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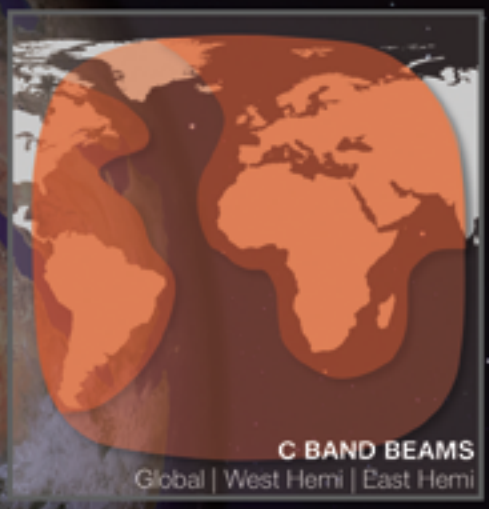

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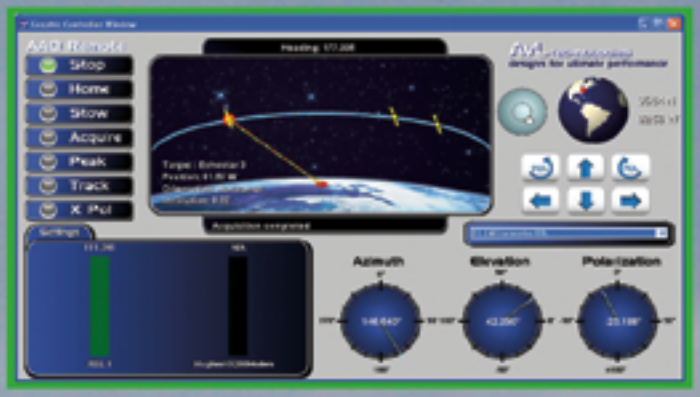

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InfoBeam: ESA + Airbus Cement Copernicus' Next Build

At the 36th International Symposium on Remote Sensing of Environment in Berlin, the European Space Agency (ESA) and Airbus Defence and Space signed the development and production contract for the Jason-CS/Sentinel-6A satellite.

Jason-CS/Sentinel-6 is a mission to carry out high-precision measurements of ocean surface topography. The contract is worth 177 million euros. The implementation of the second satellite will follow the approval of the program by the Council of EUMETSAT, the European meteorological organization, in June 2015 and it is co-funded by EUMETSAT and by the European Union via the Copernicus program.

The satellites will measure their distance to the oceans' surfaces with an accuracy of a few centimeters and use this data to map it globally, repeating the cycle every 10 days. Observing changes in sea-surface height using such a high level of precision provides insights into global sea levels, the speed and direction of ocean currents, and ocean heat storage. The measurements made are vital for modeling the oceans and predicting rises in sea levels. This data will also be used increasingly for weather forecasts and storm surge warnings.

The Sentinel-6 mission is part of Copernicus, the European Earth observation program, and is a continuation of the program that was started in 1992 to collect satellite-based measurements of the oceans' surfaces. Weighing around 1.3 tons, the Jason-CS/Sentinel-6 satellites will ensure that measurements are carried out on a continuous basis from the years 2020 and 2026 respectively, at an altitude of around 1,350 kilometers. Operations for the missions, each running for five-and-a-half-years, will be overseen and managed by EUMETSAT in Darmstadt, Germany. Development of the satellites will be based on the highly successful CryoSat program.

As with CryoSat, Airbus Defence and Space in Friedrichshafen will be the prime contractor for the space segment and lead the industry consortium on behalf of ESA. Thales Alenia Space France will construct the main instrument, a radar altimeter, whose predecessor is already being used on CryoSat-2, Jason-3 and Sentinel-3. Further instruments are being developed by NASA/JPL in the USA. The American National Oceanic and Atmospheric Administration (NOAA) is also a partner of Sentinel-6/Jason-CS.

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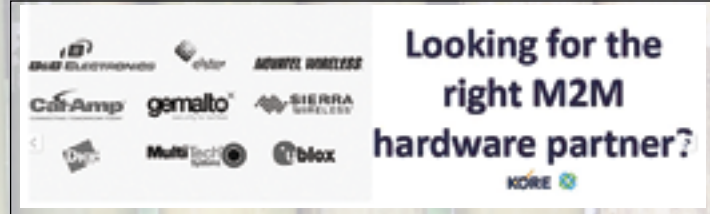

KORE Wireless, a provider of Machine to Machine (M2M) wireless data networks, presented its expert knowledge and a customer showcase to CeBIT Australia with their M2M / IoT Zone.

