

Worldwide Satellite Magazine – May 2016

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SatMagazine

May 2016

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Second GPS III Launch Services Contract Awarded To SpaceX

The US Air Force has awarded the first competitively sourced National Security Space (NSS) launch services contract in more than a decade.

Space Technologies Corporation (SpaceX) was awarded a contract for Global Positioning System (GPS) III Launch Services. This is a firm-fixed price, standalone contract with a total value of \$82,700,000. SpaceX will provide the government with a total launch solution for the GPS-III satellite, which includes launch vehicle production, mission integration, and launch operations and spaceflight certification.

The launch will be the second GPS III launch and is scheduled to launch from Cape Canaveral Air Force Station, Florida, in May 2018.

GPS III is the next generation of GPS satellites that will introduce new capabilities to meet the higher demands of both military and civilian users. The satellite is expected to provide improved anti-jamming capabilities as well as improved accuracy for precision navigation and timing. GPS III will incorporate the common L1C signal, which is compatible with the European Space Agency's Galileo global navigation satellite system and compliment current services with the addition of new civil and military signals.

This is the first of nine competitive launch services planned in the FY 2016 President's Budget Request under the current Phase 1A procurement strategy, which covers awards with FY 2015-2018 funding. The next solicitation for launch services will be for a second GPS III satellite. This award marks a milestone in the Air Force's ongoing efforts to reintroduce a competitive procurement environment into the Evolved Expendable Launch Vehicle (EELV) program as directed by Frank Kendall, Under Secretary of Defense for Acquisition, Technology and Logistics.

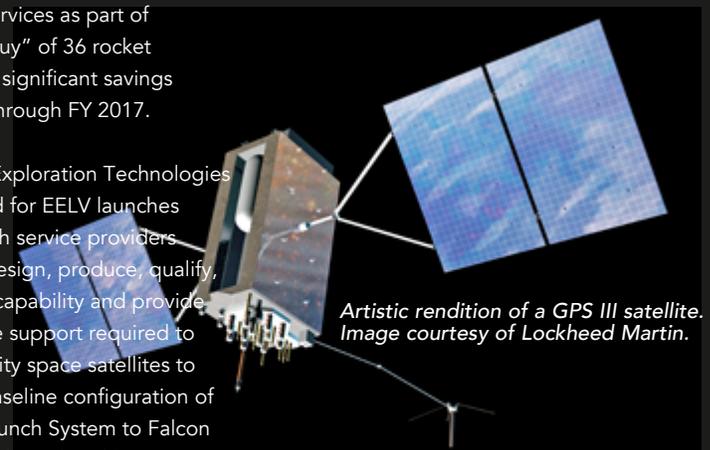
The Phase 1A procurement strategy reintroduces competition for national security space launch services. Under the Phase 1 strategy, United Launch Alliance (ULA) was the only certified launch provider. In 2013, ULA was awarded a sole-source contract for launch services as part of an Air Force "block buy" of 36 rocket cores that resulted in significant savings for the government through FY 2017.

In May 2015, Space Exploration Technologies (SpaceX) was certified for EELV launches resulting in two launch service providers that are capable to design, produce, qualify, and deliver a launch capability and provide the mission assurance support required to deliver national security space satellites to orbit. The certified baseline configuration of SpaceX's Falcon 9 Launch System to Falcon 9 Upgrade was recently updated for use in National Security Space (NSS) missions.

The Air Force Space Command's Space and Missile Systems Center, located at the Los Angeles Air Force Base, California, is the US Air Force's center of excellence for acquiring and developing military space systems.

According to Lieutenant General Samuel Greaves, the US Air Force Program Executive Officer for Space as well as the SMC Commander, this launch services contract award achieves a balance between mission success all the while meeting operational needs and lowering costs as well as reintroducing competition for National Security Space missions.

spacex.com



Artistic rendition of a GPS III satellite. Image courtesy of Lockheed Martin.

InfoBeam Articles

Second GPS III Launch Services Contract Awarded To SpaceX	2
Globalstar + Manx Teaming Up	4
Bringing Their GaN Plan To A New Broadcast Satellite Modulator	6
NSSLGlobal Navigates To A Majority Ownership	8
Controlling Interest Of O3b Networks Now In SES Hands	10
Lockheed Martin Blasts Off + Takes Students On Experience Of A Lifetime.....	12
First Partner For Thuraya's North American M2M Service	14
Outerlink Global Solutions Obtains FAA Okay	14
ETL Systems To Showcase New Tech.....	15
India's Seventh & Final IRNSS Satellite Launched	16
Telesat To Obtain Two Ka-Band Satellites	17

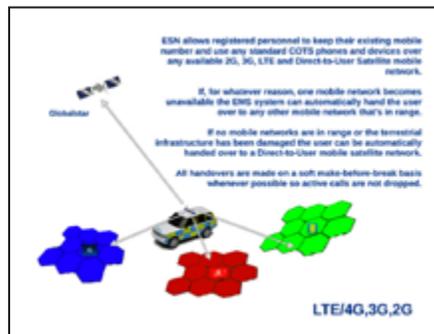
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Globalstar + Manx Teaming Up To Develop Integrated Cell + Mobile Satellite Service

Globalstar Europe Satellite Services Ltd., a wholly owned subsidiary of Globalstar Inc. and Manx Telecom, an AIM listed company and the Isle of Man's leading communication solutions provider, now have an alliance to develop EMN—this is a new multiple technology communications system that aims to be the world's first communications service to switch between multiple cellular networks and a DtU (Direct-to-User) mobile satellite network.

Using Globalstar's Low Earth Orbit (LEO) satellite constellation, EMN is intending to be a BYOD (Bring Your Own Device) solution that will enable users to communicate as normal with their existing devices, such as smartphones or tablets, but with ubiquitous nationwide coverage via satellite operations. With EMN, which uses Manx Telecom's Smart SIM technology, when a user's signal level begins to weaken due to the limited reach of the carrier's coverage or disappears due to a natural or man-made disaster, connectivity will be automatically handed over to another mobile network that is in range. If a terrestrial network is not available, network connectivity will be transferred onto Globalstar's system.

One of the first services to be developed by the new alliance, and supported by specialist technical consultancy firm, Intelcomm, is FRAN. FRAN will enable all first responders



to continue making and receiving calls in the event that cellular networks become unavailable. This will be especially vital in a fast developing emergency situation when users suddenly have their communication cut off due to network overload, pre-emption or land-based infrastructure damage.

First responders need truly ubiquitous and affordable mobile communications. Previous attempts have included using satellites as 'backhaul' to deliver signals to terrestrial masts. However, unlike EMN's DtU approach which connects users directly via satellite, a backhaul solution is still dependent on the reach and integrity of terrestrial infrastructure—something that cannot be guaranteed, as became apparent during 2015 when severe weather in the UK damaged terrestrial infrastructure, impairing emergency services' ability to operate.

Using the satellite network directly, the

EMN solution does not require the backhaul solution. The satellites orbit at 1,400 km above the Earth, providing much lower latency than other satellite networks in higher orbits. In addition, there is high reliability in that there are one or more satellites visible from any given point.

In the summer of 2016, Manx Telecom and Globalstar are targeting a trial service of FRAN involving parties from the emergency services community.

According to Jay Monroe, the Chairman and CEO of Globalstar, the EMN solutions will ensure that first responders can continuously communicate and help them to perform their crucial roles far more effectively. Gary Lam, the Manx Telecom CEO, added that his company's Strongest Signal SIM technology will provide much-needed balance and backup to the emergency communications architecture and will dramatically increase overall reliability.

globalstar.com/

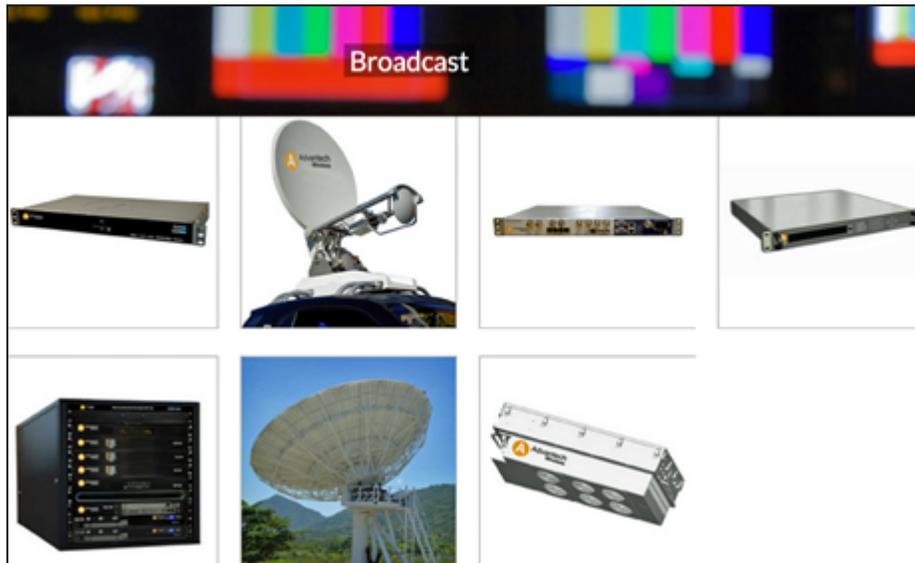
manxtelecom.com/

Features

Coastal Mapping & Monitoring... An EO Opportunity For The O&G Industry	18
<i>By Dr. Peter Hausknecht, Earth-i</i>	
An ORBIT Case In Point: New Opportunities For EO	22
Reaching Out To The World... The Commercial Value Of The Human Touch	24
<i>By Anver Anderson, STN</i>	
The Internet Of Space	26
<i>By Genaro Grajeda, Elara Communications</i>	
Illuminating Global Awareness	28
<i>By Rakes Narasimhan, BlackSky</i>	
GOES-R... Providing Better Data For Hurricane Protection	30
<i>By Liam Jackson, Penn State</i>	
Satellite Imagery Maps The World	32
<i>By Marie-Pierre Boutin, PlanetObserver</i>	
The Challenges Faced By Teleports & Ground Stations.....	34
<i>By Andrew Bond, ETL Systems</i>	
Focus: Designing A Multi-Purpose Satellite Tracking System.....	38
<i>By Peter Karabanow, Hiltron Communications</i>	
A Big Impact On Satellite Design: Miniature Valves.....	42
<i>By Bryan Reid, Marotta Controls</i>	

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Bringing Their GaN Plan To A New Broadcast Satellite Modulator



Advantech Wireless demo'd their new WSM-5000 DVB-S/S2/S2X High Throughput Wideband Broadcast Satellite Modulator at NAB2016—the unit is designed to transmit carriers of up to 600 MHz.

Efficiency improvements of up to 30 percent result from the combination of single high throughput carrier operation on a typical HTS transponder, the lowest roll-off in the

industry, unpaired signal clarity, low SNR support and the Ultra-Fast ACM+AUPC compensation capabilities of the WSM-5000.

The new Wideband Broadcast Satellite Modulator was developed to meet the needs of broadcasters as well as broadband providers. The WSM-5000 supports ETSI EN 302 307 DVB "Annex M" features such as time slicing, to enable the mixing of broadcast and broadband

services over the same satellite carrier for improved deployment flexibility; allowing deployment of this efficient transmission architecture in virtually every HTS network.

Additionally, while at NAB2016, Advantech presented the details of their Ultra HD ready satellite solution for broadcast applications at a meeting of the Sociedade Brasileira de Engenharia de Televisão (SET).

Anderson Markiewicz, Vice President, Sales, Latin America at Advantech Wireless, discussed the latest developments of using Gallium Nitride (GaN) technology SSPAs for Ultra HD TV transmission and Advantech Wireless' A-SAT-II™ solution that dynamically adapts to multiple applications to minimize and automate network operation, optimizing the use of the satellite resources, and providing best user experience.

Designed to guarantee reliable transmission over satellite even in harsh and hostile conditions, Advantech Wireless solutions for Broadcast Applications enable mobile TV contribution in High and Ultra High Definition.

www.advantechwireless.com

Advertiser Index

Advantech Wireless.....	13
Arabsat Satellite	9
AvL Technologies	7
Bartington Instruments	15
CASBAA Singapore	37
CPI Satcom Products	11
HILTRON Communications	19
International Astronautical	35
ND SatCom.....	cover + 3
Newtec CY	5
SatFinder	41
Singapore Exhibition Services	29
Teledyne Paradise Datacom	17
W.B. Walton Enterprises Inc.	21

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NSSLGlobal Navigates To A Majority Ownership Position Of Marine Electronics Solutions

NSSLGlobal has acquired majority shareholding of Marine Electronics Solutions Ltd. (trading as UK Electronic Solutions Ltd.), a specialist in installation, maintenance, supply and development of communications and navigation products and solutions for the maritime, government, offshore renewables and oil & gas sectors.

