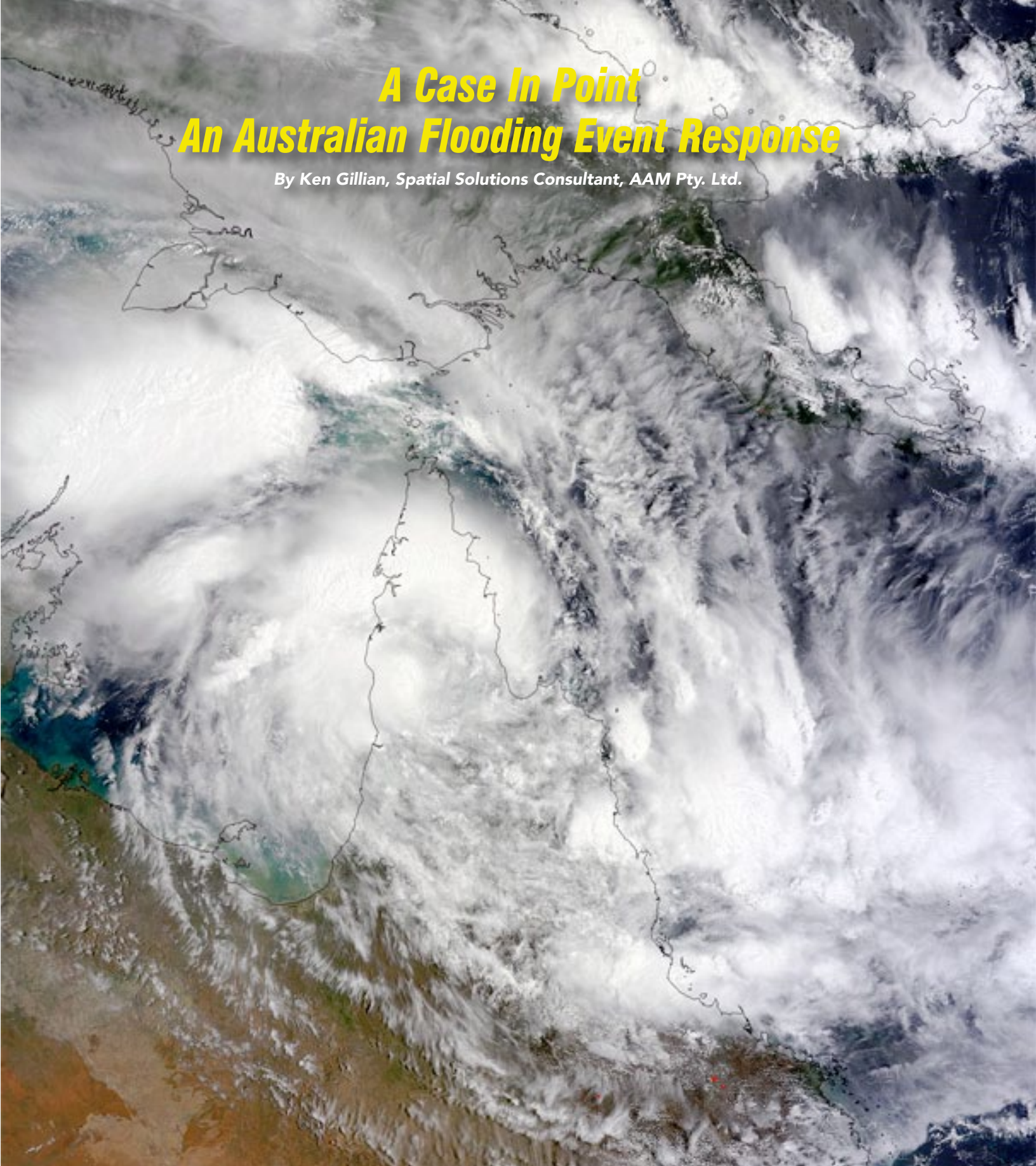
Boeing's introduction of an all-electric platform boosted propulsion as a differentiating factor by proposing a platform with a much better mass/power ratio (but with downsides). If all-electric platforms may not be the way to go, Boeing's move clearly impacted the differentiation aspects.

Given the context, competition is high and will continue to increase. Satellite manufacturers and launch services providers will have to differentiate their products or prepare for the consequences of being stuck in the middle (competition based on price). They will have to be innovative and regularly find new ways to differentiate, ultimately for the satellite operators' pleasure.

Editors note: Information for this article was extracted from NSR's report ***Satellite Manufacturing & Launch Services, 3rd Edition***

A Case In Point
An Australian Flooding Event Response

By Ken Gillian, Spatial Solutions Consultant, AAM Pty. Ltd.



On January 22, 2013 the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Terra satellite flew over a weakening Tropical Cyclone Oswald over northeastern Australia. At that time, the center of the system hovered over the York Peninsula of Queensland, while associated clouds and rain bands stretch northward across Papua New Guinea.

Natural disasters are an all too familiar occurrence for those living throughout Asia and the Pacific region of the world. In 2013, a number of isolated and extreme weather events have occurred that have had a dramatic impact on the region and its people.

In January, areas of Queensland and New South Wales, Australia, were struck by ex-Tropical Cyclone Oswald. This event produced unprecedented volumes of rain that resulted in major flooding across the region.

The swift, changing, and often unpredictable, nature of such severe weather events is what drives emergency management agencies to ensure the force and impact to communities and livelihoods are minimized as much as possible.

Preparedness is crucial. Authorities need timely access to a range of GIS data to help with planning and decision-making processes to ensure the initiation of coordinated responses and the community remains well informed and safe throughout the emergency situation.

As one of the largest geospatial companies in the region, AAM has more than 50 years of experience capturing, monitoring and interpreting the state and condition of the environments that make this part of the world so truly unique. The company was able to quickly recognize and understand the threat that ex-Tropical Cyclone Oswald posed and the needs of the responding agencies.

With access to a broad range of ground, air and spaceborne imaging systems, AAM was quickly engaged by local, state and federal government agencies to implement a multimodal approach to data acquisition for designated high risk areas. The company was also asked to develop and implement innovative data hosting and distribution to users via OGC Web Mapping Tiling Services (WMTS) through the AAM GeoCloud service.

In addition to the mobilization of aircraft, AAM immediately contacted its satellite imagery partners and arranged for the worst affected areas (Grafton, Bundaberg and Rockhampton) to be acquired. Fourteen satellites, one plane and a dedicated team of specialists were all committed to the task.

DigitalGlobe and RapidEye each committed their constellation of high-resolution satellites to the acquisition of optical, multispectral imagery. Recognizing the difficulty in acquiring optical aerial or satellite imagery in the wake of a cyclone, AAM also engaged with e-GEOS, whose constellation of high to low resolution radar satellites, COSMO-SkyMed,

Figure 1. WorldView-2 acquired satellite image, 50cm, of the Rockhampton Airport in Queensland, February 2, 2013.

An Australian Flooding Event Response (Cont.)

can acquire imagery during daylight and evening hours and—perhaps most importantly—the ability to penetrate cloud layers.

When the request for imagery was received from the federal agency, Geoscience Australia, via the Optical, Geospatial, Radar and Elevation Panel (OGRE), AAM was able to draw from an extensive catalog of images.

After presenting a number of options for optical imagery at Rockhampton and Grafton, Geoscience Australia agreed to procure a WorldView-2 image at Rockhampton acquired on February 2, 2013, which clearly demonstrated the dramatic transformation that occurred within the space of only three weeks. *Figure 2* accurately reflects the state and condition of the Rockhampton township on January 14, 2013. *Figure 3* helps to clearly illustrate the sudden transformation, scale and intensity of the event that followed, mere weeks later.

AAM immediately notified partner DigitalGlobe of its needs and began preparation of the relevant order files to ensure teams in Australia, Singapore and the U.S. could position resources as well as process requests with the high level of urgency needed. The key tasks and milestones achieved were as follow:

- *Notice to proceed confirmed on Tuesday, 5 February at approximately 4:00 p.m.*
- *AAM submitted the request to DigitalGlobe and confirmed the requirements by 9:45 pm on the same day*
- *Imagery available for download via secure FTP on Wednesday, February 6 by 8:00 a.m. AEST*

AAM is proud to have collaborated and participated with the large number of agencies who worked tirelessly to respond to this event and others within the Asia-Pacific region and other geographies.

AAM provides a diverse range of geospatial services and technology, including land survey, aerial and satellite mapping, as well as GIS solutions to industries that include mining and minerals, energy, infrastructure, utilities and government.

The company also recently announced its merger with Vekta Pty Ltd., as part of a major investment in Australia's geospatial sector. This merger provides AAM with the critical mass to make further investment in the rapidly growing geospatial sector and to continue to provide geospatial services to federal, state and local governments in the Australasian, Asia Pacific and African markets.

For more information, please contact
info@aamgroup.com

About the author

Ken Gillian is a Spatial Solutions Consultant at AAM, based in Australia and has more than 10 years of experience in the geospatial industry. Ken has specialized in the area of satellite-based remote sensing and currently supports vendor relationship and account management, data procurement and marketing functions of the business for AAM. Ken has attained experience with a number of optical and radar Earth observation systems including satellites operated by DigitalGlobe, RapidEye, e-GEOS, JAXA and developed core skills in a range of GIS and photogrammetric programs. Ken and the broader AAM team develop fit-for-purpose solutions for a wide range of applications that meet the needs of organizations across government, private and educational sectors.

Figure 2 (left). WorldView-2 satellite image, 50cm resolution, of Rockhampton, Queensland, acquired on January 14, 2013.
Figure 3 (right). Worldview-2 satellite image, 50cm resolution, Rockhampton, Queensland, acquired on Febuary 2, 2013.

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This year, the course is moving to a new location in Oxfordshire. Now located close to the **Satellite Applications Catapult Centre** in Harwell, the course will include a tour of the centre and hands-on demonstrations of the facilities.

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SatBroadcasting™
News Corp.—The Next Step, BSkyB? Not "If," But "When..."

By Chris Forrester, Senior Contributor

June was a busy month for Rupert Murdoch. Prior to announcing his divorce from Wendi Deng on June 13th, on June 11th News Corp's shareholders approved the company's plan to divide itself into two entitites, effective as of June 28th.

The split of News Corp.—not from Ms. Deng—means the much talked-about, and somewhat toxic, publishing arm of News Corp. will separate from the broadcasting and film divisions, hereinafter to be called 21st Century Fox.

"We are pleased that the proposals have been approved by an overwhelming majority of the outstanding shares, and that our shareholders clearly recognize the anticipated benefits of the separation," News Corp. chairman and CEO Rupert Murdoch said in a statement. "We are on track to complete the separation on June 28th and look forward to launching two new industry leaders."

That may be true, but it also removes a lot of baggage from the 21st Century Fox operation. Out goes the myriad hacking and corruption scandals (with many of the U.K. accused now appearing in the U.K. courts). While such will not wipe the slate clean, as far as Mr. Rupert and Mr. James Murdoch are concerned, it does. And, at the very least, this move does permit 21st Century Fox to start planning for an acquisition of the 60 percent of BSkyB that it does not already own.

Rupert Murdoch at the 'SKY'' launch

A young Murdoch, a believer in satellite broadcasting.

That's the view of analysts at Miami-based investment bank Espirito Santo which, in a recent update, gave BSkyB a target price of 990p, a 26 percent premium over current levels and a potential market capitalization of a spectacular 16 billion pounds (or US$24 billion).

News Corp. initiated its pursuit of BSkyB in 2010 (at 700p a share). However, local opposition in the wake of the News of the World hacking scandal forced the company to abandon that attempt. A threat by the U.K. broadcasting regulator OFCOM that they could start an investigation as to whether Rupert and James (and, by implication, News Corp) were 'fit and proper persons' to hold a U.K. broadcasting license led to BSkyB passing that test with flying colors and won praise for the manner in which Sky itself had stayed aloof and untainted by the News of the World problems.

Where are we now? The News of the World is dead and gone. Those accused are now threading their way through various court appearances—and possible jail sentences. News Corp.'s interest in BSkyB is no more, or won't be after the June 28 split.

James Murdoch and Chase Carey have both referred to the BSkyB bid as "unfinished business." The question for Murdoch-watchers is whether a bid for BSkyB might happen ahead of a U.K. general election (in May of 2015), or whether 21st Century Fox will await a new U.K. government.

The problem for 21st Century in bidding for the remainder of BSkyB is that there remains in the U.K. as sort of an unwritten rule that acquisition should be by 'anybody but Murdoch,' as far as progress in British media is concerned. Now News Corporation will own The Times (of London) and The Sun, and has a zero connection with 21st Century (other than the Murdoch name), it will be interesting to note how the U.K. 'Establishment' handles any sort of bid by 21st Century Fox for BSkyB.

It's not as if we have not been down this road before. Attempts by the—then—News Corp to enlarge its influence were totally thwarted.

"The split should isolate BSkyB from any potential risk attached to the result of the News of the World investigation—and may open the way to a new bid for BSkyB, in our view," analysts at Espirito Santo said in a note. They raised their target price to 990p a share, an offer which would value BSkyB at nearly 16 billion pounds.

In 1997, BSkyB formed a partnership with Carlton TV and Granada to bid for the U.K.'s digital terrestrial licence (ONdigital). The regulator ordered BSkyB out of the

The Next Step, BSkyB? (Cont.)

Despite the hype surrounding News Corp.'s expected foreign bribery settlement, experts said last week that U.S. and British prosecutors may allow Rupert Murdoch's media empire to escape criminal charges and pay a Foreign Corrupt Practices Act financial sanction that falls well below record levels. News Corp. is in the process of negotiating a settlement with the U.S. Department of Justice (DoJ) to resolve bribery allegations that came to light during the phone-hacking scandal. If correct, this will see another potential problem eliminated for the firm.

consortium, which subsequently failed. Since then, there has not been a single year wherein BSkyB was not under some sort of investigation. In some years, there have been two or three sets of legal enquiries into one aspect or another of Sky's activity. In other words, whatever Rupert Murdoch does, and no matter what hat he might be wearing, any bid for BSkyB is going to be minutely examined by U.K. regulators, Parliamentarians, and rival media concerns, as well as the European Unnion Regulatory Commission (which passed the 2010 application).

However, the prize, if he can achieve the acquisition, would be a huge "win." Murdoch could then consolidate his European Sky broadcasting assets under one umbrella and probably float the lot off independently from 21st Century Fox.

Another variation on this theme might be some sort of European reverse acquisition. Readers with a long memory will recall the attempt back in 1996 to launch a European-wide payTV system—this had Canal Plus and Bertelsmann as participants, along with BSkyB and Havas. That came to naught, so Murdoch tried once again.

In late 1998, he launched News Corporation Europe. Rupert Murdoch invested in a grand statement at the Savoy Hotel, London where he made a few vague promises to expand his News Corp. media empire into mainland Europe—and instantly wiped 8.5 percent off Canal Plus' share price (Nov. 23, 1998). Murdoch at the Savoy press conference said News Corp Europe (NCE) would not have a set budget but, instead, would examine each project on a case by case basis. Canal Plus, at the time, made no response to Murdoch's announcement.

The first step, he said, would be an Italian payTV joint-venture, then NCE's first specific project would be a new channel, established with Paris-based network TF1 and targeted at 15 to 24 year olds, due to launch in 2000 on the Television Par Satellite (TPS) payTV bouquet. Mrs. Letizia Moratti, formerly head of Italian pub-caster RAI, was to be chairman of NCE and would join the main News Corp. board and that of BSkyB. Murdoch said BSkyB would be welcome to join the new Europe-wide venture as partners, "if that was the decision of the board of BSkyB." That enterprise attempt also came to naught.