Director of KORE Asia Pacific, Thomas Mooney, said the M2M/IoT Zone was an opportunity to exhibit a diverse range of key customer M2M focused solutions, to highlight the many facets of the Internet of Things. "In our M2M/IoT Zone, KORE clients Pervasive Technology, Rallysafe, MT Data and mCare Watch, all exhibited their unique solutions hailing from different industry verticals, mHealth, the environment, fleet tracking and telematics and global race vehicle tracking. This gave attendees a greater depth of knowledge and understanding on how the whole M2M ecosystem works by being able to interact with the products, see them in action and talk to experts about how they work."

www.koretelematics.com/

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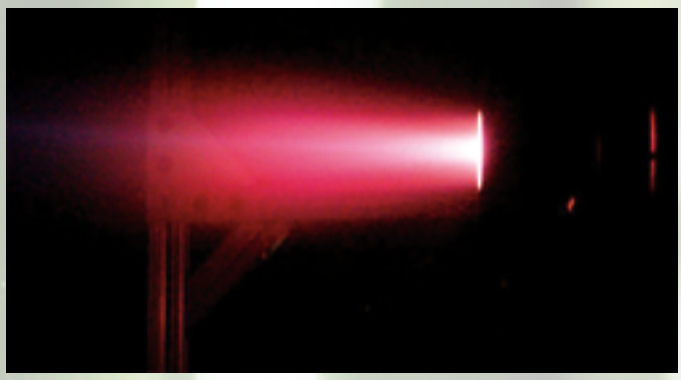
InfoBeam: Japan Awards Electric Propulsion Patent



The Elwing Company has been formally granted its second patent by the Japanese Patent Office (JP 5 561 901), joining more than 30 patents for its breakthrough E-IMPAcT satellite electric propulsion technology.

This new patent completes Elwing's intellectual property holdings in Japan, allowing Elwing to offer Japanese satellite manufacturers its most advanced propulsion system design.

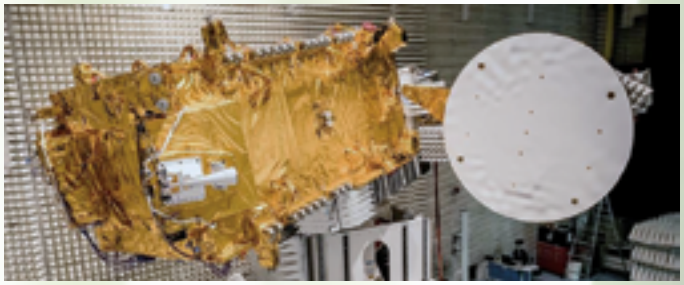
Elwing's E-IMPAcT technology, which can operate without an auxiliary power source or the implementation of non-mechanical thrust vectoring or oxidizing propellants, has been tested and proven at the Electric Propulsion and Plasma Dynamics Laboratory at Princeton University (EPPDyL), and has undergone further testing at NASA's Propulsion Research and Development Laboratory, located at the U.S. Army's Redstone Arsenal in Alabama.

In early 2014, the technology underwent initial testing at the European Space Agency's ESTEC in Noordwijk, The Netherlands.

Gregory Emsellem, CEO of The Elwing Company, said, "We look forward to establishing our first cooperation with Japanese aerospace companies, who have clearly demonstrated their leadership in electric propulsion innovation with the record-setting Hayabusa mission, and recent contracts with Mitsubishi Electric in Qatar and Turkey."

www.elwingcorp.com/

InfoBeam: SpaceX Launches TurkmenAlem52E/MonacoSAT



The TurkmenAlem52E/MonacoSAT telecommunications satellite was successfully launched on April 27th 2015 by a SpaceX Falcon 9 launched—the satellite was built by Thales Alenia Space as prime contractor, on behalf of the Turkmenistan Ministry of Communications.

TurkmenAlem52E/MonacoSAT will allow Turkmenistan to operate its first national satellite telecommunications system, ensuring enhanced, secure telecommunications for the country. The satellite is built on a Thales Alenia Space Spacebus 4000 C2 platform, will weigh 4,500 kg at launch and offers a design life exceeding 15 years. Its coverage zone encompasses Europe,

Central Asia up to the Chinese border and virtually all of Africa. The Turkmenistan Ministry of Communications will use Monaco's 52 degrees East orbital position, via the Monaco-based satellite operator, Space Systems International—Monaco (SSI).

Thales Alenia Space was in charge of satellite design and manufacture, along with the manufacture of ground support equipment for the two satellite control stations, all associated services, provision of launch services and insurance. The Turkmenistan team received intensive training from Thales Alenia Space engineers to ensure trouble-free satellite operation. The first Turkmenistan telecom satellite was produced and ready to ship in just 27 months, more than four months ahead of the contractual deadline.

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InfoBeam

Kratos To Support Thaicom 8 + Brings A Ground System To Hodoyoshi-3 + -4 Satellites

Artistic rendition of the Thaicom 8 satellite. Image is courtesy of Orbital ATK.