The further strengthening of the already existing long term strategic relationship will allow these companies to pool their engineering expertise to provide their respective customers with an enhanced global support, as well as a broader product and service offering for both existing and new customers.

Sally-Anne Ray, Group CEO of NSSLGlobal, said, "For NSSLGlobal, this is a logical next step in our long-lasting and well-proven partnership with UK Electronics Solutions. Besides increasing our service engineering capability with an additional team of highly skilled and customer focused system & service engineers NSSLGlobal will also further strengthen its service and support reach in UK, and the North Sea Region, which is strategically important for our activities in the UK, Germany and Denmark. In addition, UK Electronics Solutions have a number of interesting developments and value-adds that we see becoming an integral part of our future maritime and offshore offering."

Paul Rutherford, the Managing Director of UK Electronics Solutions Ltd., said, "NSSLGlobal

and UK Electronics Solutions have already enjoyed a strong cooperation on service, products and solution development, which with this deal will become even stronger and benefit both companies and our customers. We welcome being able to provide our customers with a broader and more competitive hardware, airtime and service offering through NSSLGlobal's market leading solutions."

As part of this deal, Paul Rutherford will join the NSSLGlobal management team and will continue to lead UK Electronics Solutions as well as taking an active role with NSSLGlobal's UK based service engineering teams.

nsslglobal.com/

Controlling Interest Of O3b Networks Now In SES Hands



SES S.A. has agreed to increase their interest in O3b Networks (O3b) to 50.5 percent and, in doing so, will take a controlling share in the company—the transaction is subject to regulatory approvals which are expected to be completed during H2 2016.

SES will pay USD 20 million to increase its fully diluted ownership of O3b from 49.1 to 50.5 percent, bringing its aggregate equity investment in O3b to date to USD 323 million (EUR 257 million).

On completion, SES will consolidate O3b's net debt, which is currently USD 1.2 billion. The transaction is expected to generate returns exceeding SES's hurdle rates for infrastructure investments.

This investment strengthens SES's differentiated global network and capabilities and enhances the company's growth strategy in the following ways...

- » Expands SES's global reach and satellite-enabled solutions by complementing SES's GEO network with O3b's unique, 'game-changing' global solution, in operation since September 2015
- » Augments SES's differentiated capabilities in Enterprise, Mobility and Government by adding O3b's dynamic suite of products and customers

» Enhances SES's foundations for sustainable growth with O3b's strong growth outlook underpinned by its unique service offering

O3b delivers a unique capability and solution, which is already in operation, for Enterprise, Mobility and Government clients, particularly for applications where low latency is an increasingly essential feature.

The combined GEO/MEO satellite network and capabilities give SES a truly compelling and differentiated service offering within the industry, strengthening SES's unique positioning across the data-centric markets.

The consolidation of O3b is expected to generate annualized revenues of between USD 32 million and USD 36 million per satellite at steady-state. Looking forward, both SES and O3b will benefit from the strong synergies and strategic fit across both businesses."

O3b Networks operates a constellation of 12 High Throughput Satellites (HTS) in a Medium Earth Orbit (MEO) around 8,000 kilometers from the Earth. The company offers customers a 'fiber in the sky' solution, with each of the constellation's beams capable of delivering up to 1.6 Gigabits per second (Gbps) of throughput at a low latency of less than 150 milliseconds, a significant improvement over geostationary connectivity. Since the start of commercial operations

in September 2014, O3b has become the fastest growing satellite network in history in terms of contracted capacity. The company now serves more than 40 Enterprise, Mobility and Government clients across 31 countries.

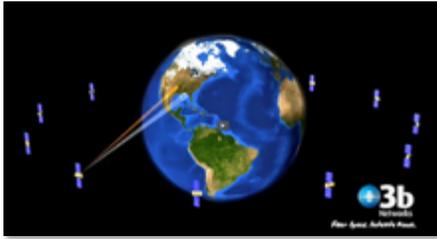
To date, more than 50 percent of customers have already upgraded their initial service commitments, demonstrating the attraction of O3b's unique and 'game-changing' solution. Consequently, O3b has a fully protected contract backlog of USD 350 million.

O3b's global customer base includes Digicel Pacific, Royal Caribbean Cruise Lines, American Samoa Telecom, Speedcast, Rignet, Bharti International (Airtel), Timor Telecom, CNT Ecuador, Entel Chile and (via SES Government Solutions) the U.S. National Oceanic and Atmospheric Administration (NOAA).

O3b has procured an additional eight satellites to accommodate rapidly-expanding demand, with four satellites expected to be launched during H1 2018 and the remaining four satellites expected to be launched in H2 2019. These procurements will increase the size of the current fleet from 12 to 20 satellites (including three satellites currently flying as in-orbit back-up).

At 'steady-state' utilization, which is targeted to be achieved by the end of the third year of a satellite's commercial service, the full operational constellation is expected to generate annualized revenue of between USD 32 million and USD 36 million per satellite.

O3b is expected to generate revenue of more than USD 100 million in 2016, nearly doubling the revenue recorded in 2015. The company's operational and financial performance trends are currently consistent with the criteria that SES requires to be satisfied before moving to control, including significantly improving EBITDA.



The acquisition is expected to become free cash flow accretive to SES (before financing activities) by 2018 and become net income accretive to SES by 2018/2019.

As part of the IFRS purchase accounting treatment, the transaction will give rise to recognition of a gain of approximately USD 500 million relating to the remeasurement to fair value of the current non-controlling interest in O3b.

The final amount will depend on the closing date of the transaction. SES's BBB/Baa2 investment grade credit rating is expected to be re-affirmed by Standard & Poor's and Moody's.

Having agreed to acquire a controlling share of O3b, with the ensuing consolidation of the company's debt, SES will assess over the coming months the optimization of the enlarged group's funding structure. SES is committed to maintaining its progressive dividend policy.

The Board of O3b Networks has agreed to evaluate an Initial Public Offering (IPO) process for the remaining 49.5 percent of O3b shares, following receipt of the requisite regulatory approvals and the subsequent completion of SES's increase in ownership to 50.5 percent.

From April 29, 2016, and subject to O3b not having launched an IPO, SES has a call option to acquire all of the remaining 49.5 percent of shares in O3b for a baseline sum of USD 710 million, adjusted for an interest charge, calculated at market rates, to reflect the timing of the potential exercise of the call option.

Any decision which SES may take to exercise the call option will be subject to satisfying the company's stated investment hurdle rates.

Should such an exercise be relevant, and depending on the timing, potential financing sources, including capital markets, will be evaluated to determine the most appropriate financing option, in keeping with the company's commitment to maintaining SES's investment grade credit status (BBB/ Baa2).

A put option, effective from October 1, 2017, and subject to O3b not having launched an IPO, is held by the other shareholders of O3b, under which SES would have the obligation to acquire all of the remaining shares in O3b for a baseline sum of USD 710 million, adjusted for an interest charge, calculated at market rates, to reflect the timing of the potential exercise of the put option.

ses.com/

Lockheed Martin Blasts Off + Takes Students On An Experience Of A Lifetime

How many adults wish these programs, Generation Beyond and STEM, were around when they were thoughtfully planning their futures with their career guidance counselors?

Stand back as today's generation steps out as the first graduates to participate in the STEM and Generation Beyond programs.

Lockheed Martin has launched Generation Beyond, a first of its kind, national educational program to bring the science of space into thousands of homes and classrooms across America.

The Science, Technology, Engineering and Math (STEM) program is designed to inspire the next generation of innovators, explorers, inventors and pioneers to pursue STEM careers.

"Our children—the elementary, middle and high school students of today—make up a generation that will change our universe forever. This is the generation that will walk on Mars, explore deep space and unlock mysteries that we can't yet imagine," said Marilyn Hewson, Lockheed Martin Chairman, President and Chief Executive Officer. *"They won't get there alone. It is our job to prepare, inspire and equip them to build the future—*



Lockheed Martin's Chairman, President and CEO: Marilyn Hewson.



and that's exactly what Generation Beyond is designed to do.^{kj3}Hewson announced Generation Beyond at the opening ceremony of the Lockheed Martin-sponsored USA Science & Engineering Festival, the largest—and only—national STEM event."

The new STEM education program will offer several interactive tools to engage and inspire students and educators:

Online Curriculum: The core element is an online curriculum for middle school teachers and students, including lesson plans for teachers, a virtual field trip and activities students can bring home to share with their families. The deep space curriculum will be shared freely with thousands of middle schools across the country, reaching hundreds of thousands of American students.

Lockheed Martin Mars Experience Bus: In addition to the curriculum, Generation Beyond includes a real-life Mars Experience Bus that will travel the country providing student riders with an interactive experience simulating a drive along the red planet's surface. The Lockheed Martin Mars Experience Bus is the first immersive virtual reality vehicle ever built and replicates 200 square miles of the Martian surface. The Mars Experience was built with the same software used in today's most advanced video games.

Hello Mars App: Lastly, Lockheed Martin has launched a Hello Mars smartphone app, allowing students to find Mars in the sky, travel there virtually and receive real-time Mars weather reports.

The online tools and fun can be found at www.lockheedmartin.com/generationbeyond

Lockheed Martin has played a leadership role in both space exploration and STEM education and the company has partnered with NASA and has participated in every US Space Mission, including each journey to Mars.

Over the past five years, Lockheed Martin has contributed almost \$70 million to STEM programs and maintained strong partnerships with:

- » National 4-H Council
- » Girls Inc.,
- » National Geographic
- » Project Lead the Way
- » National Science Teachers Association
- » Girls Who Code
- » FIRST Robotics

"Generation Beyond is a perfect example of Lockheed Martin's ingenuity in using cutting-edge technology and high quality curricula to encourage young people to explore STEM fields in a hands-on way that will stay with them for a lifetime," Jennifer Sirangelo, president and CEO of National 4-H Council.

"4-H and Lockheed Martin are dedicated to creating interactive, experiential programs that ignite passion for STEM topics in young people, then help guide them down a pathway for a fulfilling STEM career. What better way to engage young students than getting them excited about exploring space?"

www.lockheedmartin.com

First Partner For Thuraya's North American M2M Service Is Named... X2nSat



connectivity enables real time monitoring and control to support applications in the government, utilities, remote banking, O&G and mining sectors," he said.

Bilal El Hamoui, Chief Commercial Officer at Thuraya, is extremely confident of this partnership and that this agreement will further enhance the company's commitment to provide end users with the best solutions, no matter where they are located across the globe. Additionally, he added that the launch of this new service will address the M2M / IoT market that requires a highly efficient, low latency, IP network.

Global satellite communications solutions provider X2nSat is partnering with Thuraya Telecommunications Company to offer an innovative, new, M2M service in North America.

X2nSat is the first to sign a Service Partner Agreement that will offer Thuraya's dedicated M2M service and new terminal to customers in North America.

Thuraya announced in March the launch of their M2M service and FT2225 terminal.

Working in partnership with X2nSat, Thuraya will now be able to further extend its reach into US markets.

The gap in the market between the current 'store and forward' and IP broadband services will now be addressed by the X2nSat solution, according to the CEO of the company, Garrett C. Hill.

"X2nSat will offer the new Thuraya FT2225 fixed terminal, which offers exceptionally efficient bandwidth usage, low latency IP networking and high levels of security. The FT2225 always on

www.x2nsat.com
www.thuraya.com



Thuraya's FT2225 terminal.

Outerlink Global Solutions Obtains FAA STC Okay For IRIS

Outerlink Global Solutions now has FAA STC approval of the company's fully integrated IRIS voice, video, flight data and broadband SATCOM system in the Bell model 206L and 407 series helicopters—the IRIS solution promotes safer operations as well as delivers immediate cost savings and reduced downtime.

IRIS combines multiple features currently available from various vendors into one single solution at a fraction of the cost that an operator would pay for each of the components it replaces. The two onboard boxes, a control head and processor provide continuous aircraft and internal data, audio and video recording. The system can record up to 1,000 hours of data received from over 200 sources, depending on model

type, giving the operator unprecedented insight into the operation of the aircraft. The system also includes internal, always-on wireless connectivity for electronic flight bags ("EFB's") or for continuous data downloads.

With an open architecture and push-to-talk solution, IRIS gives operators the latest communication technology with just one installation. From the ground, crews can monitor aircraft data and receive immediate alerts and warnings when an aircraft exceeds a defined parameter. In addition, pilots and crew can communicate via talk groups using push-to-talk technology.

The software suite accompanying IRIS provides the only integrated time-synced playback of audio, video and flight data,

giving operators insight into how their fleet is being flown. Due to its software-based configuration, IRIS is protected against obsolescence. If satellite providers come up with faster service in other bands, IRIS users can adapt by simply changing their antennas. The adaptability is another cost saving factor for operators to consider when choosing a communication and data-monitoring tool.