To bring the story up to date, we all know how successful Murdoch's operations are in Germany and Italy. Both have more work to do, however, few would doubt the wisdom of Murdoch's longer-term vision. News Corp. has extended its interests beyond Europe's natural borders and into the Middle East with Prince Alwaleed Bin Talal's Rotana Group, or in places such as Afghanistan (with Moby), as well as with TataSky in India and Star TV.

In other words, Murdoch is already ahead of the game, and no doubt could derive a scheme to by-pass the pesky London regulators, and center his 21st Century Europe operation somewhere else. In tax-friendly Luxembourg, perhaps? You never can tell!

However, getting back to the 'anybody but Murdoch' threat from the British government, it emerged on June 14th that a future Labour government would slap a new cap on cross-media ownership—clearly with Murdoch in its regulatory sights. The next two years will certainly be interesting, not the least for an unencumbered Rupert Murdoch who is out to achieve a lasting legacy in Europe.

Murdoch, with Prince Alwaleed bin Talal, one of the richest men in the world.

About the author

Senior Contributing Editor Chris Forrester is a well-known broadcasting journalist and industry consultant. He reports on all aspects of broadcasting with special emphasis on content, the business of television, satellite broadcasting, and emerging applications. He founded Rapid TV News and has edited Interspace and its successor Inside Satellite TV since 1996. He also files for Advanced-Television.com. He was also appointed an Associate (professor) of the prestigious Adham Center for Television Journalism, part of the American University in Cairo (AUC), in recognition of his extensive coverage of the Arab media market.

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Inmarsat's Rocket Science Made Simple Satellite Connectivity For Aviation Explained

By George Nicola[1] and Michele Franci[2]

Any satellite communication system is required to balance bandwidth and power distribution over the coverage defined by its target market. Inmarsat has been operating global satellite communication systems servicing the mobile market space, including aviation, for more than 30 years. In this article, the differences between the current and upcoming satellite communication networks are explained to potential users to allow an accurate assessment of which offering could satisfy their communication needs.

The Inmarsat-5 network will offer global coverage via three, geostationary Ka-band satellites, providing uniform coverage in both bandwidth and power with the flexibility to move bandwidth into regions where traffic requires it. The selected spot beam architecture supports an uniform distribution of power, allows for frequency re-use and, ultimately, allows a consistent end user experience.

Couple this with a complete turnkey satellite and ground infrastructure with everything owned and operated by a single entity and built for scalability, resilience and performance, and there will be clear differences in the resulting service offering and reliability between this constellation, built for mobility from the outset, and that of the existing Ku-band service providers. Generally speaking, these providers collate patchwork networks through third party agreements with multiple satellite operators with systems that were originally deployed to address alternative communication needs.

Introduction To Communications Channel Theory

Before assessing the performance of any communication channel, it is essential to understand the communications systems governing theory. Shannon's Theorem [1] gives an upper bound of the throughput capacity of a link in bits per second (bps), as a function of the available bandwidth and the signal-to-noise ratio.

$$C = W \log_2\left(1 + \frac{P}{N}\right)$$

Where

C = Transmit rate (bits per second)

W = Bandwidth

P = Power

N = Noise

The theorem shows that there are only three key parameters that can be manipulated in order to optimise the capacity of a communications link: Bandwidth, Signal Power and Channel Noise. Communication channel providers develop their technologies in order to achieve the optimal link capacity based on their market needs and this document examines the Inmarsat-5 optimisation with a view to serving the mobile communication market.

Signal Power + Distribution

$$C = W \log_2\left(1 + \frac{P}{N}\right)$$

The formula above shows that an increase in the transmit power level results in an increase of the communication link throughput, likewise a decrease in power will result in the opposite effect reducing the throughput. Power can be independently adjusted in both the forward and return link directions.

Signal Strength Impact Explained

As an example, the higher the output power at the transmitting antenna, the higher the modulation coding rate that can be achieved and ultimately the higher data rate can be realised for the user. Another way to improve the link throughput would be to increase the size of the receiving antenna in order to have a higher level of energy received at the aircraft; this is where operational constraints become apparent, as, this would lead to an unfeasible installation for a commercial or business aircraft.

It would also be possible to increase the signal strength from the satellite; however this would mean focussing the satellite spot beams over a smaller area to the detriment of the overall satellite coverage as on-board power cannot be increased freely, due to satellite power being limited; similarly power in any single spot beam cannot be increased freely due to the limitations in space qualified amplifier equipment availability. In the opposite direction, i.e. from the aircraft to the satellite, the transmitted power is limited by regulatory requirements meant to protect adjacent satellites from harmful interference and therefore must be properly managed.

The Inmarsat-5 satellite constellation provides a global coverage through a combination of two on-board communications payloads, the Global Service Beams (GSB) and the High Capacity Payload (HCP). The GSB payload uses small spot beams (approximately 2 degrees wide) to build the global coverage footprint and uniquely distributes the power

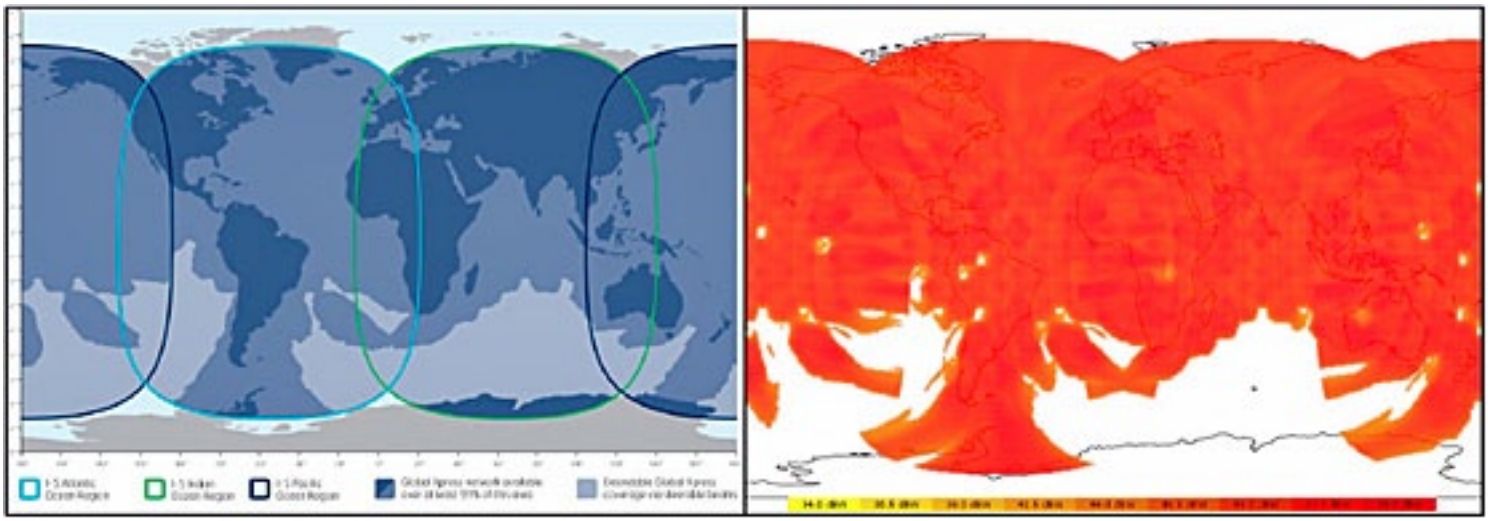


Figure 1. Inmarsat 5 Coverage and Power Level Distribution[3]

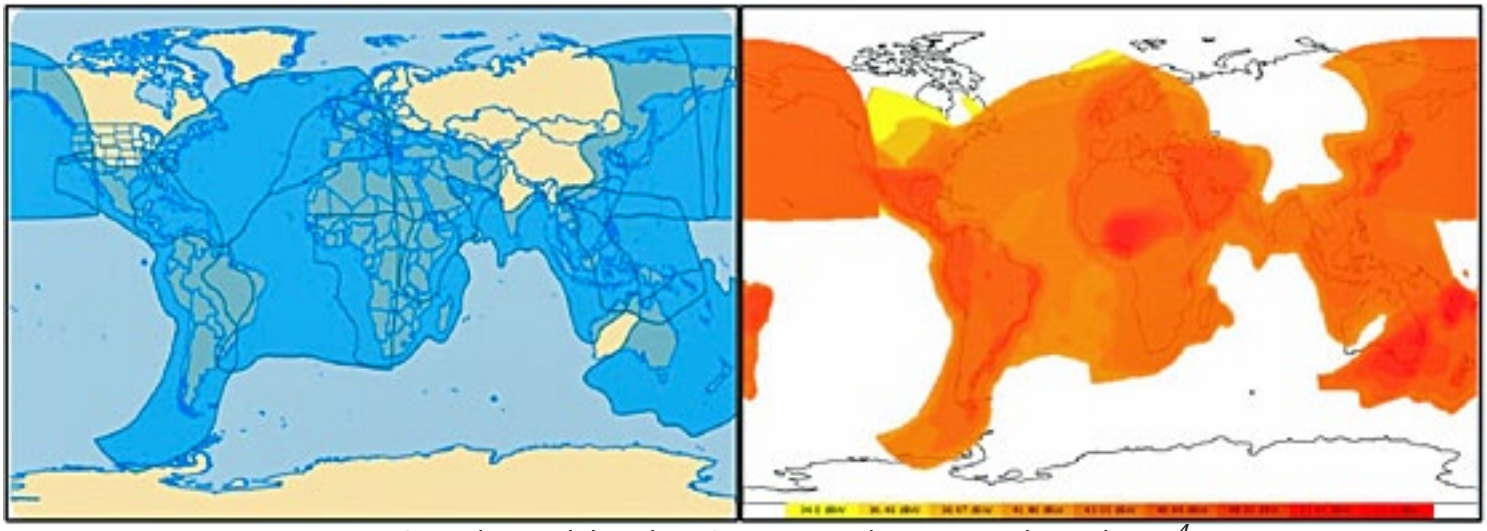


Figure 2. Intelsat Mobility Fleet Coverage and Power Level Distribution[4]

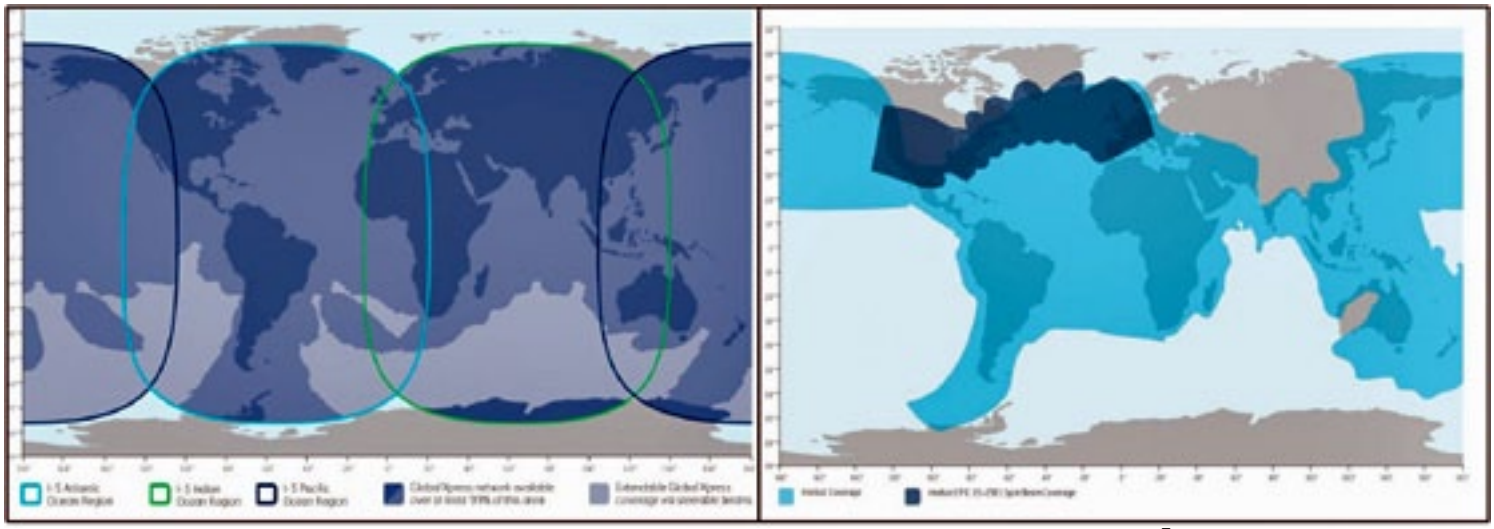


Figure 3. Inmarsat-5 and Intelsat EPIC High Throughput Spot Beams[5]

evenly across their footprint. With the lattice of spot beams established, the result is a higher, more focussed power for use. The GSB is then supplemented by the HCP which can independently steer six ~1.2- degree wide beams, every beam supporting 8 x 100MHz channels, on each satellite across any area that requires additional capacity on demand. *Figure 1* on the previous page shows the global coverage of the constellation and the power level distributed by the GSB payload only.

This spot beam architecture is in contrast to all existing Ku-band satellites that utilise wide beams to provide their regional coverage. The wide beams have in general a lower overall power density and higher variance of power across their footprint. *Figure 2* on the previous page shows the footprint and power levels across the Intelsat mobility fleet.

The coverage charts show that Inmarsat-5 offers a greater global service, however it is also clear from the plotted power levels that the average power available for use on the Intelsat wide beams is considerably lower than for Inmarsat-5. The result is lower throughput for the users on the Ku-band network and the higher variance of power results in a varying end user's experience as the user moves within the beam.

As described in public information, Intelsat EPIC is Intelsat's upcoming new generation satellite constellation, operating in Ku-band, with one satellite under construction (IS-29e) and one other planned. This satellite will offer spot beam coverage, similar to Inmarsat-5, over some of the North Atlantic air routes and overlay a wide beam for the remainder of its coverage region. This scheme will result in high power and performance in some areas and lower performance in others. *Figure 3* on the previous page shows a comparison of the wide beam Intelsat coverage (light blue) with the IS-29e EPIC spot beam coverage (dark blue) overlaid next to that of Inmarsat-5.

Bandwidth Availability + Management

$$C = W \log_2\left(1 + \frac{P}{N}\right)$$

Within Shannon's Theorem it is shown that another means of increasing the upper bound of the communication link is to increase the bandwidth.

Bandwidth Contention Explained

To understand how bandwidth can be maximised within a communication channel, it is important to consider the issue of bandwidth contention. This is effectively like an airline deliberately overselling tickets on a particular flight on the premise that not everyone will arrive to travel, however when everyone does, someone must be left behind.

Telecommunication spectrum is a scarce resource, and therefore spectrum allocations are used to saturation by the operators.

Inmarsat-5 operates in Ka-band which not only has a larger frequency allocation (approximately 9 times larger depending on the region of operation) but is also still relatively unoccupied compared to the Ku-band. *Figure 4* below shows the difference in allocations between the bands.