Kratos Defense & Security Solutions, Inc. has announced that Thaicom Public Company Limited (Thaicom), Thailand's satellite operator, awarded Kratos Integral Systems International (Kratos ISI) contracts for a Satellite Control Center (SCC) and a Tracking, Telemetry and Command (TT&C) Station.

Both will support the new Thaicom 8 satellite. The projects, which are direct contracts with Thaicom, were awarded to Kratos under two separate procurements.

Scheduled for a first half 2016 launch, Thaicom 8 will have a total of 24 Ku-band transponders covering Thailand, South Asia and Africa and will serve customers' needs for increased Ku-band capacity.

Thaicom 8 is a GeoStar2 telecommunications satellite built by Orbital ATK. This will be the 16th Orbital ATK GeoStar satellite that Kratos ISI has supported.

Kratos ISI will deliver a complete satellite control system for Thaicom 8 based on Kratos' EPOCH® command and control and OASYS® flight dynamics solutions, which are the flagship products of the EPOCH IPSTM Integrated Product Suite.

EPOCH IPS is an all-in-one satellite fleet management system with the ability to simultaneously control multiple satellites from different manufacturers from a single consolidated system.

EPOCH IPS presents a more efficient and economical alternative to costly stove-piped command and control systems and provides Thaicom a control platform that can scale to support any future satellite fleet expansion needs.

The TT&C station, provided by the Kratos ISI UK team, will be the primary TT&C Earth station for Thaicom 8 and will include an 11m C-band turning head antenna with a monopulse tracking system and fully redundant RF system.

The antenna offers continuous wide-angle steering combined with high-accuracy pointing and tracking from its precision drives system, while the RF system is fully frequency-agile.

As such, the system will support both nominal on-station and emergency TT&C operations.

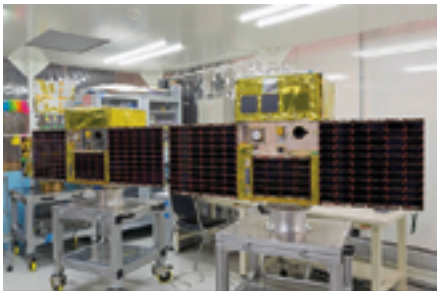
"We are very honored by the trust Thaicom has shown in the quality of our products and services as well as our ability to provide the end-to-end satellite ground system that will help ensure safe and efficient operations of the Thaicom 8 satellite," said James Kramer, Senior Vice President at Kratos ISI. "It was an important milestone for Kratos ISI as we continue to support the Asian satellite market."

Additionally, the company has revealed that an EPOCH IPS ground system from Kratos Integral Systems International (Kratos ISI) is providing command and control for two micro-satellites.

Hodoyoshi-3 and Hodoyoshi-4 were developed by the University of Tokyo in the first program of the Cabinet Office of Japan and launched in June 2014—the satellites are now operational and transmitting earth observation images.

The EPOCH IPS system was provided under the contract with Fujitsu Limited Japan and Integral Systems Japan to support

Kratos ISI EPOCH IPS screenshots.



Hodoyoshi-3 and Hodoyoshi-4 satellites. Photo is courtesy of the University of Tokyo.

development and testing of the micro-satellites at the University of Tokyo and provide command and control for them once on orbit.

The program is under the direction of Professor Shinichi Nakasuka, University of Tokyo, School of Engineering/Department of Aeronautics and Astronautics.

The EPOCH T&C Server and the EPOCH Client modules provide command and control for the satellites. The Server provides complete off-the-shelf satellite telemetry and command processing for operations and test environments.

The Client provides complete operations capability for real-time monitoring and control of all satellite and ground equipment systems and functions.

Hodoyoshi-3 has 40m and 200m GSD Cameras and Hodoyoshi-4 has a 6m GSD Camera to capture earth remote sensing images.

Hodoyoshi-4's first wide-angle camera image was successfully down-linked. Newly developed advanced components such as a high speed X-band transmitter and an ion propulsion system will also be tested on Hodoyoshi-4.

A "Hetero Constellation" experiment using two satellites with different capabilities in the same orbital plane will also be carried out.