IRIS is compatible with a full range of aircraft, from older analog models to the newest on the market. Even with a mixed fleet, IRIS provides an integrated monitoring and communications system for operators. In addition, IRIS meets all aspects of the FAA 135.607 ruling.

outerlink.com/?q=IRIS

ETL Systems To Showcase New Technologies At CommunicAsia2016



ETL Systems will be showcasing their new RF distribution technologies at this year's CommunicAsia in Singapore.

ETL will be exhibiting the smallest matrix of its kind on the market. The new 64 x 64 Hurricane boasts inclusive LNB powering in a 4U compact, modular chassis.

Hurricane's flexible design offers optimized performance and a range of customizable options to suit a particular set of RF needs, such as fiber inputs, variable gain and variable slope which can be individual to each feed.

ETL has also designed new functionality and increased benefits into a series of advanced products.

These new features may be found in the firm's StingRay RF over Fiber and Dextra splitters and combiners.

New StingRay models on display at the show will include redundancy systems for reliability and standalone component modules.

New Dextra models now include options with integrated DC & 10MHz pass.



ETL Systems Dextra splitter front panel.

If attending CommunicAsia2016, take the opportunity to visit the ETL Systems at Stand 1V3-03.

etlsystems.com/

India's Seventh & Final IRNSS Satellite Launched



The launch of IRNSS-1G. Photo is courtesy of R Satish Babu/EPS.

In its 35th flight (PSLV-C33), ISRO's Polar Satellite Launch Vehicle successfully launched the 1425 kg IRNSS-1G, the seventh satellite in the Indian Regional Navigation Satellite System (IRNSS) on April 28, 2016, from Satish Dhawan Space Centre SHAR, Sriharikota—this is the 34th consecutively successful mission of PSLV and the thirteenth in its 'XL' configuration.

After the PSLV-C33 lift-off at 1250 hrs (12:50 pm) IST from the First Launch Pad with the ignition of the first stage, the subsequent important flight events, namely, strap-on ignitions and separations, first stage separation, second stage ignition, heat-shield separation, second stage separation, third stage ignition and separation, fourth stage ignition and satellite injection, occurred as planned.

After a flight of 19 minutes 42 seconds, IRNSS-1G was injected into an elliptical orbit of 283 km X 20,718 km inclined at an angle of 17.867 degree to the equator (very close to the intended orbit) following which the satellite successfully separated from the PSLV fourth stage.

After separation, the solar panels of IRNSS-1G were deployed automatically. ISRO's Master Control Facility (MCF) at Hassan, Karnataka took over the control of the satellite.

Over the coming days, four orbit maneuvers will be conducted from MCF to position the satellite in the Geostationary Orbit at 129.5 degrees East.

IRNSS-1G is the seventh of the seven satellites constituting the space segment of the Indian Regional Navigation Satellite System.

IRNSS-1A, 1B, 1C, 1D, 1E and 1F, the first six satellites of the constellation, were successfully launched by PSLV on July 02, 2013, April 04, 2014, October 16, 2014, March 28, 2015, January 20, 2016 and March 10, 2016 respectively. All the six satellites are functioning satisfactorily from their designated orbital positions.

IRNSS is an independent regional navigation satellite system designed to provide position information in the Indian region

and 1500 km around the Indian mainland. IRNSS provides two types of services, namely, Standard Positioning Services (SPS)—provided to all users and Restricted Services (RS)—provided to authorized users.

A number of ground facilities responsible for satellite ranging and monitoring, generation and transmission of navigation parameters, etc., have been established in 18 locations across the country.

This successful launch of IRNSS-1G, the seventh and final member of IRNSS constellation, signifies the completion of the IRNSS constellation.

India is now one of five countries with its own navigational system, meaning the nation is free of dependence upon other countries for their navigation needs.

The name, NAVIC (Mariners), is in honor of India's mariners and fisherman who have been navigating using the sun and the stars as waypoints for hundreds of years.

isro.gov.in/

Telesat To Obtain Two Ka-Band Satellites

Telesat has procured two prototype Ka-band satellites for operation in Low Earth Orbit (LEO) that the company anticipates launching mid-to-late 2017 as part of a test and validation phase for an advanced, global LEO satellite constellation that Telesat is developing.

Through an authorization issued by Innovation, Science and Economic Development Canada (ISED), Telesat has secured priority rights to certain Ka-band spectrum in non-geostationary orbits (NGSO) at the International Telecommunications Union (ITU) to operate such a constellation.

Telesat has contracted with Space Systems Loral (SSL) of Palo Alto, California, and Surrey Satellite Technology Limited (SSTL) for the procurement of the prototypes.

By drawing on the advanced technologies and expertise of these leading manufacturers, Telesat will test and demonstrate two distinct spacecraft in LEO, a key step in optimizing the design and performance of Telesat's contemplated LEO constellation.

With this contract, SSL currently has 21 LEO satellites in production. SSL also has two GEO satellites in production for Telesat.

According to John Celli, the President of SSL, the prototype spacecraft SSL is providing to Telesat demonstrates the versatility of the company's LEO capabilities, and because of the firm's focus on low cost production, a growing range of satellite contracts are now in SSL's "win" column.

Dave Wendling, Telesat's Chief Technical Officer, offered the fact that the firm's Anik F2 satellite was the first to provide Ka-band high throughput satellite capacity, and that Telesat's global constellation development of advanced, high throughput LEO satellites, which will operate in Ka-band, will offer a number of important advantages for the global delivery of high capacity broadband services.

www.telesat.com/

www.sslmda.com/

sstl.co.uk/



Coastal Mapping & Monitoring... An EO Opportunity For The O&G Industry

By Dr. Peter Hausknecht, Chief Scientist, Earth-i

The SS Torrey Canyon is not a name many will remember—in the spring of 1967, this fully laden oil tanker was navigating toward the docks at Milford Haven in South Wales.

Sadly, through a combination of human error and machine failure, the ship hit rocks off the Cornish coast in South West England—approximately 32 million gallons of crude oil spilled onto extensive regions of English and French coastlines.

This incident's devastating impact on the local environment and the subsequently unsatisfactory clean-up operation led to a number of new laws and regulations that were imposed on the oil industry. One aspect of the UK government's response to the disaster that did work was the monitoring of the oil slick from the air.

The production technologies for the transport of oil and gas have improved since this oil spill event and so has our understanding regarding the sensitivity of coastal environments and the need to minimize all potential threats.

Remote sensing provided a wide overview of the disaster and potential spill impact sites. Today, with the much more common use of satellite images, this information can be quickly collected and distributed to the people that require these crucial observations.

Through the lessons learned and the increased efforts that followed incidents such as the Exxon Valdez and the Deepwater Horizon oil spills, the guidelines for good practice in using Earth Observation (EO) data have been developed and refined.

Documents published by the International Association of Oil & Gas Producers (OGP) and IPIECA (the global oil and gas industry association for environmental and social issues on surveillance), and the Open Geospatial Consortium guidance on the Common Operating Platform (see the references below) reflect current good practice as to how the industry responds to such events.

While the current price of oil (and gas, for that matter) means that there is little impetus to spend money on anything beyond a company's core activities and obligations; however, there is a real opportunity for the entire industry to come together and collaborate on solutions.

The entire oil & gas industry, in collaboration with the respective regulators, could jointly develop their high resolution base line mapping and subsequent monitoring methodologies using as much EO data and technology as required to reach a fundamentally improved knowledge base of the coastal zones around the globe that could be affected by an oil spill disaster.

By working together, familiar guidelines could be created, common analysis methods and reporting developed, prevalent data acquisition strategies generated and a unified industry voice developed to communicate with regulators and to ensure the acceptance of these new methodologies, all based upon the implementation of Earth Observation images.

The industry has already created a body through which such activities could be coordinated. The Sub-committee on Earth-Observation under the IOGP—Geomatics committee—together with the geospatial subcommittee and members from the Environmental committee, they are certainly up for such a task.

Any new disaster will hurt the entire oil & gas industry, not just the individual company or companies who are unfortunate enough to be in charge of and operating the failed asset, all at a time when the industry can least afford such a blow. From a balance sheet perspective, a Joint Industry Project (JIP) to address the coastal mapping and monitoring needs required by each company and the relative costs shared according to their stakes in exploration and production makes a great deal of sense.

Most oil & gas development projects these days are operated as joint ventures, with two, three or even six participating companies reducing the business risk—sharing the efforts required to address any incident and to work together in JIPs makes for more than simply economic sense.

These partnerships will include EO service providers, research and development teams and the oil industry under the guidance of, and with expertise from, the environmental agencies. They would all work together to develop 'state of the art' data models and implementation scenarios that will allow the regular use of EO images. Such joined efforts will obtain the approval and acceptance of the regulators as best practice monitoring methods and, hence, minimize the efforts required for EIAs (Environmental Impact Assessment) in new development projects.



The European Sentinel program is providing their data sets at no charge, as is the United States Landsat mission. These are excellent sources of regular, free data at medium spatial resolution, ideal for timeline monitoring programs, be such on a monthly, quarterly or yearly basis.

When used in combination with high spatial resolution baseline data, they provide an excellent opportunity to use EO methods via a manageable budget. Only if material change or sudden events are detected or if a new baseline is needed will new high resolution data be necessary.

Shared efforts in JIPs would minimize the amount of work required, as the same satellite images will be used only once. As for commercial data, multi-client license agreements are quite common these days at reasonable up-lift costs for multi-user data sets.

This process does require a certain visionary level among environmental management teams in the oil and gas industry—without a vision, many new technologies would not be implemented and firms would not be where they are today.

Coastal environments are the most vulnerable ecosystems affected by any offshore oil and gas incident, even if such cannot immediately be defined as a disaster. The slightest oil contamination, for example, on a coastline with mangroves will dramatically affect such an ecosystem.

Coastal areas are the breeding grounds for the majority of marine life on Earth, whether turtle nesting beaches, coral reefs or flat water estuaries. In light of new incidents, the oil & gas industry must have the best possible baseline maps and monitoring methods in place to minimize any potential impact on these sensitive areas of our planet—to be aware of such methods after the next spill disaster event is definitely too late.

The satellite images on this page—taken recently by Earth-i's high resolution DMC3 constellation—show recent examples of different mangrove coverage along the northern coastline of Australia, some of them close to large oil and gas fields. These areas are isolated and can only be realistically monitored by remote sensing; hence, EO methodologies provide an optimal solution for initial mapping and subsequent monitoring.

Spatial detail, such as individual trees, coastal damage, debris fields, contaminated areas, access tracks or shallow water obstacles just to name a few can be identified. Such detailed information would be very useful both for the preparedness teams and response teams in case of any incident.



Figure 2. Detailed 1 meter spatial data acquired with DMC3 over the Kimberly coast (N Australia, Oct. 2015) showing sandbanks and healthy mangrove habitats along the coast. Image courtesy of Earth-i.



Figure 1. Exmouth Gulf coastal island: Detailed 1 meter spatial subset of DMC3 data acquired over the Exmouth Gulf area (NW Australia, Oct. 2015) showing part of a small island close to Tent Island Nature Reserve. Image courtesy of Earth-i.

earthi.space/

References

IOGP/PIECA:
<http://www.ipieca.org/publication/assessment-surface-surveillance-capabilities-oil-spill-response-using-satellite-remote-s>
<http://www.ipieca.org/publication/assessment-surface-surveillance-capabilities-oil-spill-response-using-airborne-remote-se>

OGC:
<http://www.opengeospatial.org/projects/initiatives/ogpoilspill>

Dr. Peter Hausknecht is a seasoned subject matter expert in Earth Observation and worked with a multitude of sensors and data sets, both airborne and spaceborne instruments during his 25+ years career. He holds a PhD in Geoscience from Munich University with a thesis on an active thermal infrared laser remote sensing system.

Starting in 1986 as a student research assistant at DLR, German Aerospace Centre, he held a position as a research scientist from 1991 to 1997. Subsequently moving to Australia, he was a project manager for a new unique airborne hyperspectral optical and thermal sensor at Fugro Airborne Surveys in Perth.

In 2002, he joined HyVista Corp. as their Senior Scientist working again mostly with airborne hyperspectral data, transforming the operational data processing chain and expanding the international customer base. In early 2007 Peter joined Woodside, Australia's leading oil & gas company, where he stayed until 2015 as the subject matter expert on Earth observation and remote sensing for the company. For a number of years he was leading the GIS, Mapping and Modelling team and successfully supervised quite a number of remote sensing projects within the company.