As discussed in the previous section, Inmarsat-5 operates a spot beam architecture that allows a uniform distribution of capacity and bandwidth. The constellation evenly distributes capacity across the GSB spot beams and implements a seven colour frequency re-use scheme to allow for frequency re-use to be implemented and further optimise the allocated spectrum. Where traffic profiles demand, the GSB spot beams can have a further transponder assigned as required and if the traffic profile still demands additional bandwidth the HCP can steer a beam into the area to

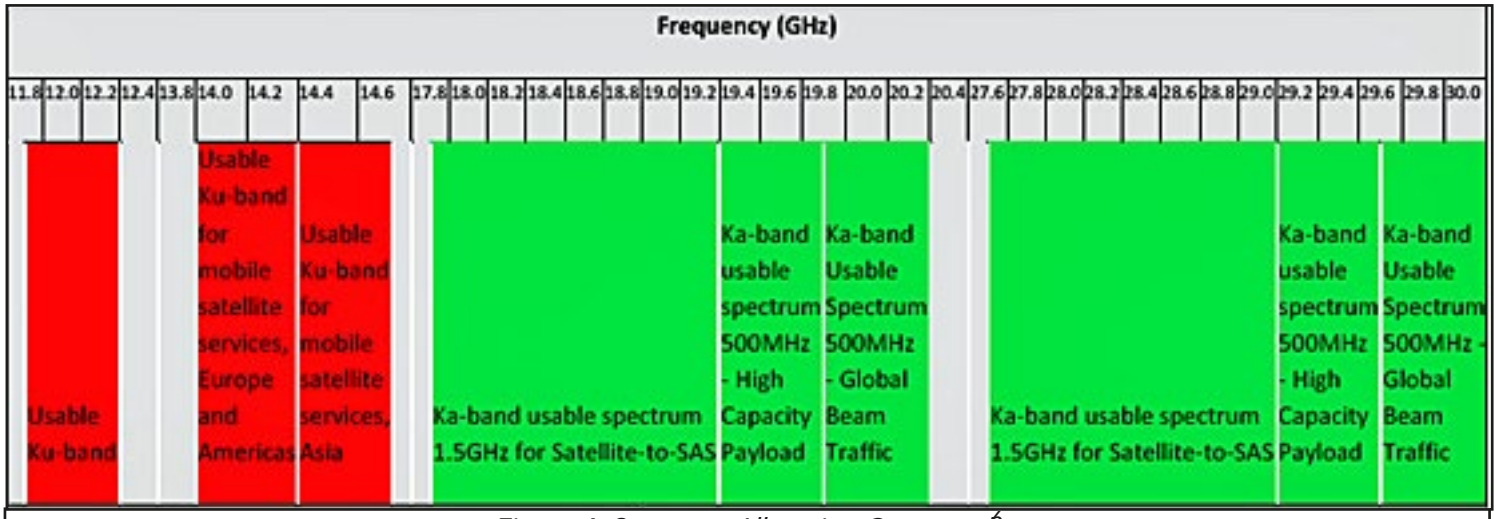


Figure 4. Spectrum Allocation Compared[6]

accommodate the additional users. To quantify this overall bandwidth capability, a single GSB beam can provide up to 50Mbps, therefore where a second transponder is assigned a further 50Mbps will be available and the HCP could add up to an additional 120Mbps for every allocated channel (of which there could be eight simultaneously) in a given region.

On comparison of Ku-band wide beam coverage to that of the Inmarsat spot beams covering the same area, it can be shown that the Inmarsat-5 constellation will apply more capacity in any one region than the equivalent Ku-band satellite. This is shown in *Figure 5* along with a comparative capacity calculation. Due to the larger Ka-band frequency allocation and that these allocations are not currently being shared, the chances of bandwidth contention are reduced significantly. The competing Ku-band systems are disadvantaged by their saturated frequency band and by the density of Ku satellites already deployed along the GEO arc which do not provide sufficient and adequate "free slots" to accommodate forecasted and in some cases current traffic demands. We believe the availability of Ku-band transponder capacity for aviation service providers is already limited in many geographical areas.

Like For Like Capacity Calculation

The below example provides the transponder capacity calculation available within the two example satellite regions shown within *Figure 5*. below. It is important to note that Ku-band satellites such as IS-22 share transponders for traffic in both directions; Inmarsat-5 has independent transponders for each traffic direction.

- ***Ku (IS-22)***
  - » *12 x 36MHz = 432MHz*
  - » *Shared amongst various services including fixed satellite services i.e. TV and media*
- ***Inmarsat-5***
  - » *38 spot beams cover the same regions*
    - ◊ *2 x 32 MHz x 38 beams = 2.4GHz*
  - » *Additional scalable High Capacity Overlay available with up to 8 x 100MHz channels available in a specific region*
    - ◊ *2 x 100MHx x 8 channels = 1.6GHz*
  - » *Dedicated to mobile service use*

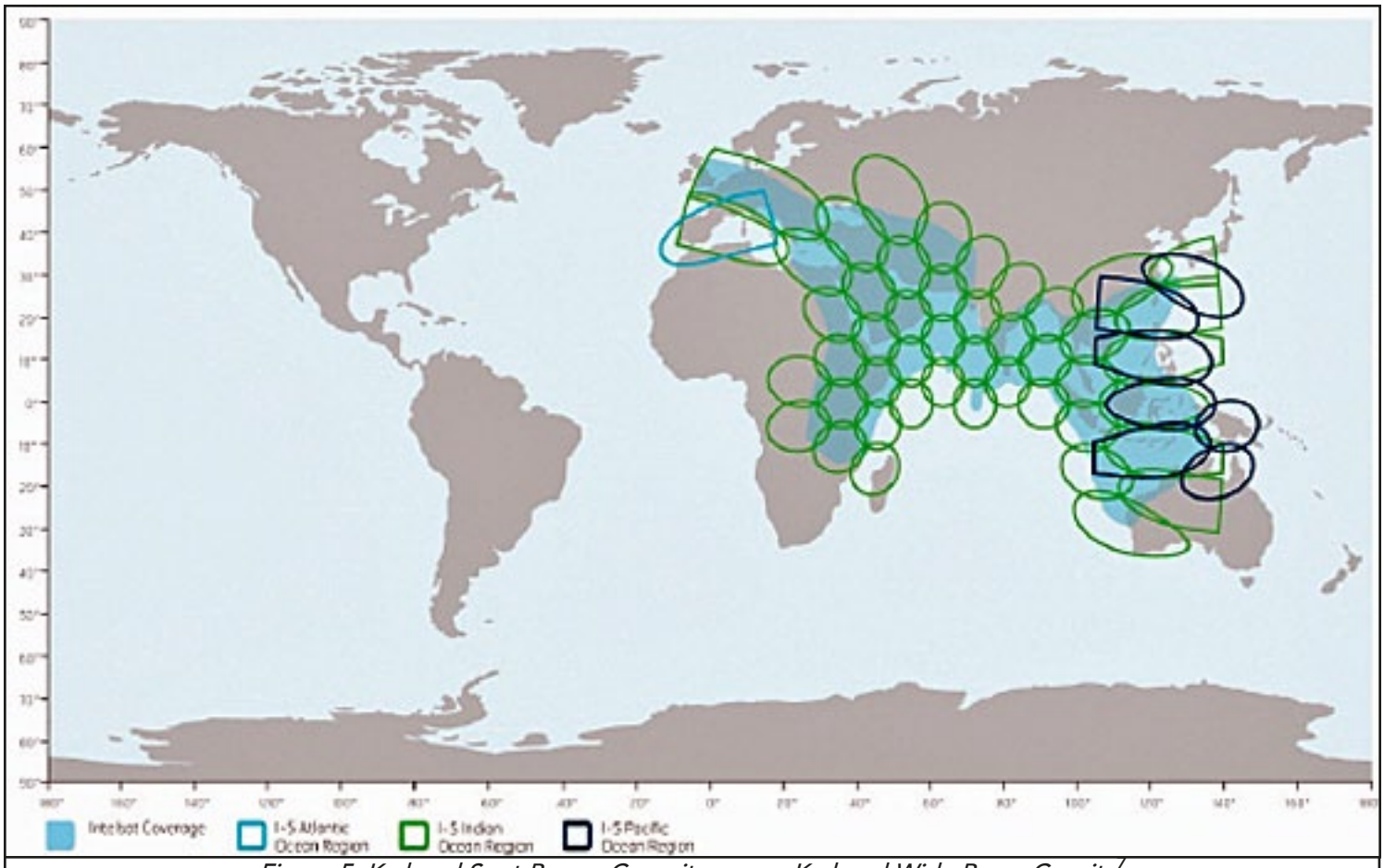


Figure 5. Ka-band Spot Beams Capacity versus Ku-band Wide Beam Capcity

The example shows Inmarsat-5 has almost six times more capacity assigned within similar regions of satellite coverage with the GSB beams that can then be further supplemented with HCP beams if the traffic profile demands.

Public information reflects that the upcoming Intelsat EPIC satellites will focus bandwidth into the spot beams covering some of the North Atlantic flight routes and then have capacity within a wide beam for the remainder of its footprint. The transponder sizes and bandwidth management scheme of the upcoming satellite has not been published and therefore it is very difficult to fully assess the capacity of the channel.

This configuration may raise its own issues in terms of bandwidth contention however, as where there is an overlay of spot beam to wide beam, frequencies cannot be shared. From available public information, we believe the IS-29e may therefore run into frequency constraints, unless a new method of frequency management is planned but not yet disclosed.

Network Technology Advantages

The Inmarsat-5 ground segment is based on the latest version of the highly successful iDirect Evolution platform, not available to other users. This significantly increases the channel density supported on each piece of hardware. The system supports seamless handover between beams and load balancing of users among multiple channels in the same beam, all of which requires a new approach to system scalability.

The network will consist of three pairs of Satellite Access Stations (SAS) located around the globe, with each pair serving one satellite to provide rain-fade protection through diversity of the feeder link, and complete failover in the event of a catastrophic disaster. SAS sites and strategic network peering points are connected together in a redundant global ring.

The Inmarsat-5 constellation, terminals and ground network have been designed and implemented with mobility as the primary application with the global coverage and high performance spot beam architecture as described within this paper only part of the overall system advantage.

The entire end-to-end system is built and owned by Inmarsat, with the ground infrastructure duplicated in each region. This end to end approach delivers a more resilient, higher performance and more cost effective network than other solutions that interconnect leased capacity from multiple satellite providers across their respective regional coverage. This benefits the end users through providing a completely homogenous network and terminal infrastructure with seamless handover functionality and all resources managed and controlled from a single point. With each region's ground infrastructure duplicated offering resilience from local interference or equipment failure, the turnkey implementation is very different to the competing mobility offerings from other service providers. Other providers patchwork services together through lease agreements from several satellite suppliers resulting in more complex ground architectures and harder handover co-ordination.

Summary

In summary to the analysis carried out, the authors believe the Inmarsat-5 constellation has clear and significant advantages over the existing and future Ku-band mobility satellite systems. The larger relatively unoccupied Ka-band frequency allocation makes it ideal for global mobility solution. This is because the use of spot beams can evenly distribute higher power levels across the satellite footprint and manage frequency assignments flexibly to suit traffic demand.

This suitability for mobility is further supported by the turnkey implementation approach taken by Inmarsat with all infrastructure owned, operated and managed by a single operator and implemented as a homogenous network with both ground and mobile technologies built by the same suppliers.

The frequencies are allocated and controlled from a single point along with the satellites within the region therefore alleviating any dependence on ad-hoc patchwork agreements between multiple satellite service operators with distributed networks and complex data backhaul architectures attempting to provide a single service to a third party.

Toward the end of the decade, we expect satellite constellations such as Intelsat EPIC will enter into service and move toward spot beams in the Ku-band to increase the power and manage the bandwidth available in specific regions. However, we do not anticipate that these regional based services will answer the call for a global mobile satellite service as effectively as the Inmarsat-5 constellation.

Footnotes

[1] Technical Marketing Manager, GX Aviation – Inmarsat

[2] Vice President Global Xpress Commercial – Inmarsat

[3] Inmarsat-5 coverage and power distribution provided by Inmarsat

[4] Intelsat Mobility Coverage from website, February 2013

[5] EPIC Spot Beam coverage from Apex blog: **http://blog.apex.aero/cms/wp-content/uploads/2012/07/Panasonic-Intelsat-map-2.jpg**

[6] Frequency Allocations governed and published by the International Telecommunications Union (ITU) Radio Regulation Articles 2012

[7] Inmarsat spot beam layout from Inmarsat, Intelsat IS-22 wide beam coverage.

References

C.E Shannon, "Communication in the presence of noise," Proceedings of the Institute of Radio Engineers

Intelsat website: **www.intelsat.com**

APEX Blog: **http://blog.apex.aero**

The Case For Space-Based OTVs

By William J. Ketchum

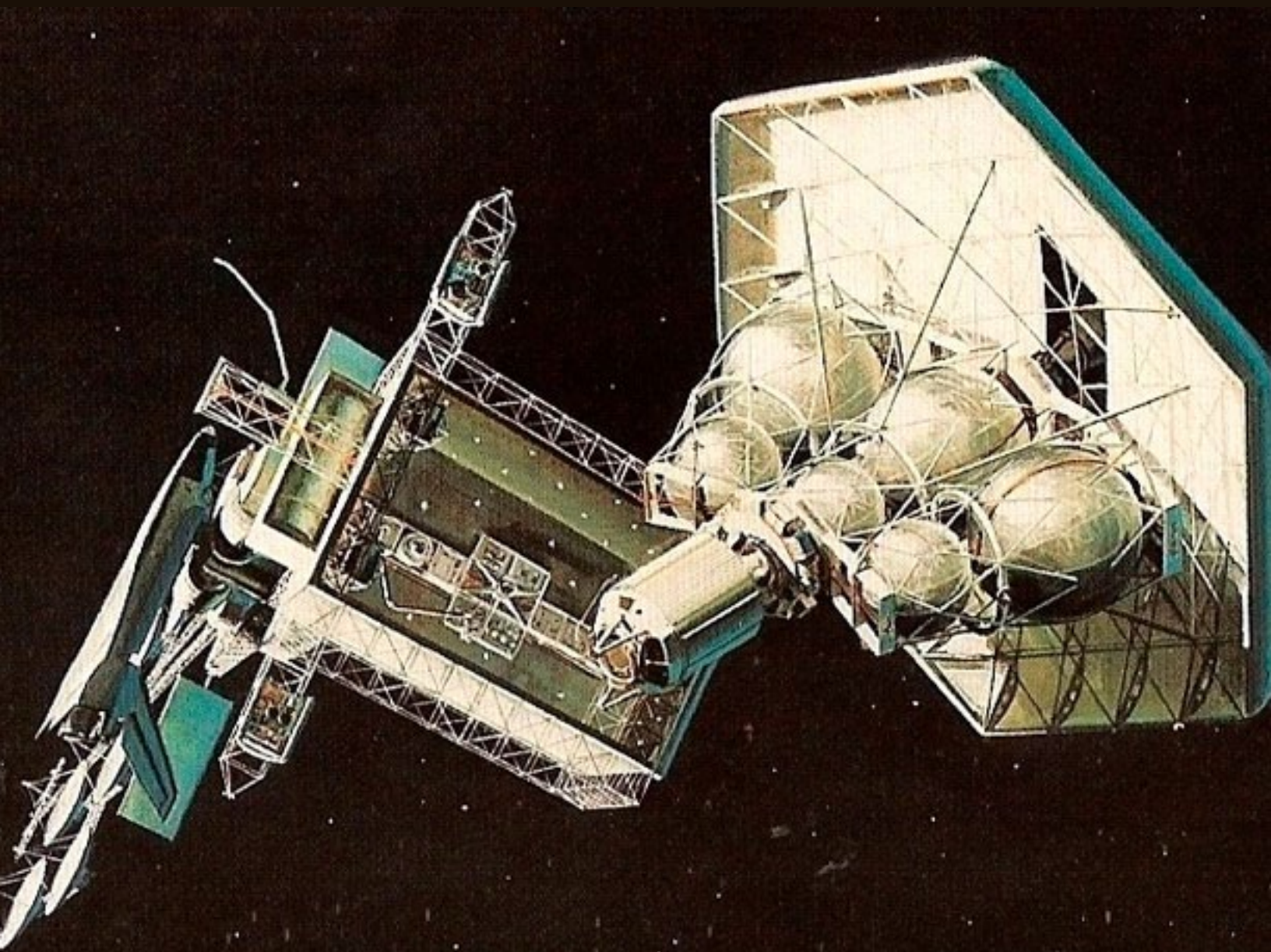
This article will introduce readers to a proposed new concept for delivering payloads/satellites to geosynchronous orbit (GSO) that weigh twice as much—and cost half as much—to launch than with expendable launch vehicles, and to service and refuel satellites on- orbit, and to conduct other missions not currently possible.