At an international level, Peter was a founding member of the OGEO (Oil & Gas Earth Observation) interest group in 2010 and later was elected chairman of the IOGP (Int. Association of Oil and Gas Producers) subcommittee on Earth Observation. After leaving Woodside, Peter is further pursuing his career in Earth Observation and currently working with EARTH-I, a newly formed UK satellite data company, as their Chief Scientist.

An ORBIT Case In Point: New Opportunities For EO

New opportunities for Earth Observation have the potential to affect many aspects of our lives, with applications ranging from weather monitoring to disaster control, space research, oil & gas exploration and defense intelligence.

As the need for instant access to up-to-date data and images from small satellites has increased, so has the requirement for a fast and reliable communication link between orbiting satellites and ground stations.

In 2015, Spaceflight wanted to expand its ground station network, which is dedicated to cost-effective spacecraft communications and operations for small-satellite customers, to New Zealand.

One of the most challenging tasks was to enable Spaceflight engineers at their US control station to remotely control the Gaia-100 ground station, located in New Zealand. The site in New Zealand is quite a distance from

the Spaceflight headquarters as well as from ORBIT facilities where the ground station was assembled.

Each of the company's ground stations are sighted to minimize communications latency and data throughput while offering the most comprehensive global coverage.

The company was looking for a reliable Earth observation ground station solution, the Gaia-100 3.7m (12.1 feet) system suited their requirement perfectly.

A Solution

The Gaia-100 series is a high-performance ground station solution for tracking and communication with Low Earth Orbit (LEO) satellites for Earth Observation (EO) and remote sensing applications.



The Gaia-100 offers a small footprint and the radome coverage provides an environmentally shielded system, performing in X- & S-frequency bands and implements a 3-axis design, which eliminates the key-hole phenomenon.

Based on proven technology and an affordable system, the Gaia 100 offers an excellent price performance. These were the main features that Spaceflight was looking for when selecting the Gaia-100/3.7 as their ground station.

Gaia is designed to withstand extreme weather conditions and to handle a broad range of challenging applications. ORBIT's unique Advanced Control Loop™ algorithm guarantees unsurpassed accuracy, and enables Gaia ground stations to meet the most rigorous accuracy standards.

The prediction algorithm embedded into the control loop mechanism guarantees high pointing accuracy and maximum G/T over the tracking period without degradation of gain performance.

Delivery & Installation

ORBIT delivered this standard system to Spaceflight as scheduled in early August of 2015. Upon delivery, teams from ORBIT and Spaceflight collaborated to install, test and deploy the system. After the installation and testing process, which required only a few days, the system was approved for operation.

The Customer's Point Of View

According to Jason Andrews, the Chief Executive Officer of Spaceflight, the ORBIT ground station solutions have been critical to expanding the capability of the Spaceflight network of ground stations, enabling reliable communications between satellites and ground users, which furthers the company's vision to add more capacity across more continents to satisfy more customer demand.

orbit-cs.com/

spaceflight.com/

Editor's note

All article photographs were taken by Or Dadush, System Engineer at ORBIT.

ORBIT is able to offer tailored solutions and highly responsive service to customers with different cultural and technical requirements. The company develops, integrates and installs end-to-end turnkey communication solutions and services for air, sea, land and space applications. Based on a customer-centric approach, ORBIT offers integrated turnkey solutions for defense, government and commercial organizations.

Spaceflight, a next-generation, integrated space services company, is revolutionizing the business of spaceflight by delivering a new customer-centric model for accessing space. A full service launch provider, the company provides a straightforward, cost-effective, and comprehensive suite of products and services including state-of-the-art satellite infrastructure, rideshare capabilities, and global communications networks that enable commercial and government entities to achieve their mission goals.

Headquartered in Seattle, Washington, Spaceflight provides its services through a global network of partners, ground stations and launch vehicle providers.



Reaching Out To The World... The Commercial Value Of The Human Touch

By Anver Anderson, General Manager, STN

With the rate of technological changes throughout our industry, occasionally the human factor can get lost in the noise.

All over the world, teleport operators are asking the identical question, "What is it you do?"

At which point, the teleport representative—whether they be of an engineering or sales and marketing discipline—will reply with more TLAs (Three Letter Acronyms) than you can take a brass-handled stick to with... "Oh we do VSAT, IP, MPEG2, MPEG4, H264—and H265... sometimes with HEVC for UHD TV and in 4K...but 8K is coming too... or we might backhaul your GSM unless you just need a thick pipe of IP for remote access; unless of course you're just interested in TT&C."

Then, they may go on to ad, "On the other hand, we could convert NTSC to PAL for you and deliver it to the right STB. And don't forget we can FEC from one-half to nine-tenths, but mostly three-quarters for 8PSK in the broadcast market. And don't even get me started on DVBS2x where my gradation of my modcod is so finely stepped I can maximize your throughput to the nth degree—and that's even without ACM"



These are inclusions that have probably populated every PowerPoint presentation any of us have seen during the circuit of exhibitions and conferences for the last 15 years. However, this really isn't what we do... that's how we do what we do.

What we really do is bring people together. Whether via broadcasting cultural content from home, or helping those in remote locations to connect with the rest of the world via the Internet, bringing business to faraway offices, offshore or even out at sea, it's the human connection that really makes a significant difference.

Over the last 20 years or so, world travel has become commonplace, even to the point of the mundane. The growth of diaspora populations originating from nations all over the world has increased dramatically—the movement of the national populations of Europe is a good example.

Often, one of the first activities many travelers engage in when they get to their destination is to call home. As master lyricist Neville Holder once said so eloquently, "The call of home is loud," and that's the case for most of us. On a business trip, for example, a British businessperson will naturally roll through the hotel TV channels until they alight on the BBC news channel—



STN's Network Operations Center (NOC)

in the same way an American might search for the familiarity of a Fox News or CNN or how someone from Turkey will seek out TRT.

Naturally, news is important, especially for those visiting abroad for a short period of time. However, what of the folk who travel and stay, perhaps purchasing a new home, in a new country, where they learn a new language and, for a variety of personal reasons, decide to settle and live within an entirely new culture.

Personally, I've never really understood the term 'ex-pat,' which always sounded to me as if by leaving your point of origin, you lose some right to have a feeling of belonging to your roots. Ex patriot? I think not.

In my view, the majority of people living overseas experience a feeling of increased patriotism and belonging and have a genuine yearning to keep up with what is going on at home and to enjoy programming that is well-known and comforting in their own language. Even—and you might say especially—for those members of the world's security services who work overseas, the need to access Skype or Facebook to make contact with home is crucially important to them.

There are many reports regarding the world's migrated people, notably from places such as India—with reportedly some 3.25 million people of Indian origin living in North America, 1.5 million in the UK, more than 3 million in the Middle East and, again, more than 3 million in South Africa.

The statistics relating to China are also dazzling—3.5 million in the US, 1.4 million in Canada, 1 million in Russia. Another example that you might find surprising—the 1.3 million people who have migrated to Peru from China. Quite amazing what you one discover with some studious Googling!

Whether the country of origin is a population powerhouse such as China or India, or a smaller emergent economy, the increasing mobility and migration of people suggests that there is a significant need all over the globe for information and entertainment programming from home.

Of course, it's not just where you're from—there are other significant factors, as well, that are primarily language and religion. Across the African continent, there is a demand for francophone programming—in DRC,

Madagascar, Cameroon and the Ivory Coast, to name but a few. Additionally, in Canada as well as in some of France's neighboring European countries, such factors are absolute necessities.

There are a plethora of religious channels worldwide. Whether the faith be Christian, Islam, Hindu, Sikhism or Judaism, there's a network of satellites, fiber, terrestrial TV or Internet already in place to extend the reach of their religious ministrations.

The need and requirement to bring people together is equally applicable in a business context, as there is no doubt that every vertical sector or industry is its own unique community of people with shared interests. Suppliers need to speak to customers, service providers need to speak to complementary partners, and everyone needs to speak with their colleagues, wherever they are and whenever the requirement arises, 24/7, 365 days a year.

Today's satellite solutions have powerfully demonstrated how business runs better when communications are reliable. Whether you are building business in a highly developed or in an emerging economy, offshore, or even in the air, satellite connectivity is there.

Today we don't think twice about contacting someone on-board a rig off the Nigerian coast. Similarly, we expect a credit card transaction at a gas station in Kazakhstan to be successfully completed.

All in the satellite industry play an important role in creating the conduit for communications, culture and commerce across continents for the communities of the world. When you're next asked, "What does your teleport do?"

Give them a new TLA... WTPLEE... we touch people's lives, everywhere, every day.

stn.eu

STN helps broadcasters deliver content to audiences using world-class technology and expertise. STN transmits more than 650 TV channels, delivering global service via satellite and fiber from its state-of-the-art teleport facilities in Slovenia.

STN provides playout, encryption, and channel localization services, enabling a range of customers, from global media leaders to multiscreen start-ups, to rapidly and efficiently deploy quality services. STN was recently named Independent Teleport Operator of the Year 2016 by the World Teleport Association.



The Internet Of Space

By Genaro Grajeda, Satellite Telecommunications Project Manager, Elara Comunicaciones

As we enter the second half of the decade, we hear more often about how the Internet of Things (IoT) is changing the way we live in several different ways.

Either through simple home automation to extensive and complicated smart cities, we continue to find different ways as to how technology can make our lives much simpler now than how they were in the first decade of the XXI Century. According to the International Telecommunication Union, IoT is the global infrastructure for the information society, enabling advanced services by interconnecting both the virtual and physical things based on the existing information and communication technologies.

It is not a clear when IoT was born; however, according to Dave Evans of the Cisco Internet Business Solution Group (CIBSG), IoT began taking shape approximately in 2004 and most likely IoT started developing between 2008 and 2009. According to the CIBSG, it is expected that 50 billion devices will be interconnected by 2020.

A 2014 Gartner IT research is more conservative in its projections and expects that by 2020 there will be 25 billion interconnected devices. When considering these number of devices interconnected, it is clear that it will challenge several established technologies and will require, by itself, new and disruptive ways to communicate efficiently.

One of the most interesting challenges will be to offer the throughput and coverage needed to deliver what the users need. It is expected that through GSM, LTE and wireless networks will have the lead communicating IoT devices.

Satellite technology will have its share of the market for IoT. The Internet of Space (IoS), a term coined by the IEEE during March 2016, focuses on how satellite technologies will have an important role interconnecting devices where existing wired and wireless infrastructure fail to do so.

The Northern Sky Research report on IoT over satellite estimates that by 2020 there will be approximately five million connected devices through satellite links; this is a market of approximately US \$2 billion with an expected growth of 6.9 percent each per year.

One of the first markets in which adoption of IoT satellite technologies has been witnessed is in the Oil and Gas (O&G) vertical for which SCADA systems have been connected via satellite for more than a decade. This control and data acquisition systems keep evolving rapidly through the development of newer sensors and user interfaces that allow the analysis of critical data and trends that will much better allow safety and efficient business decisions.



Interestingly enough, SCADA systems were not cataloged as IoT projects until recent times. This is a clear sign on how technology and the way data constantly evolves which opens the opportunity to innovate in the ways we look at services.

It's precisely through breakthroughs and innovation that the satellite industry will have its way with IoT projects. Innovative proposed satellite constellations by big players of non-satellite markets are taking advantage of the possibilities of IoT.

Using Medium and Low Earth Orbits satellites, they will look to offer reduced latency links and higher throughputs at competitive prices to connect the IoT sensors over the world. Other competitors look to develop hybrid solutions where satellite links will provide the extended coverage that will no doubt need to complement the extensive terrestrial links.

When exploring the possibilities of IoT, it is important to notice that some legacy technology will have an important role connecting devices. According to the NSR report for IoT over satellite, more than 90 percent of the services would be provided by Mobile Satellite Services (MSS) working in the L-band.

Legacy infrastructure for MSS will be used by early adopters of IoS to ensure communications for the transport vertical. Nearly 50 percent of the IoT services provided by the satellite sector will be used for the Transportation and Cargo vertical markets. IoT has developed quickly in transport, with the evolution of smart cars and sensors for a variety of roles it should be of no surprise that some of the leading verticals focus on end consumer devices.

The quick development of home automation and of the interesting, yet complex, smart grid are another key development for IoT devices. Some IoT technology is readily available in the market for consumers to start automating their homes, from smart light bulbs to smart alarms and we can now do more with our cellphones to take care of our home needs.

For cities, having readily available information about the use of the electric grid and energy consumption will lead to smarter decisions on how efficient the city is and how savings can be generated using smarter, greener components. The civil government sector will require high availability to ensure the city wide services are working correctly and are obtaining the desired results. Fixed Satellite Services (FSS) should provide a scalable solution in order to provide backup for the needs of the smart cities.