Background

There are approximately 300 satellites (communications, navigation, weather, NASA, military, and so on) in GSO, with projections to add new ones to replace aging old ones already in orbit.

The global telecommunications industry alone generates revenues of more than 160 billion dollars annually with a growth of more than 10 percent per year, and represents a total investment of more than US$4 trillion, according to the Satellite Industry Association (SIA). These satellites cost several hundred million dollars each.

Current costs to launch these satellites to Geostationary Transfer Orbit (GTO) using expendable launch vehicles adds another several



hundred million dollars to each mission. Several companies (United Launch Alliance, Arianespace, MHI, Space-X, etc.) are hoping to develop the capability to launch heavier satellites to GTO at lower cost by improving on their current expendable launch vehicles (ELVs), such as Atlas V, Ariane 5, H-2A, Falcon 9, and others.

Another approach presented herein is to consider introduction of a reusable space-based orbit transfer vehicle (OTV) to further reduce cost and increase payload weight, and to provide other benefits not possible with expendable systems. The space-based OTV is an evolution of current expendable cryogenic upper stages (such as Centaur) which are currently launched on ELVs (Atlas V, Delta IV, Ariane 5, H-2A, etc.). Each of these high energy upper stages using cryogenic propellants (oxygen/hydrogen) are currently used to transfer payloads/satellites to low earth orbit (LEO) and beyond.

These vehicles are in a different class than current resupply vehicles to the International Space Station (ISS), such as the European ATV, the Russian Progress, the Japanese HTV, the Space-X Dragon, and the Orbital Sciences Corp (OSC) Cygnus, each of which have only a limited capability to operate at LEO.

Solar electric Ion propulsion systems for transferring satellites into final orbits are quite efficient but are low in thrust. They can also require weeks to months to transfer payloads into position—such limits their usefulness for missions that require a much faster response time.

Space-Based OTV

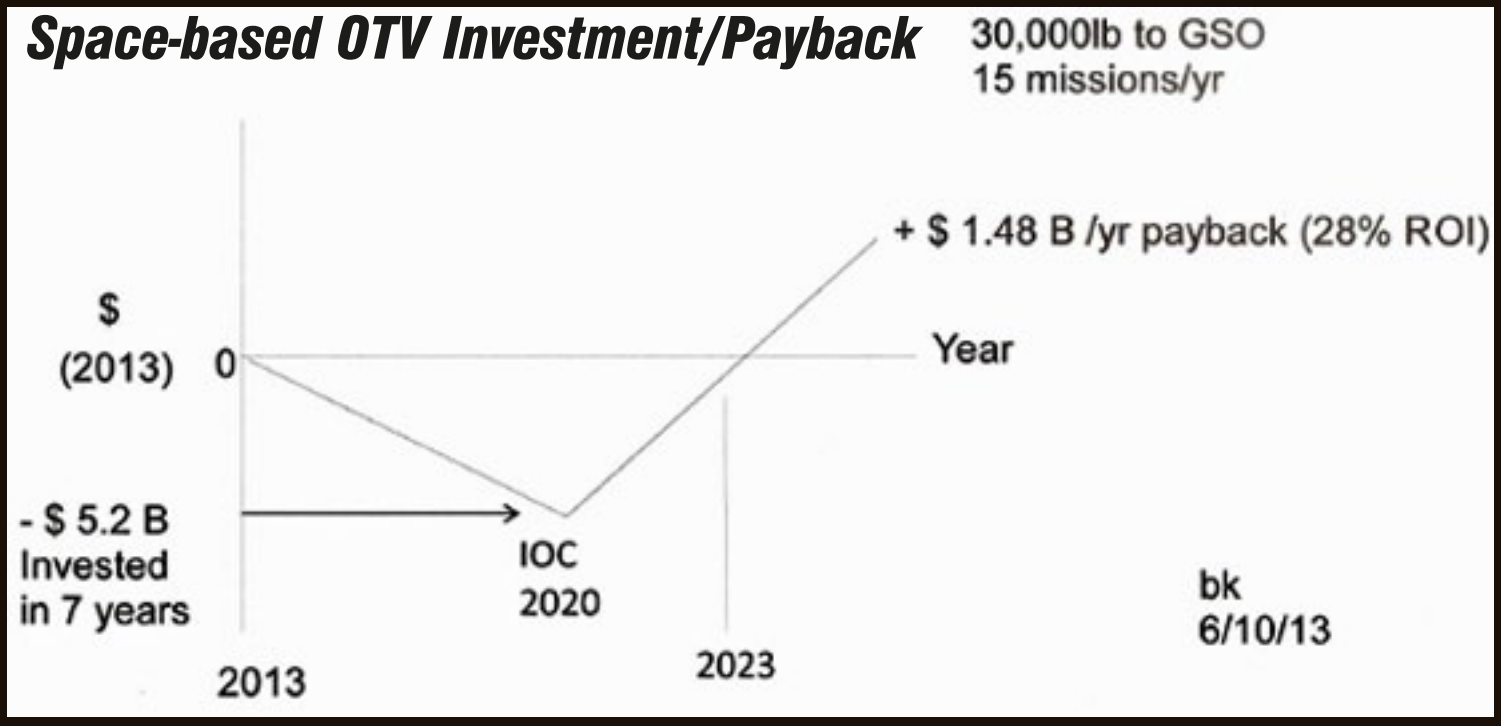
Space-based OTVs offer significant potential economic advantages over ground-based expendable systems, cutting the launch cost in half and doubling the weight of payloads. This is possible because of reduction in Earth launch costs, higher performance vehicle designs, efficient reusable vehicle operations, and lower cost propellant availability.

These OTVs will be based at a LEO facility for servicing, maintenance, and refueling, either attached to the ISS or at a separate dedicated facility. Payloads, and propellants for the OTVs, will be delivered from the Earth's surface to the LEO facility for integration with the OTVs by low cost expendable launch vehicles (i.e., Falcon Heavy) and future Reusable Launch Vehicles (RLVs).

In addition to launching new satellites, servicing and refueling of satellites already at GSO can be provided. This obviates the need for expensive replacement satellites in the event of a minor problem with an otherwise functional satellite. Satellites can also be retrieved and returned to LEO if necessary.

These OTVs can also be used to remove space debris and to capture and move space resources such as near earth objects (asteroids, etc.) to LEO for processing into useful products. Transport of astronauts/tourists from LEO to lunar orbit and return is also possible.

The potential for additional future space operations is expected as increased capabilities develop, such as the basing of a planetary transfer vehicle using advanced propulsion (nuclear) to reduce trip times to Mars and other planets. It is expected that this new capability will interest private sector investors, commercial communications satellite companies, space based solar power (SBSP) and space resource and manufacturing startups, space tourism providers, and others.



The Case For Space-Based OTVs (Cont.)

Aerospace companies such as Boeing, Lockheed-Martin, Arianespace, MHI, Space-X, Orbital Sciences, and other expendable launch vehicle companies, will also benefit from providing increased launch services to LEO.

Previous Studies

OTVs and orbital facilities previously studied in detail for NASA (references 1, 2 and 3), and current NASA research on propellant storage and transfer in space at the ISS, etc., bring us closer to achieving this capability. The prior study efforts compared many concepts in order to find the lowest cost and highest performing system for delivering space payloads to higher orbits beyond LEO. The clear advantage of a space based OTV was the result.

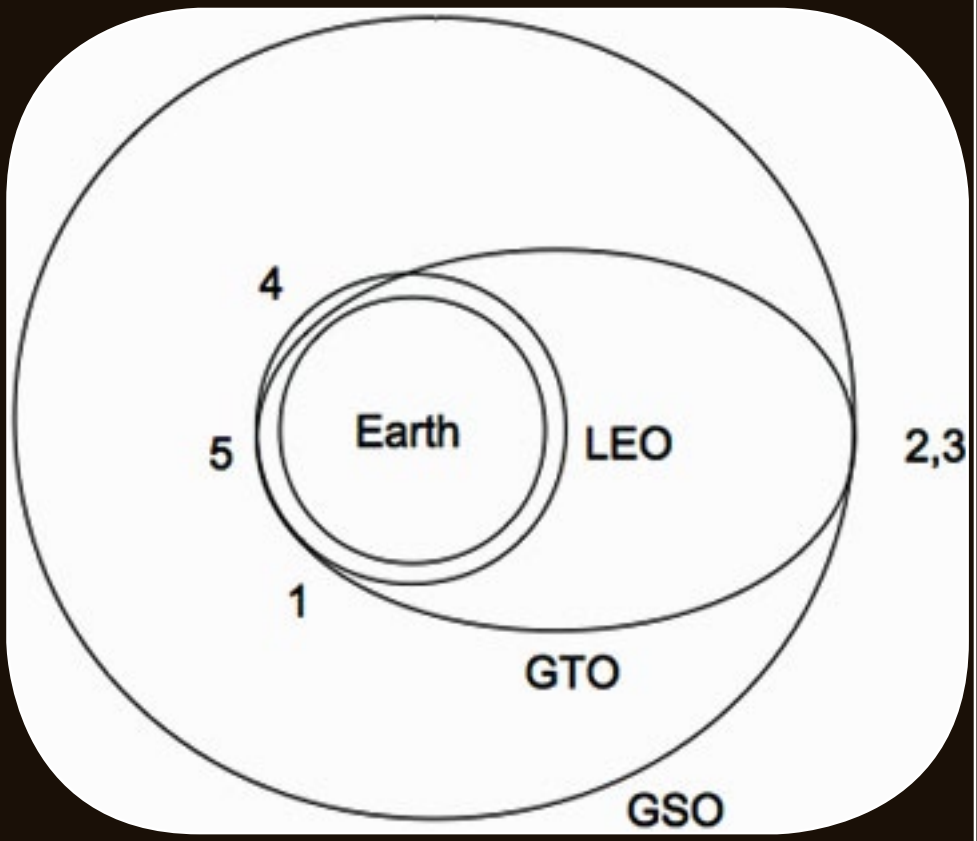
However, NASA elected not to proceed, and the idea was never disseminated to users who could have benefited. That is, until now.

There is currently renewed interest in moving beyond LEO to deliver new heavier satellites to GSO as well as accomplish other missions, such as servicing and refueling satellites, removing space debris, capturing and moving Near Earth Objects (NEOs), such as asteroids, to reduce the danger of Earth impact and to use them as resources for space manufacturing, sending astronauts/tourists to Lunar orbit and back, and more.

In the several decades since these studies were conducted, technology has advanced to such a point that development of the space-based OTV can be expected to proceed with confidence. Also, the ISS now exists, offering the possibility of attaching an OTV facility and increasing the utility and longevity of the ISS.

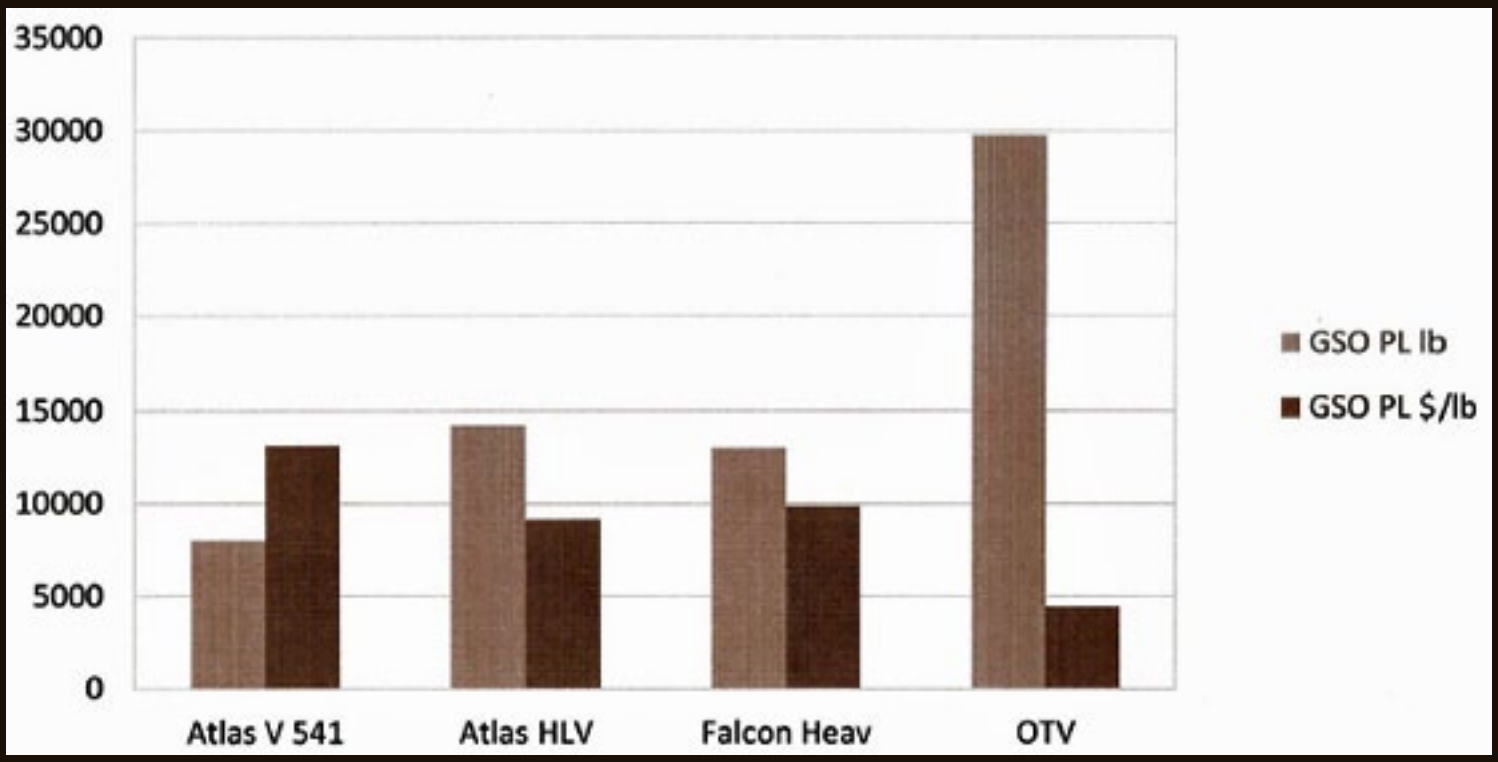
Technology Demonstration

As a first step, demonstration of one of the key technologies needed is aerobraking for the return of the OTV to LEO after mission completion. Aerobraking greatly reduces the OTV propellant requirement by taking advantage of aerodynamic drag to decrease the velocity to re-enter LEO, instead of using the main engines. Aerobraking has been successfully used on previous manned missions to LEO and to the Moon and for unmanned Mars landers. The addition of a new, deployable, geotruss aerobrake to an existing upper stage, such as Centaur, can be accomplished at no risk to the primary mission.



LEGEND

1. *OTV propulsion burn to GTO*
2. *OTV burn into GSO*
3. *OTV de-orbit burn after payload separation*
4. *OTV aerobraking*
5. *OTV circularization burn into LEO*



	LAUNCH COST $M	LEO (28.5 deg) PAYLOAD CAPABILITY LB	GTO (28.5 deg) PAYLOAD CAPABILITY LB	GSO (0 deg) PAYLOAD CAPABILITY LB	LEO PAYLOAD LAUNCH COST $/LB	GTO PAYLOAD LAUNCH COST $/LB	GSO PAYLOAD LAUNCH COST $/LB
ATLAS V 541	105	38456	18270	8003	2700	5700	13000
ATLAS HLV	130	64816	28660	14229	2005	4500	9100
FALCON HEAVY	128	117000	26460	13000	1100	4800	9800
OTV	132			30000			4400

Note:

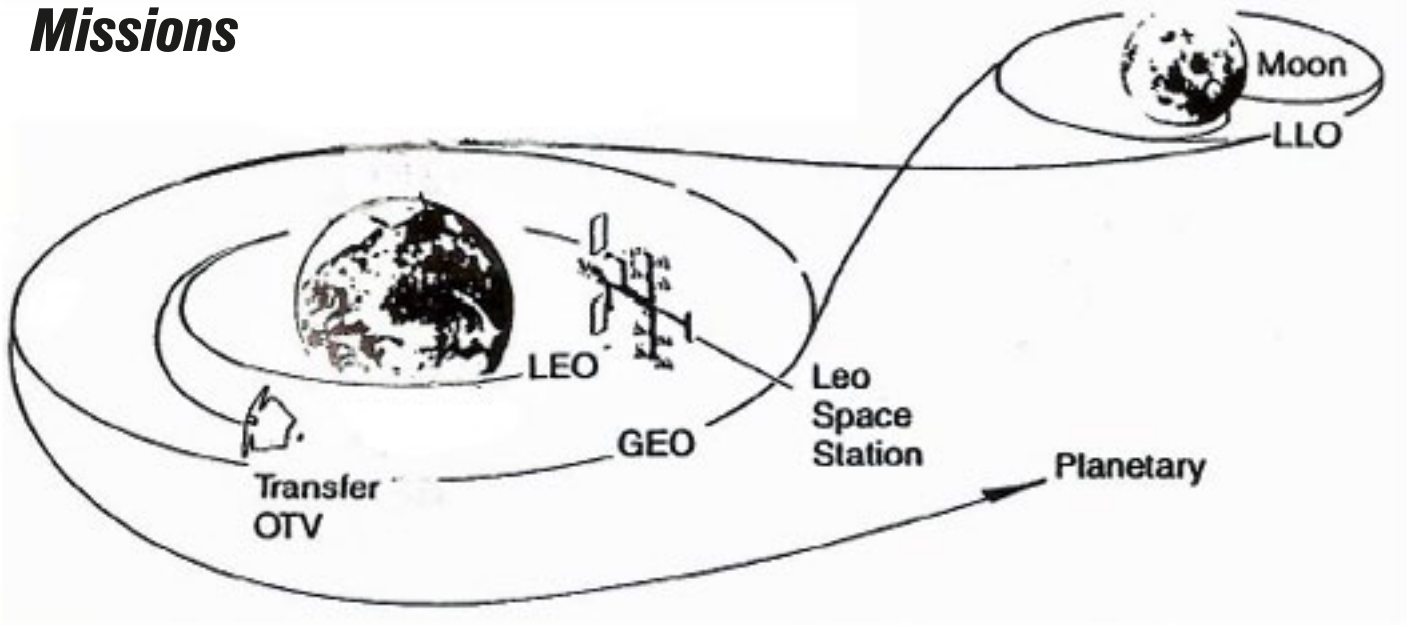
All costs are estimates (except for Falcon Heavy, which is advertised by SpaceX) and do not include payload unique launch services (such as payload processing and integration, ground support and tracking, data and TM services, and so on).

All Atlas and Falcon performance (payload) data is excerpted directly from their users manuals (ULA; SpaceX), except for Falcon Heavy GSO, which is estimated.

Space-based OTV (SBOTV) data are estimates.

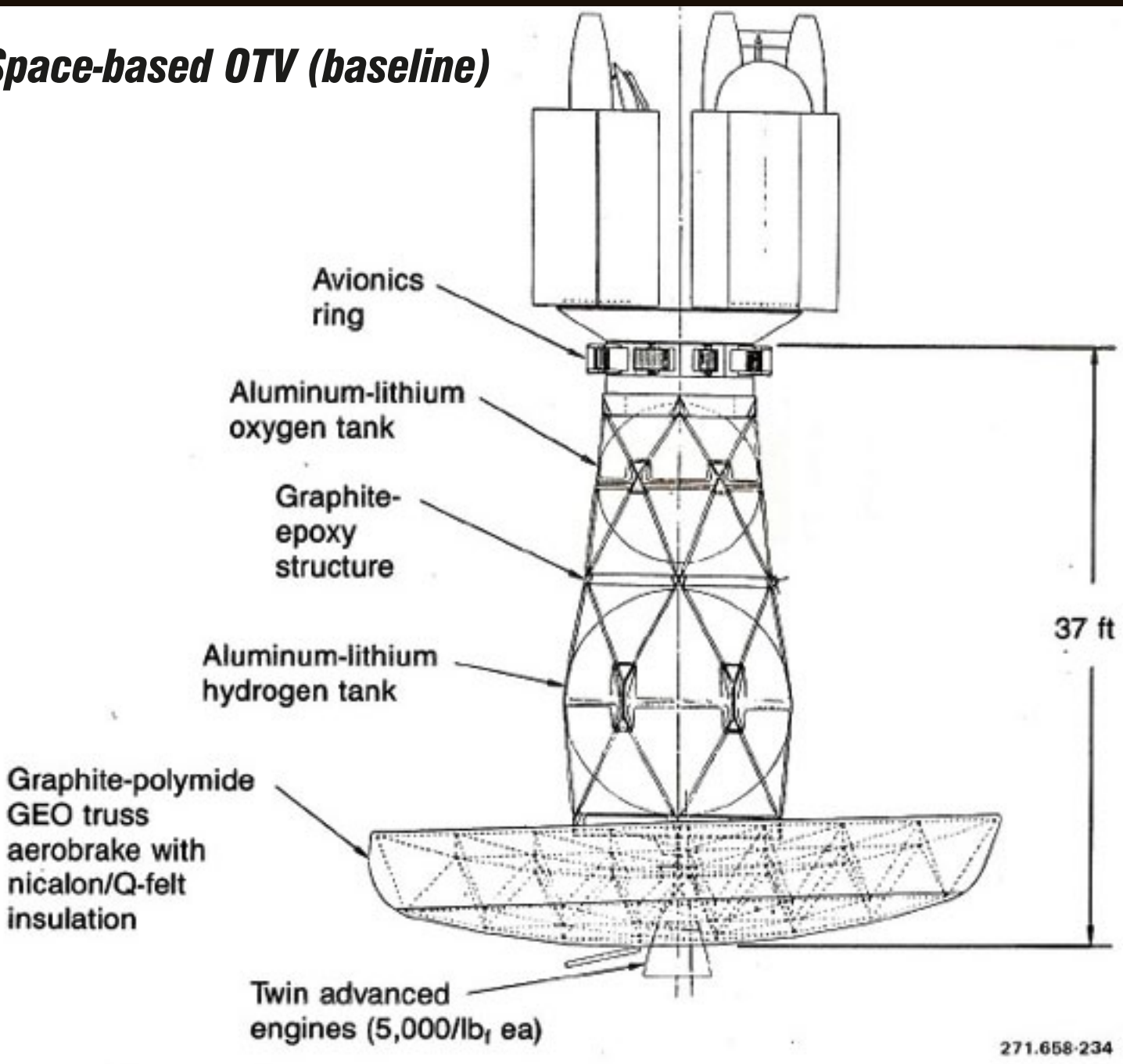
The Case For Space-Based OTVs (Cont.)

Missions



	SPACE BASED OTV	ATLAS V HLV ALONE	FALCON HEAVY ALONE
GSO DIRECT INJECTION CAPABILITY	YES	YES	?
REUSABLE UPPER STAGE	YES	NO	NO
SERVICING OF SATELLITES	YES	NO	NO
RETRIEVE OR DIVERT SPACE OBJECTS	YES	NO	NO
VERY HEAVY PAYLOADS/ MANNED CAPABILITY (LUNAR, ETC)	YES	NO	NO

Space-based OTV (baseline)



Baseline mission capability

GSO (circular, O deg incl)	30000 lb (deliver or retrieve)
	15000 lb (deliver and retrieve, or round trip)

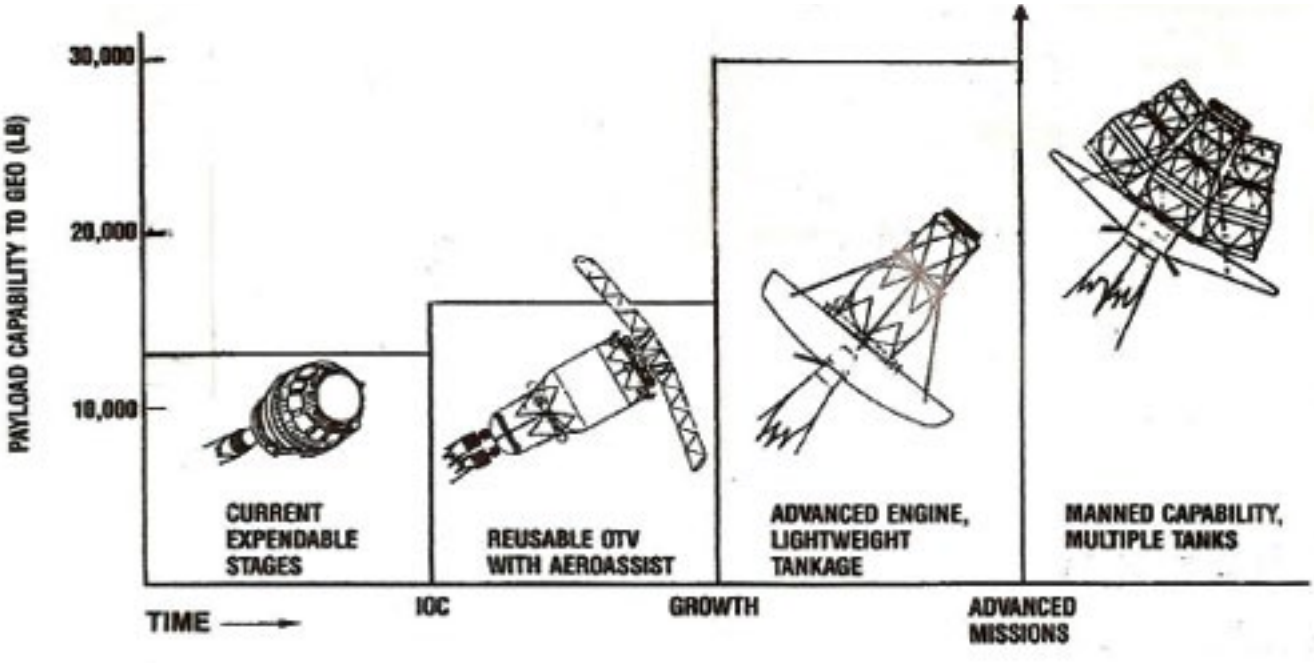
Stage description

stage ignition weight	86000 lb
burnout weight	11000 lb
usable main propellant	75000 lb

The Case For Space-Based OTVs (Cont.)

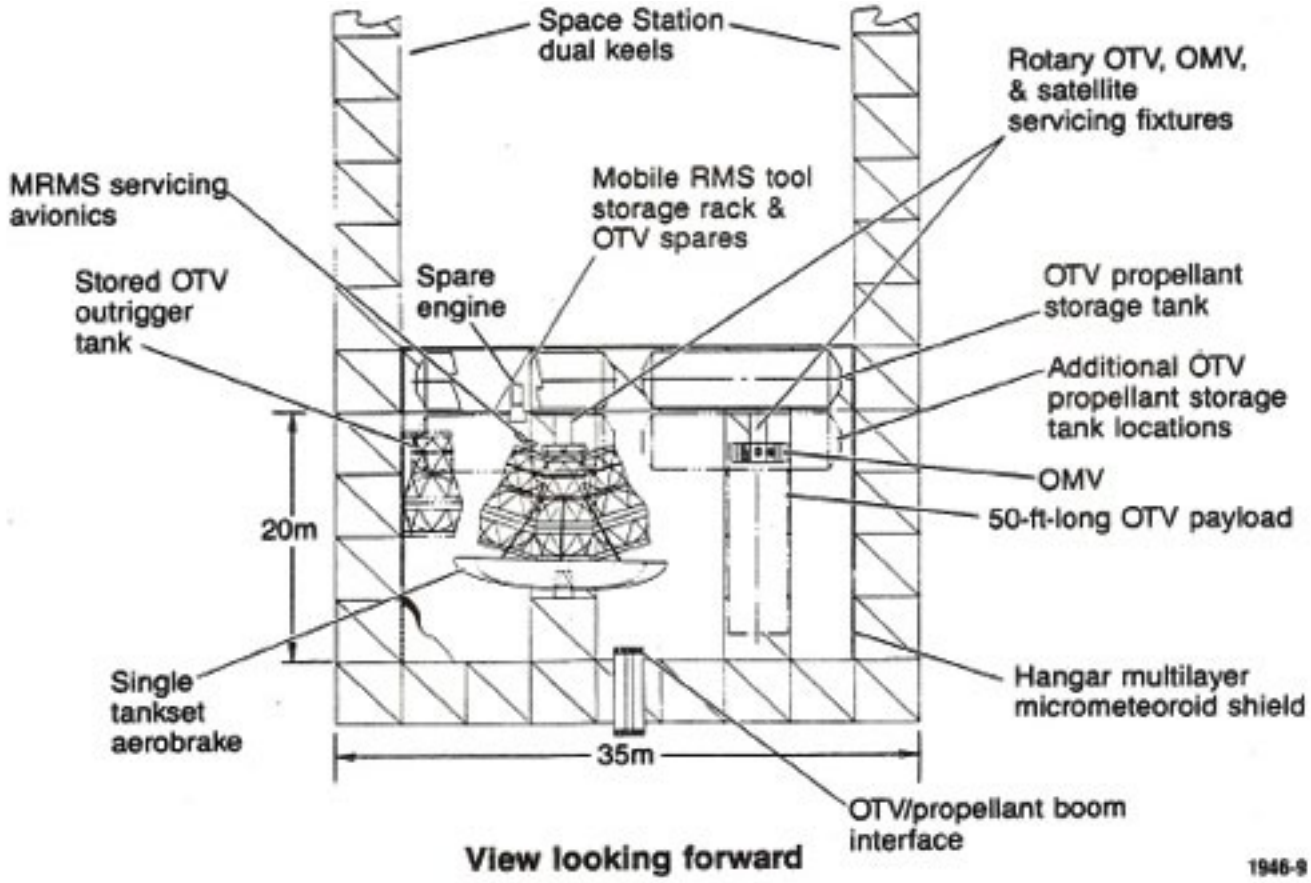
Main engine	
propellant type	O2/H2
mixture ratio	6:1
Isp	485 sec
thrust	10000 lbf (2 engines: 5000 lbf ea)
Auxiliary	
RCS	O2/H2
Fuel cell power	O2/H2
Avionics	
3 string, reprogrammable	