Another thriving sector for IoT will be the Military vertical market, for it is estimated that roughly 30 percent of the satellite IoT market would be secure communications for deployed troops. It is important to note that the military industry has been well known for having standardizing items which, by itself, will be a challenge for companies who will try to connect IoT devices for the military.

The IEEE is looking forward to standardizing the way equipment communicates as well as with proprietary equipment for each country or continent, having a standard means for coalition communication will prove one of the most successful advancement of IoT.

The military must have secured MSS in the field to ensure that the safety and success of the mission is not compromised by any means. Several telecommunication companies have already presented working solutions for the Coalition in Middle East and are working to find a way to standardize communications for several nations who are working together toward a common goal.

The satellite industry is starting to understand the reach of its share of the IoT market. While it seems that the focus of the market will be for L-band services, there are markets for FSS in Ku- and C-bands as well as for the new fleet of High Throughput Satellites (HTS).

As IoT continues to make inroads into our daily lives, so does the scope of IoS with a main goal of grasping the constant growth of consumer needs. Innovative technology will require innovative connectivity solutions for which creative engineering is the only solution. Engineers are already working in new electronics, new antenna arrays and new satellites which will make connectivity readily available, whether you are connecting devices by land, sea, air or space.

The Internet of Things is leading us into a new era of revolutionary technology that hopes to make life safer and easier. Through many devices, several vertical markets will be capable of taking smarter business decisions that will help better understand consumer trends and their general needs.

Satellite telecommunications will have to keep up closely with the growth trend of IoT devices to offer innovative solutions to solve coverage and throughput needs. One of the key components for satellite communications is to provide the needed backup for all projects which require high availability to continue viable operations for users.

The Internet of Space will revolutionize the way traditional satellite communication works and will continue to expand to address consumers needs within our interconnected world.

elara.com.mx/

*Genaro Grajeda is a Project Manager for Elara Comunicaciones, leader of satellite telecommunications, based in Mexico City with extensive experience implementing innovative solutions in the LATAM market. Prior to Elara, Genaro was a science outreach communicator in topics like astronomy and aerospace engineering with several publications in Mexico. Contact the author at **genaro.grajeda@elara.com.mx** or at **linkedin.com/in/genarograjeda**.*

Illuminating Global Awareness

By Rakesh Narasimhan, Executive Vice President & General Manager, BlackSky

On August 14, 1959, the Explorer 6 satellite captured the first satellite images of the Earth.

"When the first images appeared, people would talk about the folds in the Appalachian Mountains," recalled James Irons, a veteran scientist at the Earth Sciences Division at NASA's Goddard Space Flight Center. "For the first time, it was possible to observe from great height what people had been talking about for hundreds of years."

Since then, satellite imaging has evolved and developed into an extremely valuable resource for information about our planet.

Despite all of the technology advancements, there has been little improvement in the time required to deliver satellite imaging data since that first image of the Earth from space was acquired and dispatched nearly 60 years ago.

Today, most satellite imagery is weeks to months old by the time it is received on Earth. While the images are beautiful, how useful are they when they are that outdated? Satellite imaging has the potential to assist with vital humanitarian efforts, the global economy, security and defense, agriculture and more. But how can organizations make informed decisions using information that isn't current?

The existing state of the industry is partly due to the fact that satellite imaging is no easy task. Expertise is required in a variety of fields that include space, hardware, processing, software and communications through networks and radios.

The other aspect that has slowed the progression of this field is the cost, as that has affected most areas of the space industry. Accessing space is undeniably expensive and has consequently been restricted to those with deep pockets. As such, the valuable information obtained from space missions is limited to quite a small number of organizations.

As a society, we are constantly searching for new and better sources of information. With advancements in technology, expanded connectedness and new commercial space launch models, satellite imagery has much to offer in our quest for knowledge. Satellite imaging has the potential to be a source of extensive information and can also offer the immediacy required to make a significant impact on critical global concerns. If providers of satellite imaging capitalize on these advancements to decrease cost and increase the speed whereby images are supplied to their customers, they can improve the efficacy and accuracy of the data collected.

Consider Amazon Web Services, a comprehensive, evolving cloud computing platform that enables businesses to operate more effectively, efficiently and securely in the cloud. By creating a scalable software platform that addresses the market's need for a one-stop shop, Amazon is able to offer services that help businesses across the globe remain active and nimble. BlackSky aims to be the first company to apply a similar model to satellite imaging.



BlackSky intends to provide a way to look at our planet in near real-time to enable companies, organizations and governments to make far better informed decisions. With a constellation of 60 high-resolution microsattellites, this will be the first company to offer satellite imaging as a service. The distinct business model and massive infrastructure will position BlackSky to address and transcend the industry's current status quo with improvements of the following key elements:

Persistence and Revisit Rates

This is the key to unlocking the potential of satellite imaging—the secret sauce, if you will. It's only possible with a well-built and scalable infrastructure. With a constellation of 60 imaging satellites orbiting the Earth, BlackSky will have the ability to pass over key zones hourly—not just daily or weekly. BlackSky's frequent revisit rates will cover 95 percent of the Earth's population and will pass over major economic areas and large cities as many as 40 to 70 times each day. The images will be fresher, more current and will tell a more comprehensive story.

User Experience

Customers are looking for an intuitive system they can operate with ease and that will ultimately provides them with a high-quality product. They want to task a satellite or peruse a database of available images, which is currently a complicated and lengthy process. BlackSky's software platform is scaled for the Web and allows customers to rapidly request, receive and interact with satellite imagery via the Internet or even a mobile phone.

Cost

Due to the high cost of satellites and the launch process, most companies have traditionally owned only one or a handful of satellites. BlackSky's investment in an infrastructure of this size ensures our customers will benefit from scale advantages including tremendously decreased costs—roughly one-tenth of the cost of current industry standards.

BlackSky is implementing a revolutionary business model to help the global community see the world in a way that the planet has never been seen before. Space is no longer a distant dream or a fantasy. Space is a critical component of global comprehension and the time is now that we start to unearth the data that can only be discovered from the vantage in space.

With this enhanced global awareness, everyone can delight in a more complete understanding of the dynamic world we live in, leading to better informed decisions and a better planet for us all.

blacksky.com/

GOES-R... Providing Better Data For Hurricane Protection

By Liam Jackson, Penn State

The launch of the GOES-R geostationary satellite in October of 2016 could herald a new era for predicting hurricanes, according to researchers.

The wealth of information from this new satellite, at time and space scales not previously possible, combined with advanced statistical hurricane prediction models, could enable more accurate predictions in the future.

"For decades, geostationary satellites such as the GOES series have been the primary tool to monitor severe weather like storms and hurricanes in real time," said Fuqing Zhang, professor of meteorology and director of Penn State's Center for Advanced Data Assimilation and Predictability Techniques. *"They have helped people see what's going on in the present, but, until now, we as a community have not been able to tap into these resources to guide us to predict future severe weather."*

Geostationary satellites such as the GOES series orbit the Earth at a fixed location, taking snapshots of cloud formations and other meteorological information. The National Oceanic and Atmospheric Administration (NOAA) operates GOES with contributions from NASA.

Historically, two main challenges exist when using satellite data for hurricane predictions—the type and amount of data collected. Satellites do not directly measure many quantities related to a hurricane's intensity, such as surface pressure, wind speeds, temperature and water vapor beneath the cloudy regions of the hurricane eyewall.

They do, however, collect data known as brightness temperature, which show how much radiation is emitted by objects on Earth and in the atmosphere at different infrared frequencies. Because all objects naturally emit and absorb different amounts of radiation at different frequencies, the complexity of data poses challenges to researchers hoping to use these data for hurricane prediction models.

"At some frequencies water vapor absorbs moderate amounts of radiation passing through it, at other frequencies it absorbs most of that radiation and at other frequencies it absorbs hardly any at all. Unlike water vapor, clouds strongly absorb radiation at all of these frequencies," said Eugene Clothiaux, professor of meteorology at Penn State.

"Comparing measurements at different frequencies leads to information about water vapor and clouds at different altitudes above the Earth. This begins to tell us about the physical structure of water vapor fields and clouds, including those in the area around a hurricane," he added.

Using brightness temperature satellite data to improve model forecasts of hurricanes is not straightforward. Brightness temperature information is a complex mixture related to the ground, atmospheric water vapor and clouds. The team had to develop a sophisticated analysis and modeling scheme to extract information in useful ways for model forecasts.

Zhang, Masashi Minamide, graduate student in meteorology, and Clothiaux demonstrated in a pilot study that it is becoming feasible to use brightness data. They found definitive correlations between measurements of



Penn State researchers found a better way to use satellite data in hurricane prediction models, which could revolutionize future hurricane predictions. Pictured is satellite imagery of Hurricane Karl, which was the focus of the researchers' proof-of-concept study.



Artistic rendition of the GOES-R satellite. Image is courtesy of Lockheed Martin.

brightness temperature and information about the storm—wind speed and sea level pressure underneath the hurricane. They reported their results in *Geophysical Research Letters*.

Using data from GOES-13, the team completed a proof-of-concept experiment, analyzing data from Hurricane Karl in 2010. They used the Penn State real-time hurricane analysis and prediction system that Zhang and his team have been developing and refining for nearly a decade.

“Hurricane prediction models work by chunking individual blocks of the hurricane and this starts from the initial information that is fed into the model,” said Zhang. “We then run an ensemble of possible outcomes for the hurricane using different variables to estimate uncertainty and this tells us how the hurricane might behave. If we are able to use a higher resolution for the initial state, this could allow us to vastly improve hurricane predictions in the future.”

GOES-13 provides data at a resolution of 2.5 miles, and GOES-R will increase that to under 0.6 miles for some frequencies of brightness temperature. The increase in resolution is especially important because of the size of hurricanes. The eyewall, the layer of clouds surrounding the eye, varies in size but is roughly 6 miles thick.

Using GOES-13 brightness temperatures with 2.5-mile resolution, the eyewall is often grouped together with other parts of the storm, with only one or two brightness temperature measurements from only the eyewall itself. A 0.6 mile resolution brightness temperature measurement would

allow for up to 10 eyewall measurements to be fed into prediction models as separate chunks of information instead of grouped together with other parts of the storm.

This new data source could have implications on the longstanding challenge of predicting hurricane intensity, Zhang said. Researchers know that wind speed and other levels of activity near the eye of the hurricane are linked to future intensity, but actually collecting these data is difficult. Today, NOAA uses airborne reconnaissance to collect data, but this is only possible when the storm is within flying distance. Satellites that constantly monitor the oceans at high spatial and temporal resolution and with many frequencies of brightness temperature, like GOES-R, could remove that constraint.

“Geostationary satellites are there all the time, which makes them ideal for capturing the initial and evolving states of hurricanes, including the crucial information in the cloudy region of the storm,” said Zhang. “Using satellite data more effectively could potentially revolutionize hurricane monitoring and prediction for many years.”

Editor’s note:
The above article is reprinted from the *Science Daily* online source site, and presents materials provided by Penn State. The original article was authored by Liam Jackson.

Satellite Imagery Maps The World

By Marie-Pierre Boutin, Sales and Marketing Manager, PlanetObserver

To study the market of commercial versus non-commercial imagery and to then assess the capabilities and assets of each offering is more than just an interesting exercise.

Although raw non-commercial imagery is available at no charge, there is a growing business for high value-added products—PlanetObserver is playing a key role in that sector of the imagery market.

The commercial satellite industry has seen many new actors and satellites come into the market over the past years and there is a clear trend toward very high resolution data. There has been a significant improvement in the competitiveness of international very high resolution sensors.

The current commercial market is divided between two sets of players: the big and the small satellite companies.

Big satellite companies, such as DigitalGlobe and Airbus Defence & Space, have been in the Earth Observation (EO) market since the late nineties. Those players develop satellite constellations offering high quality and high accuracy imagery at meter and sub-meter resolution.

Then, on the other hand, the small satellite market sector has grown rapidly during the last decade. Small satellite companies focus on low-cost satellite constellations that enable lower cost design as well as low mass and size. Frequent revisit is another asset of miniaturized satellites. Small satellites basically provide an affordable solution for optical EO.