The Space-Based OTV is configured for growth

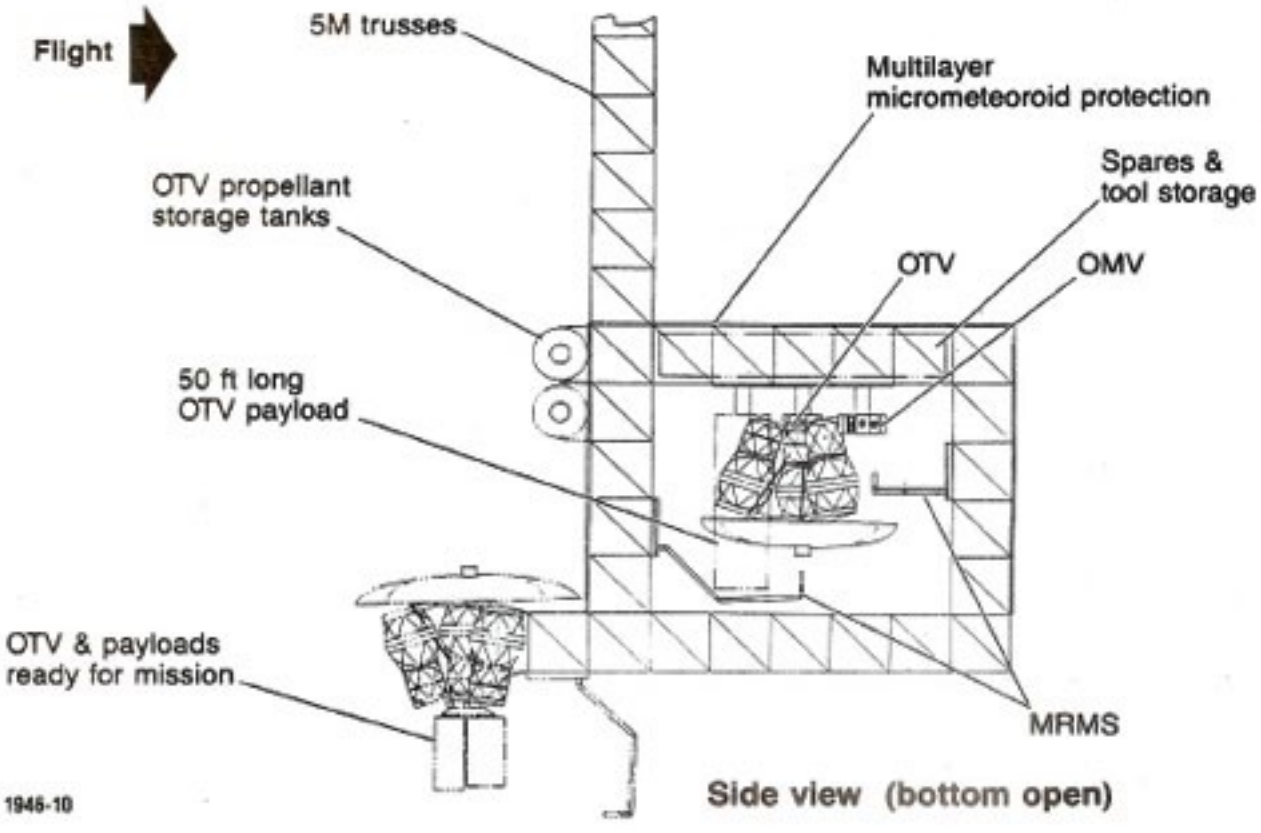


The space-based OTV evolves from an existing upper stage such as Centaur to the operational baseline. With as many as 6 additional tanksets for more propellant, increased mission capability is possible for heavier payloads and for manned missions.

Accommodations for servicing OTVs



Space station OTV accommodations.



OTV operations at the accommodations facility

Retrieve OTV
- Rendezvous OTV with station
- Capture OTV at station
- Berth OTV at propellant port

Transfer propellant
- Verify interface integrity
- Perform propellant leak check
- Transfer residual propellant from OTV to station
- Translate OTV inside hangar

Inspect OTV
- Perform visual inspection
  - TV inspection
- Determine OTV fault status
- When fault or damage detected
  - Perform damage assessment (TV/EVA)
  - Initiate electrical test routine to verify fault
  - Initiate fault isolation routine
- Formulate integrated maintenance plan

Perform OTV maintenance
- Perform scheduled/ unscheduled maintenance tasks
- Reconfigure OTV for mission
- Perform system operational testing
- Deactivate & stow OTV (if not required for mission at this time)

Mate OTV & payload
- Position OTV for payload integration
- Transfer payload to OTV
- Mate payload to OTV
- Verify OTV/payload interface
- Perform OTV/payload integration test

Deploy OTV/payload
- Perform prelaunch operations
- Transfer propellant from station to OTV
- Deploy OTV/payload

Once the primary mission of delivering a satellite to GTO (or GSO) is accomplished, the aerobrake is deployed (and the engines are restarted to de-orbit from GSO). When the Centaur reaches the upper atmosphere, the aerobrake retards the Centaur velocity to rendezvous at LEO with the ISS for capture and inspection (and potential reuse when the capability to refuel becomes available).

It is proposed that this demonstration be accomplished on an upcoming Atlas V satellite delivery mission. It should be noted that technology demonstrations using Centaur have previously been successfully conducted (to evaluate in-space cryogenic fluid management techniques) after separation of the primary payload satellite (ref. Atlas V AV-017, DMSP-18).

Conclusion

Space based OTVs offer the lowest cost for transferring heavier payloads from LEO to GSO, and also enable other missions not currently possible with expendable systems. The technology exists to proceed to construct the space infrastructure necessary to support orbital operations.

Challenges

Perhaps the biggest challenge is to first persuade that the idea of a space-based OTV infrastructure is going to be profitable and that the investment risk can be minimized.

In order to illustrate this a cost analysis has been conducted for a space-based OTV mission to deliver a payload from LEO (108 nautical miles altitude/28.5 degrees inclination) to GSO (19,323 nautical miles altitude/circular/ zero degrees inclination).

Reusable space-based OTV delivery of 30,000 lb. payload to GSO

- *Falcon Heavy delivery of the payload (30,000 lb.), and propellant (75,000 lb..) for the reusable space-based OTV to LEO = $128 million*
- *Reusable space-based OTV payload integration and mission operations = $4 million*
- *Total mission cost = $132 million ($4,400/lb.)*

Development, production, and delivery of OTVs and the Accommodations Facility to LEO (from ref 1, 2, and 3, updated to 2013 $):

- *Orbital Transfer Vehicles - $2.5 billion **
- *Accommodations Facility - $2.7 billion **

Note: These numbers were based on using the Space Shuttle for delivery of the facility and OTVs to LEO. Lower costs would be expected from using lower cost launch vehicles, such as the Space-X Falcon Heavy launch vehicle. Assuming a 7 year development program leading to initial operational capability (IOC), this amounts to an investment of $743 million per year.

With the start of GSO operational missions in 2020, it is proposed to offer a 15 percent discount from ATLAS HLV (from $9,100/lb. to $7,700/lb.).

With each OTV mission delivering 30,000 lb. into GSO at a price of $7,700/lb., and at a cost of $4,400/lb., this gives a profit of $99 million per mission.

Assuming 15 missions per year, then the $5.2 billion investment is recovered in 3-1/2 years, with a payback of $1.48 billion per year, an annual rate of return (ROI) of 28 percent.

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About the author

William Ketchum is an Associate Fellow of the American Institute of Aeronautics and Astronautics. He holds a Master of Science Degree in Aerospace Systems Management from the University of Southern California. He started his Aerospace career in 1956 at Edwards Air Force Base in Flight Test Engineering. He then worked for General Dynamics Space Systems Division, specializing in cryogenic liquid propellant rocket propulsion systems, developing the Atlas and Centaur space launch vehicles. He participated in designing the Fully Reusable Space Shuttle, Space-Based Orbit Transfer Vehicles, and Nuclear-Thermal rockets for human interplanetary missions. His military experience was in the U.S. Army Missile Command at Redstone Arsenal, testing the solid propellant Nike-Zeus Missile Defense System. His work is in Astronautics and Astrodynamics. He is a consultant for the next generation of Space Launch Systems and he is developing a small, reusable, personal spaceplane. He has written many technical reports and papers and lectured on the history of the space program at schools and public events nationwide. He lives in San Diego, California.

Note: Mr. Ketchum was the General Dynamics OTV study/program manager for NASA-MSFC three year, $2 million effort, which provided the basis for this article.

For further details, please visit:
http://www.thespacetransfercompany.com/

Demystifying Satellite Communications For The Smart Grid

By Michelle Larsen, Senior Manager, Global Vertical Marketing, iDirect

Utilities are making significant progress in developing next-generation communication networks capable of supporting the smart grid and other critical applications. However, many utilities continue to struggle with how they can affordably and reliably extend this network to 100 percent of their service territories, especially to remote substations and customer locations that are beyond the reach of primary networks.

An IP-based satellite communications (SATCOM) solution provides utilities with the real-time data exchange, operational visibility and broadband reach required for the smart grid communications system. But there are several common misconceptions about satellite's capabilities, including reliability, latency, cost and security.

The reality is that since its humble beginnings as a one-way distribution mechanism used primarily for back-up systems and consumer television service, SATCOM has undergone a major transformation in recent years. In fact many utilities today are well served by incorporating SATCOM into their smart grid communications architectures.

Today's satellite networks have advanced to become two-way, enterprise-class platforms that provide terrestrial-grade broadband connectivity. They are

Image copyright ***Automation Federation***

high-speed systems that are built on IP and integrate seamlessly with core communications technology. No longer hampered by early latency or reliability issues, satellite is a cost-effective and secure solution that can provide back-up communications and disaster recovery, and can easily support core smart grid applications like SCADA, telemetry, AMI backhaul and distribution automation.

Reliability

The Myth: *Satellite does not provide the necessary reliability/availability utilities need to run core applications.*

The Reality: Technological advancements have made today's satellite networks highly reliable and capable of providing up to 99.99 percent availability.

As utilities build out the smart grid and extend secure broadband connectivity to remote locations, they need a communications solution with comparable reliability to a fiber-based network that can handle critical applications such as SCADA without missing a beat.

Satellite has evolved into a highly reliable platform, in part due to the arrival of second-generation Digital Video Broadcasting Standard (DVB-S2) in combination with Adaptive Coding and Modulation (ACM). With these advancements, outbound throughput performance is guaranteed even during inclement weather.

"People think of satellite as a communications means of last resort. The truth is that satellite offers a lot of capabilities and flexibility so that it can be used in many different places."—Bob Gohn, Research Director, Pike Research

On the return path, the satellite industry has seen improvements to demodulators and the incorporation of a significant new coding technology, 2D 16-State Forward Error Correction (FEC), which also protects link availability during rain fade and further enhances throughput. Unlike other communications technologies, satellite is a private network, which inherently makes it more reliable.

"iDirect brings connectivity to remote locations where line-of-sight wireless, microwave, mobile telephony or wire line isn't available or can't be done cost-effectively."—Rick Geiger, Executive Director for Utilities and Smart Grid, Cisco

Additionally, satellite IP platforms using Time Division Multiple Access (TDMA) technology can efficiently share capacity across different sites within an organization. The establishment of Quality of Service (QoS) guarantees, based on applications remote site and sub-network, it preserves reliability by protecting critical applications against congestion.

When selecting a satellite platform, utilities should consider built-in features that can help them efficiently manage bandwidth and configure and prioritize traffic. iDirect's Group QoS (GQoS), when combined with the ACM capability of DVB-S2, allows utilities to specify committed information rates for different geographies and applications based on the service level required during inclement weather. GQoS qualifiers can also mirror the throughput characteristics of Single Channel Per Carrier technology, effectively creating a dedicated outbound link for bandwidth-intensive, constant applications.

Latency

The Myth: Satellite's latency is too high to support core smart grid applications such as SCADA.

The Reality: While current satellite systems are slightly more latent than terrestrial broadband, the difference is only a few hundred milliseconds and still low enough to meet the requirements of nearly every core utility application.

Developing a smart grid requires precise monitoring of energy supply and demand patterns, as well as real-time fault detection in a distribution network, no matter the locations. Several operational applications, therefore, require a timely response message form equipment assets.

"Many utilities dismiss satellite as a technology that's inappropriate for them, and they're missing the boat. There are very few utility applications for which satellite may not be ideal. Its benefits far outweigh any limitations."—Bill Moroney President and CEO, UTC (1998-2011)

As all communications systems, even terrestrial, have some degree of inherent latency, and as packet transport is not instantaneous, this delay must be accounted for as applications are designed. While terrestrial latency is a minimal 200ms or less, satellite latency, approximately 600 to 700ms, is suitable for nearly every utility application, including SCADA, substation automation, distribution automation, AMI, voice and video. In fact, about the only utility applications for which satellite may not be appropriate are teleprotection schemes that require extremely low, single-digit millisecond latency.

Demystifying Satellite Communications For The Smart Grid (Cont.)

"Encore Networks and iDirect partnered with a major utility to bring secure broadband over satellite to its remote sites. After testing our products for almost a year, there were no major interruptions or loss of SCADA data."—Jeff Boger Director of Sales, Encore Networks

Due to advancements in satellite IP technology, each control message or alarm can be delivered within a guaranteed time frame. Specifically, a methodology called deterministic TDMA (d-TDMA) designates bandwidth per remote site based on an established time limit and video surveillance and VoIP to run without interrupting the deterministic bandwidth allocated for SCADA.

To further optimize real-time applications, such as voice that can be detrimentally affected by delay, utilities can take advantage of the iDirect platform's built-in, real-time traffic management and optimization features. These features can reduce jitter by evenly spacing time slots across a shared platform and they enable the system to interrupt large data frames to prioritize voice traffic. As a result, utilities can ensure toll-quality digital telephony over a cost-effective shared medium.

Cost

The Myth: Deploying satellite is cost prohibitive.

The Reality: Today, satellite offers flexible options for utilities to own, manage and deploy networks with low up front capital investment and minimal operational expenses.

Satellite IP platforms extend high-speed broadband and advanced communications applications to the most remote locations. For utilities, this means reaching the farthest points on the grid in a more cost-effective way than other core network technologies.

Several satellite options offer flexibility related to up front capital expenditures. Some utilities may decide to own and operate their own Virtual Private Network (VPN) for security reasons or performance control. In this scenario, the utility is responsible for purchasing and implementing the satellite infrastructure, including a hub, line cards and remotes.

For utilities looking to reduce their up front capital expenditure, iDirect offers a cost-effective model called Virtual Network Operator (VNO). As a VNO, a utility organization still buys and manages satellite equipment, including remotes and line cards, and is able to maintain control and visibility over the performance and security of its own closed network.

However, with a VNO model, the utility doesn't have to invest in a satellite hub or teleport infrastructure, since it co-locates capacity in an existing hub hosted by a satellite service provider. Alternatively, for even lower capital expense, a utility could fully outsource its satellite capacity, allowing a service provider to configure and manage the network at an operational expense that's competitive with monthly cellular costs.

No matter how a utility chooses to build and manage its satellite network, iDirect provides flexibility to help utilities match their overall communications architecture needs. Whether a utility chooses to own or outsource capacity, it can leverage iDirect's Network Management System (NMS) to configure, monitor, control and automate components of its satellite network. iDirect's NMS allows utilities to manage the network from a central location. It provides a deeper view in to network performance with real-time and historical statistics and alerts to potential issues before they occur.

Security

The Myth: Satellite isn't as secure as other technologies, such as fiber, and therefore isn't adequate to protect the smart grid.

The Reality: Satellite has become a highly secure technology that supports private networks and AES encryption, and provides enhanced security features.

As utility systems become more reliant on an always-on broadband connection, security can be a concern. New industry regulations, including NERC-CIP standards, and the ability to centrally access substations are two of the drivers for more stringent protections against intrusion, while emerging applications such as smart metering are making data security paramount.

Unlike a terrestrial or cellular network that uses public infrastructure, a satellite platform configured as a closed network is inherently private and secure. The NMS must authorize devices before they can operate on the network, which guards against outside attacks and makes satellite IP more secure than WiFi. In an iDirect network, all remotes have to be authenticated based on their physical serial number before they transmit. Without this authentication from the hub, a remote will not be allowed to transmit or receive packets.

Concurrent two-way AES 256-bit link encryption adds another layer of security, making packet transmission via satellite just as secure as other communication technologies. Creation of a Virtual Local Area Network (VLAN) allows users in a broadcast domain to be grouped together logically and not physically. They do not have to be in the same location. Satellite support for VLAN tagging provides the security needed to segregate traffic by these defined groupings on a shared infrastructure. Permission is required for access.

To provide even higher levels of security, the iDirect platform includes enhanced features to make it more difficult to eavesdrop or intercept data over the satellite network. Frequency hopping allows remotes to switch in route channels based on traffic. Frequency hopping enables remotes to continuously switch channel frequencies based on traffic. Tunnel-mode IPsec creates an encrypted point-to-point tunnel between substations and the control center. The ability to support Secure Shell (SSH) connections encrypts network communications to provide further data integrity.

A Smart Choice For The Smart Grid

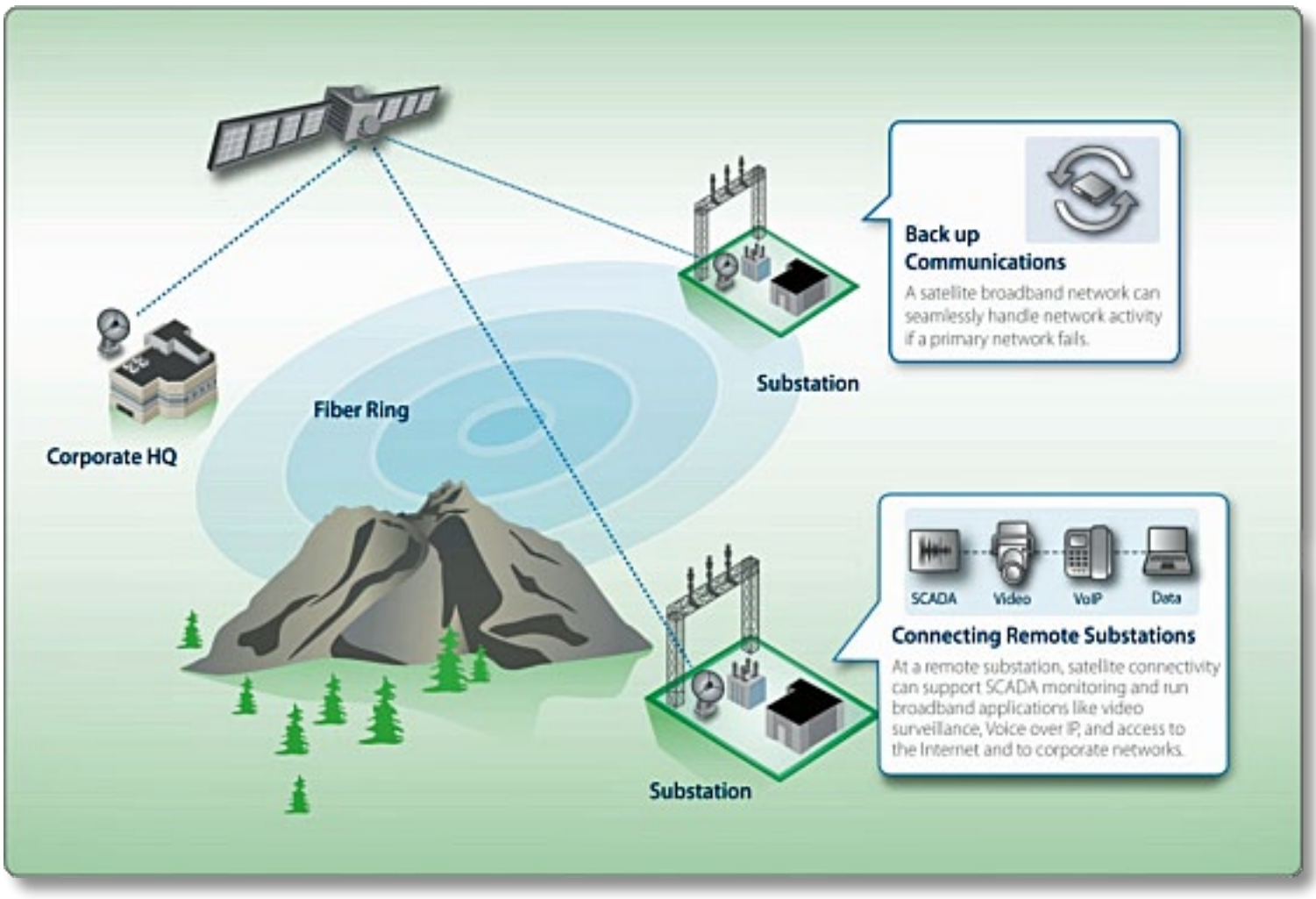
To build the Smart Grid, utilities must understand the capabilities of today's communications technologies and how they best meet technical and business requirements.

Satellite IP communications play a critical role in achieving this goal. With satellite, utility companies can reach every location they serve and help to ensure 100 percent network uptime. Since most utilities manage several different types of communications technologies, it may seem daunting to consider adding a comparatively new technology into the mix. However, the iDirect platform is simple to manage, and is designed to integrate seamlessly with other communications systems. With iDirect technology built into their overall communications infrastructures, utilities can extend broadband coverage anywhere and support a wide range of applications.

To learn more about the benefits of satellite communications for the smart grid, visit ***http://www.idirect.net/utilities***.

About the author

Michelle Larsen is a Senior Manager, Global Vertical Marketing, at iDirect. Larsen oversees the strategic initiatives and development, as well as implementation, of iDirect solutions into key verticals around the globe, including the Energy & Utilities, and Oil & Gas industries. She also defines the ongoing product development strategy for SCADA, Utilities and the Smart Grid.



Careers
The Collision Between Employers + Job-Seekers

By Bert Sadtler, Senior Contributor

With respect to Economics 101, the well-known Law of Supply and Demand usually applies when discussing the acquisition of critical talent. There are times when employers are seeking to hire critical talent and the supply of qualified candidates is limited. Then, there are times when numerous qualified candidates are pursuing a very limited demand of employers with a need for talent.

Under normal circumstances, the balance of Supply and Demand tilts one way or the other. Rarely, is the balance dead-even. Hardly ever does Supply COLLIDE with Demand at the expense of both sides.

Today, Supply and Demand are COLLIDING. The result is painful to both the employer and the talent.

What is causing this painful phenomenon?

What is the impact?

How can it be overcome to everyone's benefit?

Causitive Factors

Employers are facing reduction of earnings, re-evaluation of sales projections, concerns about winning near term contract awards and competition for bids against competitors with bids that are below cost.

Today's business climate is influenced by fear and uncertainty. The challenging times are causing large and small employers to "right-size" or "down-size" their headcount.

As a result, there is a large supply of talent flooding the marketplace.

Professionals who find themselves unexpectedly out of work are eager to re-enter the workforce. Some have ugly cash flow issues. Some believe they need to accept a reasonable offer because it may be the only one they receive. Some candidates are simply desperate to re-enter the workforce while others are uncomfortable without employment. Unemployment turns professionals into unpredictable and urgent candidates.

Employers today recognize there is a very attractive supply of available critical talent. The current conditions demand that the employer gets it right and hires the "RIGHT" talent. Things get more complicated with the actual hiring efforts.

The Impact:

With the uncertainty faced by employers and the pressure of getting it right, employers are additionally facing an unmanageable number of candidates responding to a posting. The employer's "hiring engine" was designed to handle a much smaller candidate pool. Furthermore, the market conditions cause the employer to take a more methodical, more deliberate and longer time to hire critical talent.

Employers are overlooking highly qualified candidates. For example, a senior level friend recently applied to a position with a well-known Satellite Communications employer. After making numerous follow-up attempts, my friend received a call from the employer's HR Department who said that another candidate had been selected. My friend was then told that he was not qualified since he lacked a degree. My friend responded that he held an MBA and asked if the employer had even reviewed his qualifications. He said their response was dead silence. Clearly, a potentially qualified and interested candidate had been altogether missed. How many times is the occurring today? Once is too many.

The impact affecting the talent is driven by timing. Unemployed candidates are very motivated and very eager to re-gain employment. With paralysis influencing employers, candidates are focused on moving quickly while in contrast, employers are taking longer then ever. This is the collision.

Game-changing supply is available. While limited, there is some demand to hire critical talent. The supply of talent is colliding with a hiring engine that is too slow and too overburdened to efficiently respond to candidates. Many times, qualified candidates become frustrated by the employer's slow pace and accept an offer that might be regarded as second tier.

Surviving The Collision

The first step is to recognize today's issue and the related collision.

Knowing that candidates can and want to move quickly, the employer has the ability to both resolve and benefit from the current situation.

- *A structured recruitment process needs to be developed and implemented by the employer. The process must address: "What business challenge are we solving by hiring critical talent?"*
- *Significant pre-hiring preparation is necessary in order to respond to anticipated candidate questions.*
- *With such a large quantity of available talent, the hiring focus must shift away from seeking or sourcing talent.*
- *Instead, the hiring focus needs be on FILTERING, also known as Candidate Development.*
- *Speed is critical today. Candidates do not respond well to silence from hiring managers. Employers need to maintain a dialogue with candidates and efficiently move through the hiring process.*
- *Employers need to dedicate time to filter-out candidates who don't fit while developing candidates who appear qualified to solve the business challenge.*
- *Once the hiring process has identified the "BEST" candidate, the final steps are unchanged from a "normal hiring process."*

In Summary

- *Focus on the talent*
- *Prepare well*
- *Hire quickly (As a result of a well planned, well executed process)*
- *Get it right*

About the author + Boxwood Search

Bert Sadtler is the President of Boxwood Search and a Senior Contributor for SatMagazine—There is a ongoing battle for senior level talent. A great hire can make a long term positive impact and a failed hire can prove to be very expensive. How does a company recruit and hire the right talent? It is more than just networking within the community of friends and business associates. It requires focusing on results through a process oriented approach. We are committed to reaching a successful outcome. Our recruitment method has repeatedly proven to deliver very qualified senior talent. Contact Bert at *BertSadtler@BoxwoodSearch.com* for more information.

Moving Satellites, Or, How To Learn To Love Electricity For Re-Slotting

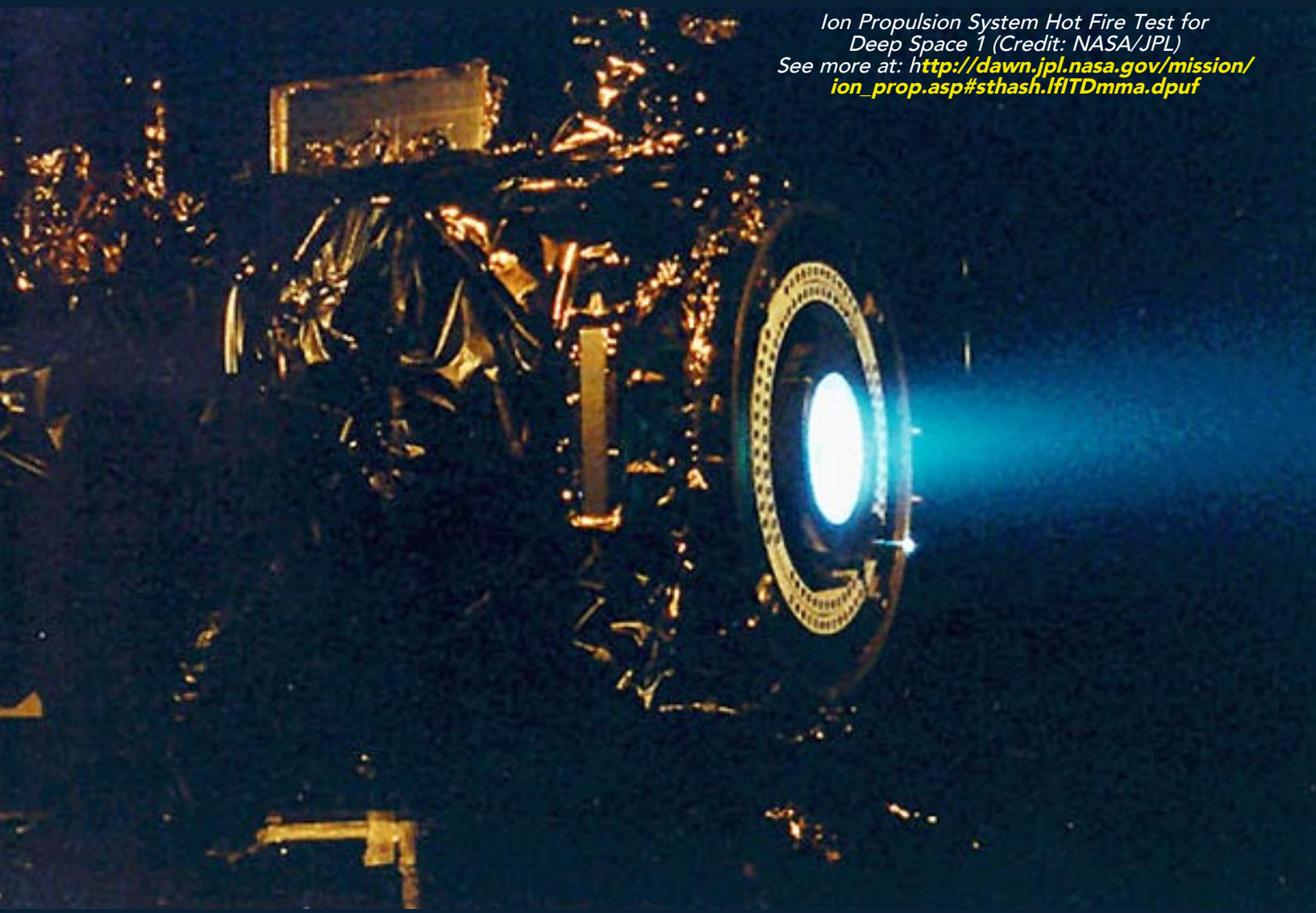
By Nick Flaherty

Often the job of a satellite is to sit above the Earth in a stationary orbit and supply TV, video and data across a wide area from a single location in the sky. To deliver the best transmission, the satellites need to be moved into the correct position—their orbital location or slot, as it is referred to—after launch. Satellites also need to be moved around during their lifetime of service, as satellites often drift out of their slot over time and require a nudge back into position.