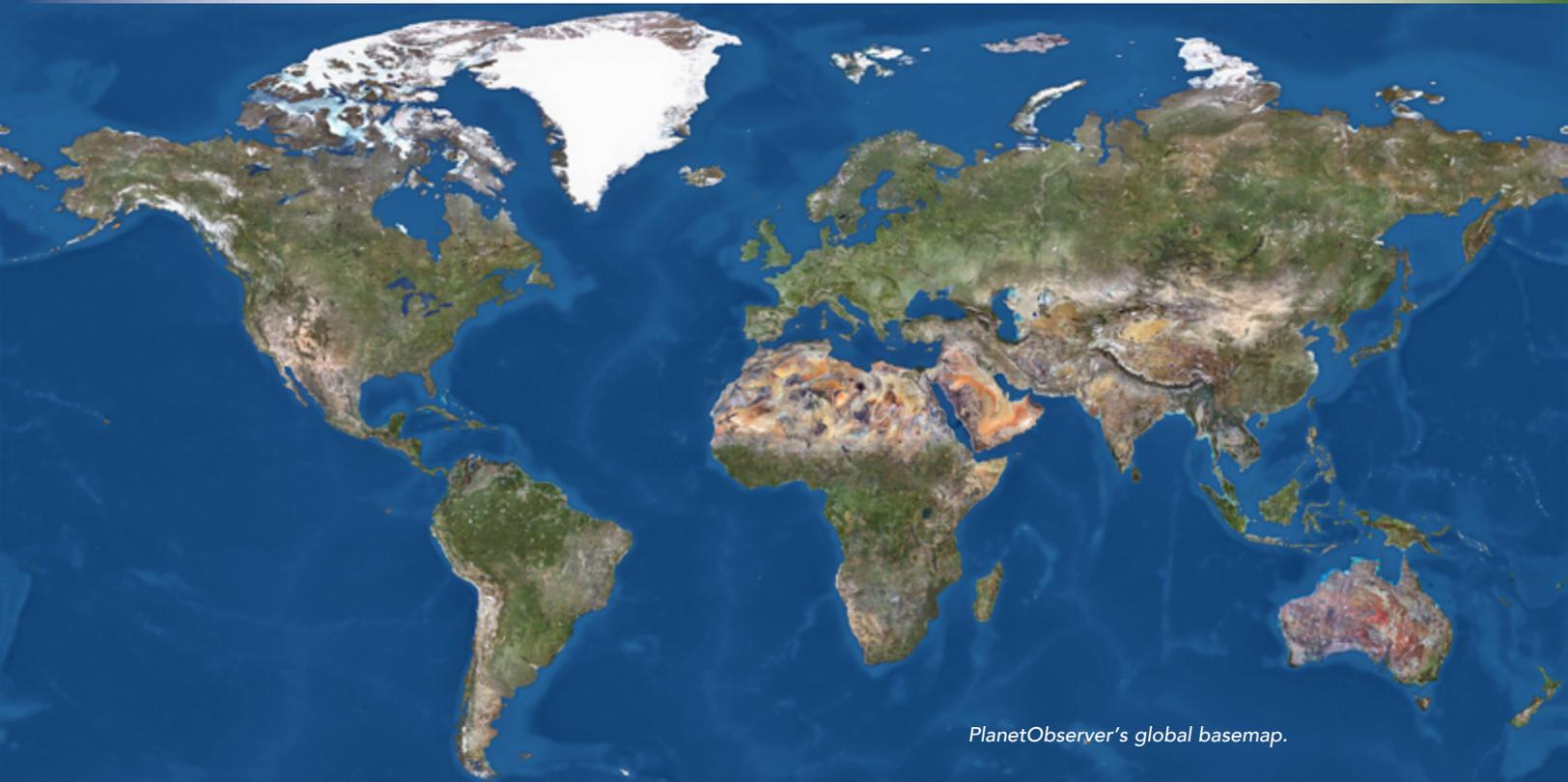


Amsterdam, The Netherlands.

Defense and intelligence applications continue to account for the majority of commercial satellite data consumption. However, more and more applications are developed for the civil market, including location-based services such as energy, agriculture and forestry.

How does non-commercial imagery position itself toward the commercial satellite market?

Non-commercial imagery has been available for decades. The most emblematic, non-commercial, EO program is, of course, Landsat. Developed by NASA and USGS, Landsat represents the world's longest, continuously acquired collection of space-based, land remote sensing data.



PlanetObserver's global basemap.



Sydney, Australia.



Doha, Qatar.

Although the Landsat series of satellites was birthed in the early seventies, Landsat data have been made available to all users free of charge only since 2008. The excellent data quality, consistent global archiving scheme and free access led to a large increase of Landsat data users. Data from the Landsat 8 satellite, which is the most recent satellite in the Landsat series, became available in 2013.

Europe also actively contributes to the Earth Observation market. The Copernicus, previously known as GMES (Global Monitoring for Environment and Security), is the European Program for monitoring the Earth. The target is to establish an autonomous Earth observation capacity.

The European Space Agency (ESA) is currently developing the Sentinel missions that include radar and optical imagery for land, ocean and atmospheric monitoring. Successfully launched in June 2015, the first Sentinel-2 satellite provides high-resolution, wide-swath optical imagery for land services. With a ground resolution of 10 m per pixel, Sentinel-2 satellite images are detailed enough to show individual buildings in large cities, agricultural plots and port infrastructures.

What do non-commercial imagery data have in common? The first goal of non-commercial geospatial information is to help users to understand how Earth and the planet's climates are changing. Non-commercial imagery is a unique resource for global change research and applications in many fields, from agriculture and cartography to regional planning and education. Another key aspect is that non-commercial imagery data focus on medium to high resolution and are freely available for download from different platforms.

How do private operators take advantage of non-commercial imagery?

Many operators provide an entire array of services based on non-commercial data that range from the retrieval of imagery data to the final image processing, spectral analysis and interpretation services. Other companies focus on high value-added niche products that have been developed from non-commercial imagery.

PlanetObserver was established with the vision of transforming raw imagery into top-quality global basemaps and is currently one of only a few providers of natural color, seamless, global imagery mosaics.

PlanetObserver global basemap, called PlanetSAT 10, is a multi-source product processed mainly from pan-sharpened Landsat 8 data and,

soon, Sentinel-2 satellite images. Raw input data are carefully selected, processed and balanced to provide high quality color and contrast. With no seams and clouds (or minimal cloud cover in tropical areas), PlanetSAT 10 mosaic covers all of the world's land mass at 10 meter resolution and offers unmatched consistency, completeness and visual appeal.

Recent imagery can be critically important for many applications. As cities and landscapes change constantly, PlanetObserver base map product is continuously updated with fresh and cloudless imagery. New areas are released on a quarterly basis and integrated into the global imagery mosaic.

Getting consistent imagery at the global scale is a major challenge for users across many industries. PlanetSAT 10 full globe, off-the-shelf imagery basemap provides essential background information perfect for mapping solutions, visualization and simulation tools and moving map apps.

Virtual globes represent one of the many applications that largely use global imagery backdrops. Whether for civil or military simulation markets, the visualization of global geographic environments requires high quality baseline imagery. PlanetObserver GIS-ready global basemap meets all industry standards, including strict accuracy, which is required to fit with any other vector or raster information layer. PlanetSAT 10 imagery product provides a perfect complement to very high resolution imagery by offering high quality consistent views at regional, country-wide or global scale.

The media and broadcasting industry are also heavy consumers of high quality imagery backdrops and geographic animations. Developers of cutting-edge weather graphics systems and content production solutions enrich their software packages with PlanetSAT 10 ready-to-use basemap.

End-users that range from TV stations to national weather services benefit from the most recent and high quality imagery products.

For these industries and others, PlanetObserver provides an off-the-shelf solution offering geo-located context that enables users to better understand and analyze specific areas of interest at regional to global scale.

planetobserver.com

Ms. Boutin joined PlanetObserver in 2001 where she held leading positions in Sales, Marketing and International Business Development. Ms. Boutin holds an MBA degree in International Business and Marketing from Edinburgh University, United Kingdom.

The Challenges Faced By Teleports & Ground Stations

By Andrew Bond, Sales Director, ETL Systems

The consumer growth for satellite services, such as pay TV and Direct to Home (DTH), has increased the pressure from consumers who demand more and bandwidth improvements in signal modulation—this means new satellites are required to ensure current and future customer satisfaction with SATCOM services.

Let's put this exponential rise in services into context... according to Netflix, the company now has 81 million members in more than 190 countries who enjoy more than 125 million hours of TV shows and movies per day, including original series, documentaries and feature films. Members can watch as much as they wish, anytime, anywhere, on nearly any Internet-connected screen. They can play, pause and resume watching, all without commercials or commitments.

There is a growing lack of desire for basic TV packages and millions of consumers are tempted by the offerings from services such as Netflix,

Hulu, Amazon, Crackle and others. These needs will drive the expected, overall global pay TV subscriber base to pass 1.1 billion customers by 2020.

Such a dramatic, ongoing increase in content streaming equates to the fact that bandwidth capacity is being stretched as has never previously been experienced by the industry.

This demand for increased capacity means that teleports and ground stations must invest in ground infrastructure technology to support increased capacity requirements. RF equipment has to operate over higher frequencies, escalating pressure on equipment rack space. Space savings are crucial to successful operations. Infrastructure must also possess the ability to increase capacity when the need arises, as well as to provide improved RF signal quality.



Where do we go from here? At ETL Systems, a global designer and manufacturer of RF distribution equipment for SATCOMs, the company has recognized the pressures faced by teleports that must invest in technology that can deliver seamless transmissions. ETL Systems has, therefore, developed a range of new technologies for satellite RF distribution.

Traditionally, the transmission of RF signals from a remote satellite dish farm to main control rooms and vice versa have been handled by copper coaxial (or coax) cables; however, as teleports increase their operations, this option is no longer suited to satisfy the presented conditions.

Copper coax cables—which carry electrical signals—have several shortcomings; they are bulky and offer only restricted bandwidth. There's also an increase in loss to the signal quality and that limits the distance within which they can transmit RF signals. Weather conditions also have an impact on signal continuity as coax cable is a highly suitable conductor for lightning. This adds to the risk of signal loss and expensive downtime.

To combat these shortcomings, improvements in satellite downlink designs are being noted. Operators are improving their signal monitoring, redundancy and quality.

To support operators, a range of RF over Fiber products have been developed by ETL Systems—known as StingRay, this technology has made significant strides to meet the ever-growing demand for bandwidth.



ETL Systems' StingRay.

The significant growth in teleport size and bandwidth demand makes fiber the perfect alternative to copper as it has a much higher information carrying capacity, with wavelength division multiplexing to place multiple feeds via a single fiber.

StingRay's high performance design offers excellent module to module isolation, making the product ideal for high isolation applications. With StingRay modules, signal quality and RF performance is preserved and that includes high isolation between modules and low IMD3, ensuring maximum efficiency in spectrum usage.

The company's range of matrices provide efficient routing of RF signals from multiple satellite feeds with added resilience and reliability from dual redundant power supplies and hot-swap components for complete 24/7 operation. Matrices are typically used in mission critical applications, such as news and sports, where downlink feeds are regularly switched to deliver live programming to millions of viewers, with routing solutions minimizing the cost of expensive downtime.

The newest addition to the firm's matrix family, the 64 x 64 Hurricane Matrix, is the smallest of its kind on the market and offers built-in LNB powering. The unique design of the L-band Hurricane matrix allows the customer to select individual input modules that exactly match what each teleport satellite feed requires.



ETL Systems' Hurricane.

Each input port can be tailored with its own modules, allowing the matrix performance to be optimized—the user does not need to compromise the performance of the entire system. ETL's proprietary technology minimizes the power consumption of the matrix, reducing it greatly when compared to traditional matrices.

With the constant changes in the market in mind, all of the company's new products have been designed to be Ka-band ready with an extended L-band operating frequency of 850-2450 MHz and designed in the most compact housing possible.

The 2015 Satellite Industry Association (SIA) State of the Satellite Industry report reveals that the industry's growth has, understandably, continued alongside the increased demand that has arrived with pay TV and DTH. For the 17th year in a row, the global satellite industry posted positive growth, now topping \$200 billion in revenue. Ground equipment revenues are up four percent on the previous year.

With the correct infrastructure in place, continued success is all-but-guaranteed for the satellite industry. Although the driving force behind growth remains the huge demand for bandwidth brought about by Pay TV and DTH, with even more data-hungry trends on the horizon, the industry must prepare now to ensure that ground equipment and teleports continue to be at their most effective to deliver the streaming signals to hungry—and demanding—consumers.

etlsystems.com/

Focus: Designing A Multi-Purpose Satellite Tracking System

By Peter Karabanow, Senior Head of Projects, Hiltron Communications

Hiltron's strategy as a systems integrator has long been to source from third-party suppliers whenever products and components of high quality and reliability are available on the open market. If these products meet these criteria, then the company internally develops and manufactures the required devices.

Becoming apparent during the early 2000s, the communications industry was in serious need of a high precision, motorized satellite antenna mount that was capable of accommodating transmission/reception antennas of up to 3.7 meters in diameter, preferably at an accountant-friendly price.

The Hiltron management team went into a *Wouldn't It Be Nice* mode and, in consultation with customers from the broadcast, telecommunications, aerospace, scientific and defense markets, mapped out a design that would potentially meet a wide range of applications.