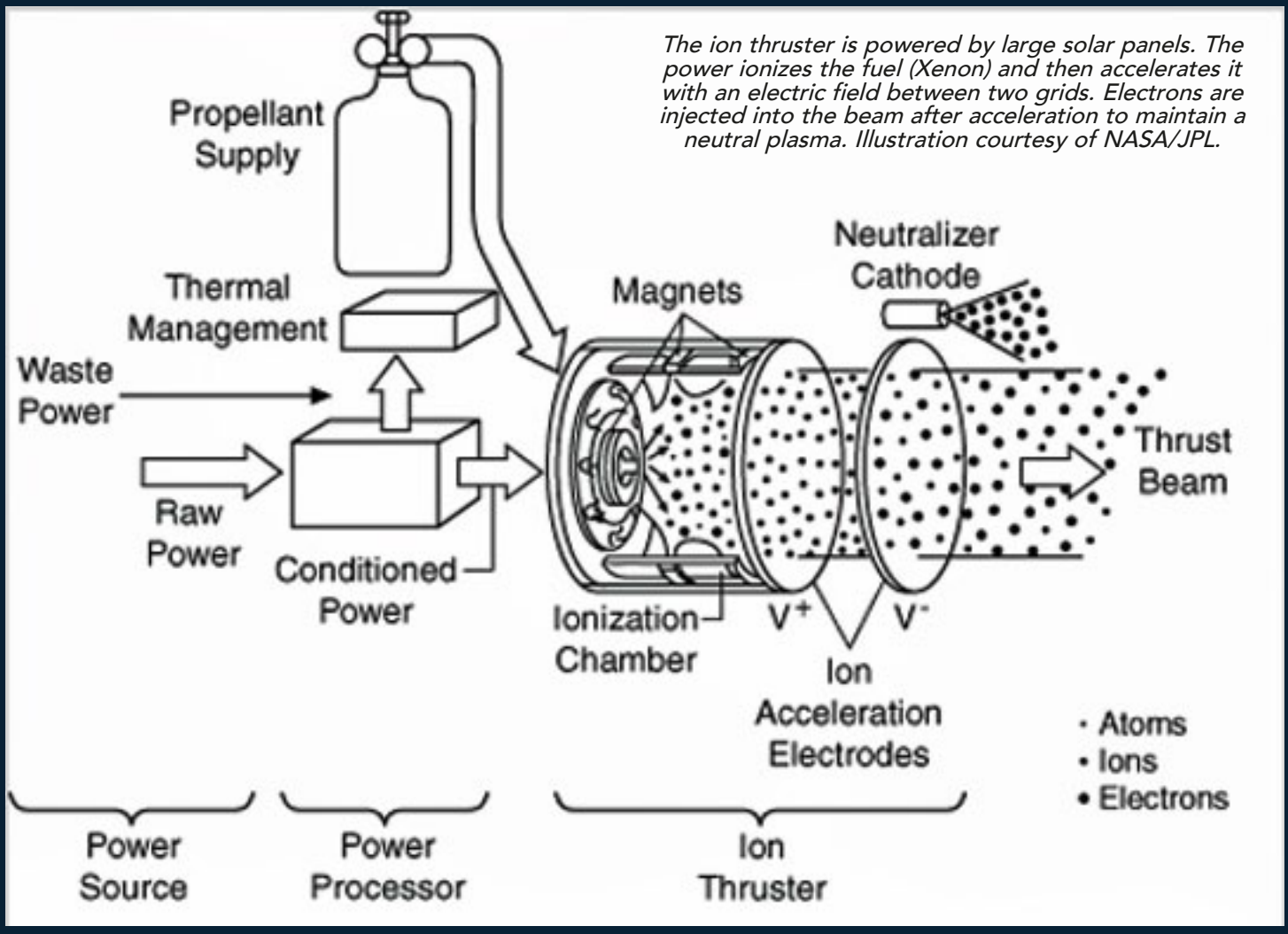
With new satellites being launched into the same orbital locations to provide more capacity, new services and redundancy to ensure they continue their operations, the best configuration to supply such requires they be moved, as well. This makes the ability to move satellites around in the heavens extremely vital.

However, moving satellites can present a real challenge. They are designed to be in place for 15 years or more, and need reactors or thrusters as well as fuel to move them into varying positions.

These thrusters have to be as efficient as possible—the larger in size they are, the more fuel they need, and the less space there is for the communications equipment and transponders that are the heart of the satellite. Having a more efficient system means either more equipment, a longer service life by having more redundant equipment, or a less expensive launch—costs play a most crucial role in all SATCOM matters.



Ion Propulsion System Hot Fire Test for Deep Space 1 (Credit: NASA/JPL)
*See more at: h**ttp://dawn.jpl.nasa.gov/mission/ion_prop.asp#sthash.lfITDmma.dpuf***



The ion thruster is powered by large solar panels. The power ionizes the fuel (Xenon) and then accelerates it with an electric field between two grids. Electrons are injected into the beam after acceleration to maintain a neutral plasma. Illustration courtesy of NASA/JPL.

The Dawn satellite, powered by a xenon ion propulsion unit, image courtesy of NASA.
The protoplanet approach phase for this spacecraft will use electricity to ionize and accelerate xenon for thrust generation

Satellite manufacturers have derived several techniques for these reactors. The latest satellites to be launched use leading edge technologies, such as xenon ion propulsion system (XIPS), which was pioneered by Boeing in the U.S. and is ten times more efficient than conventional liquid fuel systems.

Four 25cm thrusters generate streams of xenon ions for economical station keeping—requiring only 5kg. of fuel per year, which is a fraction of what older systems consume. The XIPS engine can also be used for placing the satellite in the correct and assigned orbit, also called final orbit insertion, rather than using a heavier liquid propellant.

Developments have continued to make the more traditional propellant systems even more efficient. AlphaBus is the new European platform for the next generation of high power communications satellites. Their development was by Astrium and Thales Alenia Space and resulted in satellites that were recently launched.

The AlphaBus supports large satellites weighting up to 8.8 tons for new generation mobile and broadband services, digital audio broadcast and HDTV.

At the heart of AlphaBus is the European Apogee Motor (EAM), an advanced high performance, lightweight

The Alphabus product line is Europe's response to market demand for increased broadcasting services. It accommodates missions with up to 22kW of payload power and mass up to 2 tons. As a high-power, multi-purpose platform, it gives European industry an unprecedented and unique position in the global telecom market. Photo courtesy of ESA.

Apogee motor with integrated heat shield and thrust frame, photo courtesy of Astrium.

thruster. This has a new combined combustion chamber and nozzle to move the satellite in space using MMH (Monomethyl Hydrazine) and MON (Mixed Oxides of Nitrogen) as the propellants. These propellants are driven out of valves that are perpendicular to the main axis of the satellite to steer it into position.

Two new technologies were needed for this to be applicable to satellites and they were developed by researchers in Germany. The propellants provided high motor performance via a special injector system that achieved excellent propellant atomization and mixing. A new material for the chamber and nozzle was also manufactured that was capable of withstanding high thermal temperatures and additional mechanical loads.

There are also new technologies emerging for moving satellites. Start-up The Elwing Company is raising US$25 million to bring its electrodeless plasma propulsion technology to market over the next three years.

Elwing was founded in 2002 and says its proprietary technology will enable satellites to increase the size of the payload by as much as 700kg, providing a significant increase in the number of transponders or hosted payloads possible on a single spacecraft. The company is already in negotiations

Based on the innovative electrodeless plasma thruster technology, Elwing product's higher thrust and higher thrust-to-power ratio are designed to fulfill the propulsion needs of most commercial and non-commercial satellite. One of the solutions identified by Elwing to these limitations is to take advantage of the ponderomotive force to produce a fully electrodeless plasma propulsion technology.

with government and six major commercial partners to obtain the support to integrate the technology into future satellites, as it requires 18 and 24 months to modify spacecraft designs.

Looking further ahead, the ELECTRA project from the European Space Agency (ESA) is also developing a full-electric propulsion, small to medium sized satellite platform that will be manufactured in Europe.

SES is participating in the upcoming Artes-33 program "ELECTRA" of the European Space Agency (ESA). the project aims to develop, implement, launch and commercially operate an innovative geostationary satellite platform that uses electric propulsion (instead of conventional chemical propulsion) for transfer into geostationary orbit as well as on orbit station keeping. Artistic concept of the ELECTRA spacecraft, courtesy of SES and ESA.

SES-6 under construction, photo courtesy of SES.

The project aims to develop, implement, launch and commercially operate a geostationary satellite platform that, like Elwing and Boeing, uses electric propulsion instead of conventional chemical propulsion. This will mean future satellites can use smaller, more cost effective launch vehicles than are in use today.

SES, a leading satellite operator headquartered in Luxembourg, will lead the ELECTRA project and is working with OHB System in Bremen as the prime contractor.

"Decreasing the total cost of putting a payload into orbit is a key strategic element for the satellite operator community," said Martin Halliwell, SES Chief Technology Officer. "Electric propulsion is poised to inject increased competitiveness into the satellite industry, an essential element for the sustained development of the satellite-based commercial telecommunications market."

All of these mentioned technologies help to maintain satellites in their correct slots, to beam the latest TV and Internet data to North America, Europe and Asia.

About the author

Nick Flaherty is a freelance technology journalist based in Bristol, UK, covering silicon and broadcast technologies. He writes for a wide range of trade and consumer technology publications.

PointOfView
Never Lose Infinite Hope

By Elliot Holokauahi Pulham, CEO, Space Foundation

It's a well-known mantra of strategic planners, "hope is not a strategy." I think anyone responsible for making a payroll, keeping the factory doors open, or accountable for achieving a mission, knows this.

No matter what your hopes are, it is your intentions, plans and actions that determine the outcomes.

That having been said, I still believe that hope is fundamental to success. If you've given up hope in what you're doing, all the planning in the world is probably not going to help you.

Hope is a powerful and useful ally. It is an expression of the best that you desire, the most that you are willing to work for, the good end that you, and others, are willing to sacrifice for.

Our hopes define the best expectations that we are willing to strive for, and the goodness we are willing to see in others. Our hopes are intimate and personal, and they are broad, unselfish and global.

To hope is to be human. To be without hope is to be something less. To give, create and inspire hope - that, surely, is divine. Not the "Flying Spaghetti Monster" kind of divine, but, rather, that special kind of divine that lives within us all.

What set me thinking about the importance of hope were two events, not quite a week apart, and both commonplace enough.

On May 17, along with tens of thousands of others, I snuck off to the theater, plunked down my $22 for a ticket and popcorn, and was part of the opening weekend for Star Trek: Into Darkness. While the much anticipated J.J. Abrams opus certainly deserves some mention in the context of hope, what really struck me was the utter hopelessness and despair that seems to run like cold, infected blood as a common theme in so much science fiction fare these days. The trailers that preceded Star Trek included:

World War Z: starring Brad Pitt, an apocalyptic, end-of-times bummer that proceeds from the notion that, for most of us, all hope is lost. It is being enthusiastically touted as the most expensive disaster film of all time.

Elysium: starring Matt Damon, offers us a depressing vision of Earth as a hell hole populated by the dregs of humanity, a planet abandoned by haughty, uncaring elites living just beyond reach on the Eden-like space station, Elysium.

Ender's Game: featuring Harrison Ford as a man who would make weapons of children in order to save a doomed Earth from alien invaders.

If these weren't enough variations on the theme, Oblivion, the cheerily titled current Tom Cruise vehicle, was playing in the next auditorium.

And, if none of those were adequately depressing, the post-apocalyptic SyFy channel original series Defiance has just made the leap to on-demand viewing on television.

These dim, cynical, ugly views of our future go well beyond the time-honored tradition of science fiction as cautionary folklore. They are despairing tomes of pornographic violence that seem to serve as video game opiates for spectators too lazy to pick up the game controller and simulate killing for themselves.

Poetic warnings that we could be screwing up the future have always been valid creative approaches for the genre, but this is not the thought-provoking high ground of Soylent Green or Logan's Run. This is in-your-face ugly. Hopelessness as muse.

Which takes us back to Star Trek: Into Darkness, which should have been entitled Star Trek: Out of Darkness. Without dropping a bunch of spoilers, suffice it to say that, true to the vision of the franchise that has characterized its finest moment for 47 years, this movie is about the triumph of good over evil, and the importance of things like friendship, valor, and honor. And the sum of the struggle of all its characters is the consummate hopeful expression that mankind can, and will, boldly go into the future.

At a Denver meeting a few days later, Denver Metro Chamber of Commerce boss Tom Clark casually admitted that he was a man of hope, because he had been a child of the sixties, inspired by President John F. Kennedy's challenge to the nation to land a man on the moon. It was a great comment to make, because we were discussing the future.

The venerable Denver Chamber is one of the oldest in the nation, approaching its 150th anniversary. To the great credit of the organization, the chamber is considering what role it can plan in the next 150 years - certainly a hopeful optimism that inspires informed and constructive collective action.

Consideration of the power and impact of the JFK "moment in time" often sparks discussion of the relative roles of inspiration, hope and leadership in moving the nation forward. I think that most of us who lived through the Apollo experience are profoundly convinced that visionary leadership makes a difference. There's a sense that we haven't seen the nation energized by science, technology and industry, in an "Apollo" way, for half a century.

That's probably fair. But it says something important that, five decades later, we still hope to see humanity marshal another bold and purposeful foray into space. Our ability to muster something vaguely resembling a political mandate may seem irretrievably broken, but hope, as they say, springs eternal.

Curiosity would never have landed on Mars without it.

Hope, of course, wasn't JPL's strategy for Curiosity. But, it you watched the video of NASA's mission controllers as they awaited confirmation that the spacecraft had survived its landing, you know that hope was the "12th man" on the mission. Hope was there when Shepard launched, hope was there when the Eagle landed, hope was there when Apollo 13 informed Houston that there was a problem.

This is the problem I have with an entertainment industry that tells us that, in the future, hope dies.

It does not.

It is the problem I have with political leaders who say we will never be able to afford a great space program again.

We will. We can. We must.

While hope is not a strategy, it must always be our co-pilot.

"***We must accept finite disappointment, but never lose infinite hope***."—Martin Luther King, Jr.

About the author

Named chief executive officer of the Space Foundation in 2001, Elliot Pulham leads a premier team of space and education professionals providing services to educators and students, government officials, news media and the space industry around the world. Before joining the Space Foundation, he was senior manager of public relations, employee communication and advertising for all space programs of Boeing, serving as spokesperson at the Kennedy Space Center for the Magellan, Galileo and Ulysses interplanetary missions, among others. He is a recipient of the coveted Silver Anvil Award from the Public Relations Society of America - the profession's highest honor. In 2003, the Rotary National Awards for Space Achievement Foundation presented him with the coveted Space Communicator Award, an honor he shares with the late legendary CBS News Anchor Walter Cronkite and former CNN News Anchor Miles O'Brien. Pulham is chairman of the Hawaii Aerospace Advisory Committee, a former Air Force Civic Leader and advisor to the Chief of Staff and Secretary of the Air Force and a recipient of the U.S. Air Force Distinguished Public Service Medal. He serves on the editorial board of New Space Journal.

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