The original concept was to include high-grade drives for azimuth, elevation as well as a polarization drive. This would need to be controllable by Hiltron's standard HACU antenna positioning software running on a desktop or a portable PC. A combined head and drive would be incorporated, forming a three axis motorized mount with up to 240 degrees of azimuth adjustment, 90 degrees of elevation adjustment range and fully adjustable polarization.

A choice of support plates would allow the attachment of different types of reflectors, obviously a vital concern to ensure the greatest possible mechanical compatibility. The rotating pedestal mount would need to be made of corrosion-protected hot-dip galvanized steel to provide the required rigidity and weather protection. The azimuth and elevation drive motors would operate through a reduction gear.

Much consideration was given to the azimuth movement. This would ideally be accomplished via an axle bearing with a drive motor allowing the entire satellite arc to be covered from any position on the planet. The elevation movement would be via a jackscrew with a further drive motor.

This design and the use of true angle indicators (optical encoders) would provide highly reliable and very accurate positioning far beyond the stability of commercial grade actuator devices. Low backlash was a vital requirement requiring high rigidity in the construction. The mount would need to be capable of operating in winds of up to 125 km/h and survive up to 200 km/h, subject obviously to the base construction.

The Control System

Ethernet-based control from a remote PC is obviously an important aspect for any modern SATCOM product or system. Hiltron's established ACU software would allow the satellite mount to be monitored and operated via IP-based control from a PC running a graphic user interface compatible with standard web browsers.

The control GUI would be configured to display all the information required to set and maintain azimuth, elevation and polarization, including current position and target position plus a database of potential accessible satellites. Once a satellite was selected, ACU would allow precise access parameters to be calculated at the press of a single button. The ACU would also need to be compatible via SNMP with a remote monitoring and control system.



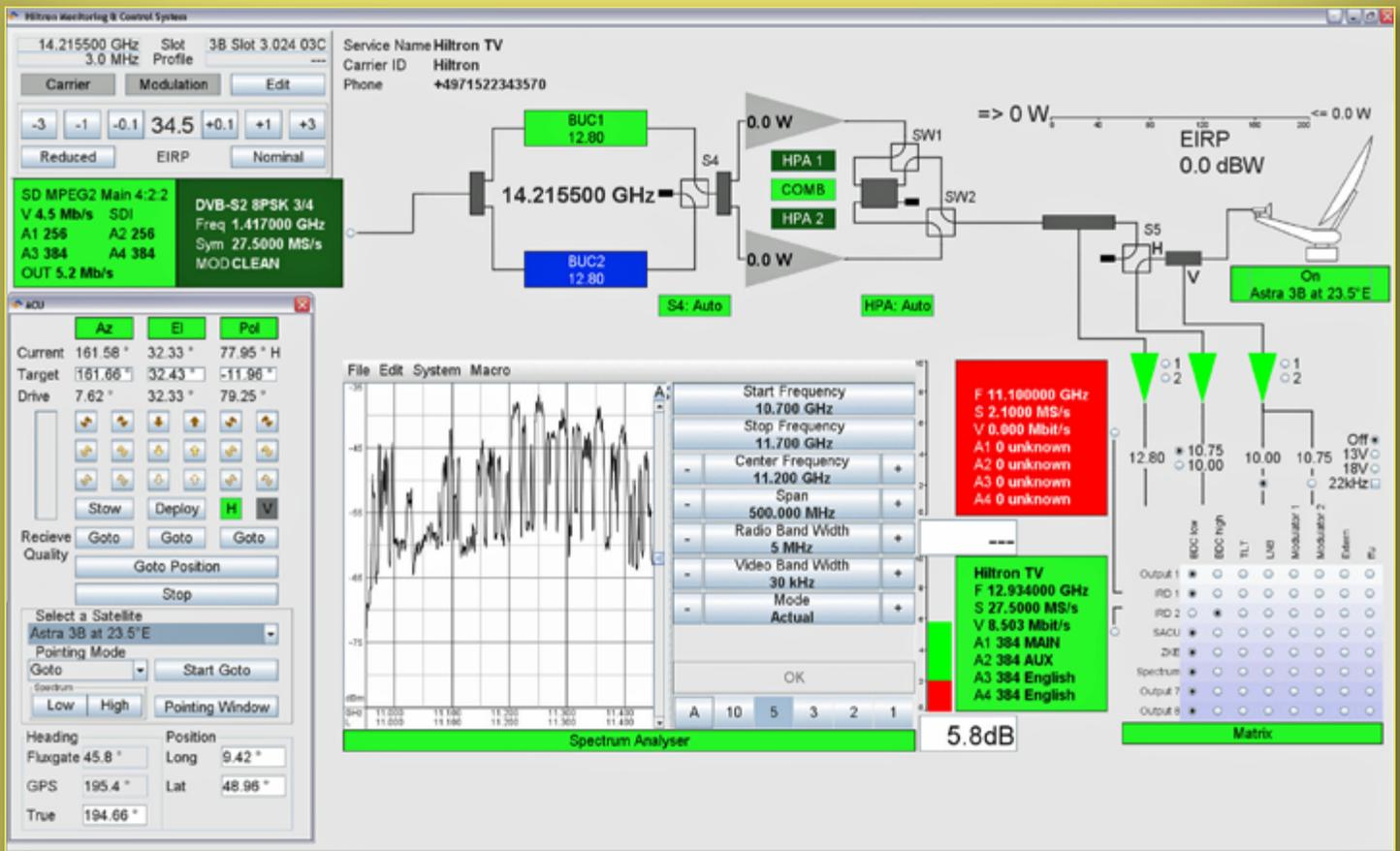


Figure 1. Hiltron HMCS monitoring and control overview GUI.

The developed specification called for azimuth and elevation to be adjustable at up to three different speeds. The mount was available in several versions to match applications, such as inclined orbit tracking, operation across an extended temperature range, integration of a de-icing system in the ACU housing, and so on.

HMAM & SORBAS

From initial discussions based on the above deliberations, the Hiltron team advanced to full-scale technical planning, structural design and then first assembly. Within a matter of weeks, there was a full working prototype of the Hiltron Motorized Antenna Mount or HMAM.

After several months of field tests, HMAM was demonstrated in June of 2010 at Broadcast Asia and, three months later, at IBC. The antenna has since become a core element of SORBAS SATCOM product family. These include the Hiltron HMCS monitoring and control software (please see Figure 1 above), HCS universal control unit, HSACU satellite antenna control unit, HMAM three-axis motorized satellite antenna mount and HDCU de-icing unit.

Central to SORBAS is the HCS-Core (shown in Figure 2 to the right), which is used as a monitoring and control element for tasks such as switching and monitoring of downconverters, integrated receiver/decoders, digital video broadcast encoders, high-power amplifiers and waveguides. HCS-Core is available in 2U high full-rack-width and half-rack-width versions.

The full-rack-width model can accommodate as many as 16 modules and is Hiltron's largest and most versatile satcom controller to date. The current range of cards includes a monitor, control and power supply for fiber optic devices, a fiber-optic switch, LNB redundancy systems for C- and

Ku-band, HPA redundancy control, redundancy for DVB MPEG encoders/modulators/IRDs and a generic monitoring and control module.

The HDCU-E element of SORBAS is a combined ice-sensing and dish heating controller for use with large satellite antennas and is capable of handling up to 450 kilowatts of power across multiple heating groups.

Each group is divided into three independently controlled heater arrays. Each array, in turn, feeds up to three antenna heater circuits. A four-group configuration, for example, allows control of 12 arrays addressing a total of 36 heating circuits. This modular control approach permits easy configuration of parameters such as antenna size, number of heater pads and the power requirement of each pad. Snow detection is via a reflective sensor with a polarizing filter.

Each heater circuit is individually supervised and controlled via user-adjustable minimum and maximum thresholds. Sequential switch-on is



Figure 2. Full-width 2U version of the Hiltron ComSys-Core (HSC-Core) universal satellite communications controller.

performed within the controller to prevent rapid changes in current load when the antenna heating process is activated or deactivated. Sequence timing is user-configurable.

The Hiltron HACU is designed to control three-axis motorized antennas. The antenna control unit and associated motor-control electronics are contained in an IP65-rated weatherproof outdoor housing with a hinged front access port secured by dual key screws.

The HACU can be operated from a PC running a graphic user interface compatible with standard web browsers. The control GUI displays all the information required to set and maintain azimuth, elevation and polarization, including current and target positions plus a database of potential accessible satellites.

LEO & MEO Applications

HHAM—on its own or integrated into a SORBAS system—has a wide range of applications. These include reception of LEO and MEO satellite signals, test and measurement tasks, redundancy antenna control for IPTV, satellite newsgathering, downlinks and uplinks. *Figure 3* shows a Hiltron HMAM with 2.4 meter antenna configured for LEO mission.

Launch and Early Orbit Phase (LEOP) is one of the most critical phases of a satellite mission and demands steady monitoring and control of the parameters from various subsystems 24 hours a day from multiple locations. An antenna system with high accuracy pointing and fast positioning with high reliability is essential. HMAM forms part of a recently completed system which consists of three stations located around the world getting enough visibility to satellite for LEOP mission.



Figure 3. Hiltron HMAM with 2.4 meter antenna for LEOP mission.

The existing HMAM design has been tailored to the LEOP requirements. The HMAM has been fitted out with a 2.4 meter antenna and with two different fixed feeds which enable the reception of C- and Ku-band circular polarized signals without need for mechanical movement of the feeds. Both feeds are localized as near as possible to the focal point of the antenna structure. To switch over the bands, it is necessary to move the azimuth to different angles to receive the same satellite.

Precise calibration of antenna direction is performed by the ACU. This is one of the important requirements for the LEOP mission. Directional accuracy and the controllable antenna travel speed are outstanding features of the HMAM. The absolute pointing accuracy for azimuth and elevation angles is better than +/- 0.05 degrees and the relative pointing accuracy is better than +/- 0.02 degrees within any operable angle range of +/- 2 degrees.

In addition to the high accuracy requirement, the antenna needs to be pointed quickly to the target. This requirement is fulfilled with a maximum elevation drive velocity faster than 1 degree/second in the elevation range 20 to 80 degrees. Maximum azimuth drive velocity is faster than 4° degrees/second over the total azimuth range (240 degrees). These high specification requirements for accuracy and controlled speed are essential to fulfill the challenging task for LEOP mission applications.

The HMAM subsystem for this project will be controlled remotely and is equipped with a wind sensor for antenna protection moving the dish automatically to survival mode for wind up to 200 km/h. As an option the HMAM can withstand winds up to 330 km/h.

HMAM-IOT

The Hiltron HMAM-IOT variant incorporates inclined-orbit tracking. To conserve guidance propellant, older satellites are allowed to drift further from their nominal target position than during their main service life. Operators therefore offer greatly reduced transponder capacity pricing. The HMAM-IOT's advanced tracking capabilities enable the antenna to follow these variations in position and is the ideal solution for cost-efficient uplinks on inclined-orbit satellites.

HMAM-Ka

IBC 2013 saw the introduction of world's first triple-axis motorized 2.4 meter, receive-only, Ka-band antenna with switchable linear and circular polarization. The HMAM-Ka was developed in close co-operation between Hiltron and ESA Microwave, based on a newly designed Ka-band polarizer. Ka-band includes the 21 gigahertz band which is becoming increasingly important for satellite downlinks. The HMAM-Ka can accommodate antennas of up to 3.7 meters diameter and is fully compatible with Hiltron's standard HACU antenna positioning system.

hiltron.de/

About Hiltron

Hiltron is a globally active system integrator, manufacturer and distributor in the field of satellite and wireless communication. The company operates from modern, purpose-built headquarters near Stuttgart, Germany. The company is part of the Danmon Group, one of Europe's leading suppliers of audio, video, transmission products and digital media solutions.

A Big Impact On Satellite Design: Miniature Valves

By Bryan Reid, Director, Business Development, Space Systems, Marotta Controls, Inc.

Miniature satellite valves pack a lot of performance in a small package, yet they are not all created equal.

Whether controlling gaseous substances or fluids, these small but powerful components should be evaluated beyond just latching or non-latching capabilities but also for size, weight and power considerations that increase satellite performance and mission lifetime while decreasing system size and complexity. In addition to making room for more payload, the same small but robust valve strategy creates a critical advantage in the event of system add-ons or changes, equipping propulsion architects with options that prevent costly delays in development.

A uniquely small and versatile valve family demonstrates these benefits; these flexible components helped both the ADM-Aeolus and the LISA Pathfinder platforms by enabling engineers to address unexpected design challenges requiring late changes to initial design plans. The same ultra-small valve family is now a key element of the Spacebus NEO's electric propulsion Xenon Pressure Regulation Assembly (XPRA), and is also being implemented in the Propulsion Module (PM) onboard a second-generation satellite constellation under development. These programs are capitalizing on small size and versatility designed for a broad range of substances and pressure levels, as well as the lowest power and smallest envelope and mass available today.

Smart Design & Packaging In An ITAR-Free Valve

Miniature valves are not new; however, more efficient packaging is redefining the meaning of small. While the torque motor valve has historically been available in a relatively small rectangular shape, Marotta's flight-qualified Miniature Solenoid Valve series demonstrates the packaging evolution. The valve body is only three-quarters of an inch in diameter and about one inch in length.

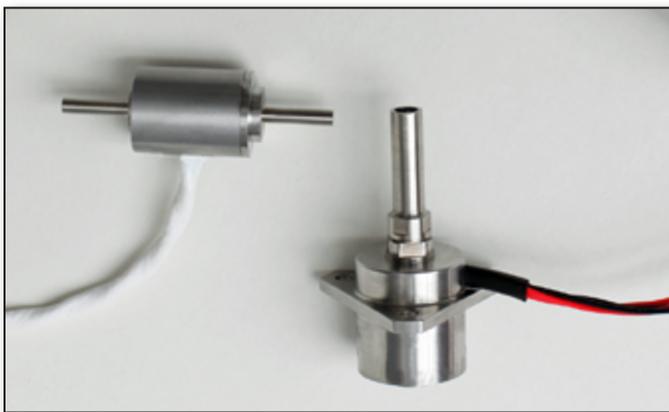


Marotta's MV602 and MV602L valve series have the smallest envelope and mass, and lowest power draw of any miniature latching/non-latching valves available today. Composed of stainless steel, all welded construction and a plastic seat, these valves meet the demand for high reliability, tight leakage and quick response, handling pressure ranges from 0 –4500 psig. Photo is courtesy of Marotta Controls.

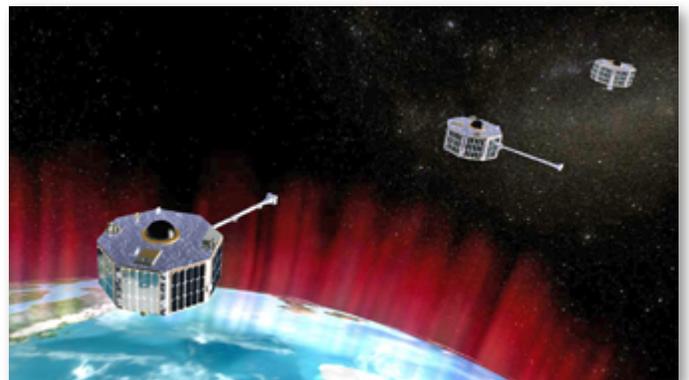
The series includes an MV602L high pressure latching option, a 2-way, 2-position valve that shuttles to the open or closed position either by switching current polarity in the single coil configuration or by energizing the open or close coils in the two coil configuration. In both cases, the valve will remain in the most recently commanded position when power is not supplied. Requiring only a brief pulse of current, the MV602L power consumption is <10 watts peak.

The MV602L's optimized, all welded design provides isolation for the widest range of satellite and spacecraft applications—a capability made even more attractive by the removal of all ITAR restrictions. Originally developed for use in Xenon feed systems, the MV602L's performance is adaptable to handle gaseous high pressure oxygen feed systems and high pressure nitrogen micropropulsion systems while maintaining the same small envelope, cost benefits and pressure capabilities.

Enabling Oxygen System Add-On For ADM-Aeolus



Cold Gas Microthruster and Latch Valve
Photo courtesy of Marotta Controls



NASA's Space Technology 5 (ST5) Mission
Artistic rendition courtesy of NASA

The MV602L latching option is a 2-way 2-position solenoid-actuated latching valve; it is derived from Marotta's Cold Gas Microthruster (CGMT) which was flight-qualified on NASA's Space Technology 5 (ST5) mission as part of the New Millennium program. While the CGMT is essentially a latching solenoid valve with a thruster divergent at the outlet, the magnetically latching, dual coil MV602L incorporates the addition of a tube stub outlet in place of the divergent.

The MV602L's size and weight advantage added unexpected value to the ADM (Atmospheric Dynamics Mission)-Aeolus, one in a series of European Space Agency (ESA) Earth observation satellites and named after Greek mythology's keeper of the winds. Launching in 2017, this first-of-its-kind mission is to acquire wind profiles from the lowermost 30 km of Earth's atmosphere—performed by a laser Doppler wind Light Detection and Ranging (LIDAR) called Aladin, the sole instrument onboard and the first wind LIDAR in space. During development, the determination was made that Aladin's lens required an additional oxygen purge system to maintain an ultra-clean environment. A constant low pressure pure oxygen gas environment of ~100 Pa was necessary to keep Laser Induced Contamination (LIC) at bay during the 3.25 years of mission lifetime.



Using a modified MV602L valve, an in situ cleaning system was implemented to provide branch isolation of prime and redundant feed lines from high pressure tanks as well as pulsed regulation of low pressure feed lines. Minor modifications such as adjustments to the MV602L coil design and the addition of nickel coating ensured compliance and safety performance for pure oxygen use. Most critically, the miniature MV602L valve enabled the addition of the In Situ system to the existing payload design without impact on the project's overall size, weight and power requirements or development timeline.

Adding Cold-Gas

Artistic rendition of the ADM-Aeolus Wind Mission, image is courtesy of European Space Agency (ESA).

Miniature valves from Marotta Controls enabled the addition of an In Situ cleaning system to ADM-Aeolus' existing payload design without impact on the project's size, weight, power and development timeline.

Micropropulsion To The LISA Pathfinder

Building on the ADM-Aeolus experience, the MV602L is playing a role onboard the LISA (Laser Interferometer Space Antenna) Pathfinder (LPF) which was launched in December 2015. The LPF's unique mission is to help develop a different method for observing the universe by detecting gravitational waves, or ripples in time and space as predicted by Einstein's theory of relativity. As a perfectly still physics lab in space, the LPF does not have a typical payload structure; the LPF is a test vehicle for the future eLISA project and the craft itself is part of the experiment.

The LPF's initial design included a Field Effect Electric Propulsion System, but plans changed as mission requirements evolved to include the need for gravitational field control and constraints on low frequency disturbances. The spacecraft had already been built, so the new system had to be developed around existing infrastructure using only unoccupied panel sections and existing electrical interfaces. A Cold-Gas Micropropulsion System was implemented instead, providing the primary actuator for precision thrust systems required to counter external forces such as solar radiation pressure. Flight-qualified in the Gaia mission, the LPF's innovative Cold-Gas Micropropulsion System relies on the MV602L as a key component, essentially handling a controlled leak of inert high pressure nitrogen gas.

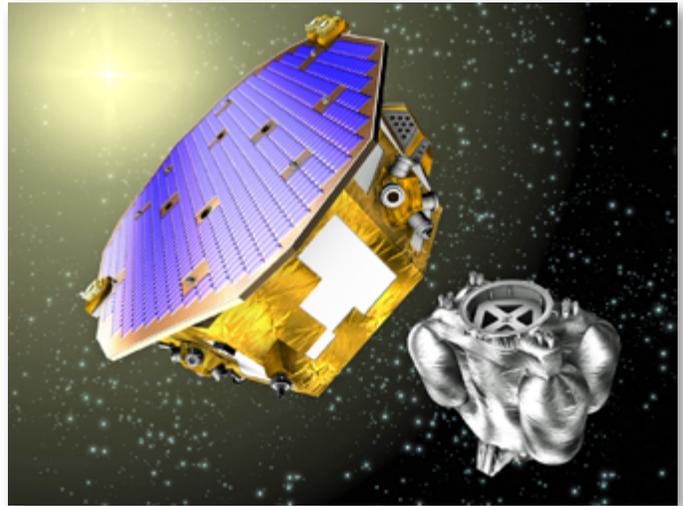
Complementing Multi-Function Valves In Spacebus NEO's Electric Propulsion

The MV602L latch valve is also an essential component within the Xenon Pressure Regulation Assembly (XPRA) used in the electric propulsion system on Spacebus NEO. The XPRA is a notable step in system simplification—essentially this is a reprogrammable digital device, allowing satellite operators to change flow rate or regulate pressure on the fly. Coupled with the MV602L, the device is enabled by a unique Multi-Function Valve (MFV), which acts as pressure regulator, flow regulator and positive isolation valve. The MV602L provides the necessary second barrier to ensure the safety of the high pressure system.

The XPRA's compact design features a smart approach to eliminating leakage and reducing valve count. In addition to providing proportional control during operation, the system's MFV also acts as a system barrier by creating the high sealing force that ensures fail-to-close leak-free operation over its lifetime. Patented and flight-qualified, this flexible device is enabling greater accuracy, robustness and system stability, even while equipping operators with new capabilities to adapt performance remotely over the course of mission deployment.



MV602L Miniature Latch Valve
Photo is courtesy of Marotta Controls



Artistic rendition of the LISA Pathfinder Mission
Image is courtesy of ESA.

The MV602L latching option is a 2-way 2-position solenoid-actuated latching valve; it is derived from Marotta's Cold Gas Microthruster (CGMT) which was flight-qualified on NASA's Space Technology 5 (ST5) mission as part of the New Millennium program. While the CGMT is essentially a latching solenoid valve with a thruster divergent at the outlet, the magnetically latching, dual coil MV602L incorporates the addition of a tube stub outlet in place of the divergent. Photo is courtesy of Marotta Controls.

While competitive with mechanical regulators, benefits of the multi-function system are significant. First, the XPRA's more accurate response characteristics mean the propulsion system requires less contingency over its life, i.e., less Xenon. Secondly, when designing a platform that may use a variety of thrusters with varying output pressures (typically between 1.5 bar and 3 bar), a different mechanical regulator would be needed for each type of thruster—whereas the XPRA can be set to any pressure in this range, easing architecture design by enabling a "one size fits all" strategy.

Non-Latching Valves Drive New Second-Generation Bang-Bang Propulsion Module Under Development

While deployments such as ADM-Aeolus and LISA Pathfinder have found value in adding miniature high pressure latch valves to existing payload designs, a nexgen constellation program has included them from the initial stages of development. The MV602, a non-latching version of the MV602L high pressure miniature solenoid valve, is used in a bang-bang mode in this second generation satellite program, re-pressurizing the Propulsion Module's (PM) hydrazine tanks with gaseous Helium (GHe). After each satellite is launched into low earth orbit, the PM will provide the thrust required to raise the satellite to its final operational orbit. This is the first deployment of the miniature solenoid valve in a bang-bang design, where the valve is pulsed open and closed within milliseconds. This deployment also extends the pressure capabilities of the MV602 valve family, managing up to 4,500 psi (310 bar) of high pressure helium.

Extending Value To Commercial Applications with Constellation Deployments

Miniature valve options such as the MV602 family have significance in the market for constellations. Here satellites step out of their traditional standalone role and into a multi-platform commercial mission—yet they still require the smallest, lightest, most power efficient and cost effective valve package possible, proven to meet the risk and reliability demands of space flight.

Costs are critical, as well, as commercial constellation missions are intended to stay aloft for only a few years at a time, a sharp contrast to Spacebus NEO, for example, with a planned mission life of 15 plus years. This trend will continue as smaller satellites with less power-generating capabilities place an even greater premium on size, weight and power. In this competitive environment, propulsion architects have a new slate of options based on the diverse performance of miniature solenoid valves. For instance, using the MFV and the MV602L, a simplified version of the XPRA could incorporate the entire propulsion system (while still providing the required two safety barriers) in just two lightweight, cost-effective components.

Enabling More Performance & Profits With Less Size, Weight and Power

Ensuring the revenue-generating capabilities of a satellite design has become an even more critical element of the satellite engineer's job. The bottom line is a big part of the design responsibility, and requires key technology and component decisions that are optimized for performance, reliability and versatility. Miniature valves are playing an essential role in this effort, with size, weight and power characteristics that protect development by enabling systems to be added, or offering versatility that can be designed in from the start. Making the right choices can make room for more payload, add to mission lifetime, and ensure the long-term profitability of satellite designs.

Bryan Reid is the Director, Business Development, Space Systems, at Marotta Controls, Inc. Bryan has more than 30 years of experience in the international Aerospace and Defence industry in both technical and commercial roles and he is instrumental in developing Marotta's space strategy and securing significant technology content on major platforms.

He was involved in the support structures for the Ariane 5 first stage Vulcain Engine, the Cold Gas Thruster Module for the Tethered Satellite System as well as several commercial aircraft applications. Bryan Reid is the Director of Business Development, Space Systems for Marotta Controls, Inc. Contact Bryan at breid@marotta.com.