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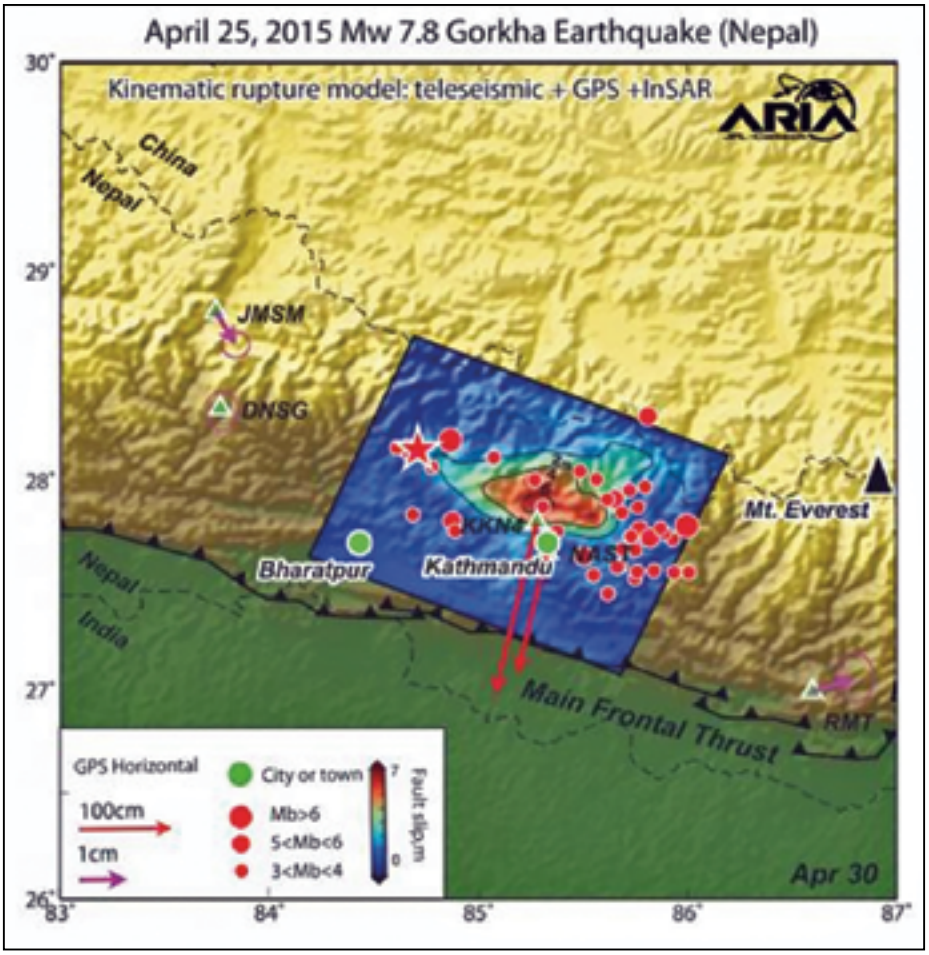
New, Advanced Data For The Nepal Earthquake Disaster Provided By Caltech + JPL Scientists

To assist in the disaster response efforts, Caltech and JPL scientists have constructed a preliminary picture of what happened below Earth's surface during the recent 7.8-magnitude Gorkha earthquake in Nepal, using a combination of satellite radar imaging data, GPS data measured in and near Nepal, and seismic observations from instruments around the world.

The team's observations and models, produced through the Advanced Rapid Imaging and Analysis (ARIA) project—a collaboration between Caltech and JPL—include preliminary estimates of the slippage of the fault beneath Earth's surface.

The fault movement was responsible for the generating the April 25, 2015, earthquake that has killed and injured thousands. In addition, the scientists ARIA scientists have provided first responders and key officials in Nepal with information and maps that show block-by-block building devastation, as well as measurements of ground movement at individual locations around the country.

The modeled slip on the fault is shown as viewed from above and indicated by the colors and contours within the rectangle. The peak slip in the fault exceeds 19.7 feet (6 meters). The ground motion measured with GPS is shown by the red and purple arrows and was used to develop the fault slip model. Aftershocks are indicated by red dots. Background color and shaded relief reflect regional variations in topography. The barbed lines show where the main fault reaches Earth's surface.



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"As the number of orbiting imaging radar and optical satellites that form the international constellation increases, the expected amount of time it takes to acquire an image of an impacted area will decrease, allowing for products such as those we have made for Nepal to become more commonly and rapidly available," said Mark Simons, professor of geophysics at Caltech and a member of the ARIA team. "I fully expect that, within five years, this kind of information will be available within hours of big disasters, ultimately resulting in an ability to save more lives after a disaster and to make assessment and response more efficient in developed and developing nations."

Over the last five years, Simons and his colleagues in Caltech's Seismological Laboratory and at JPL have been developing the approaches, infrastructure, and technology to rapidly and automatically use satellite-based observations to measure the movement of Earth's surface associated with earthquakes, volcanoes, landslides and other geophysical processes.

"ARIA is ultimately aimed at providing tools and data—for use by group ranging from first responders, to government agencies, and individual scientists—that can help improve situational awareness, response and recovery after many natural disasters," Simons said.

"The same products also provide key observational constraints on our physical understanding of the underlying processes such as the basic physics controlling seismogenic behavior of major faults," Simons added.

ARIA is funded through a combination of support from JPL, Caltech and NASA.

www.jpl.nasa.gov/
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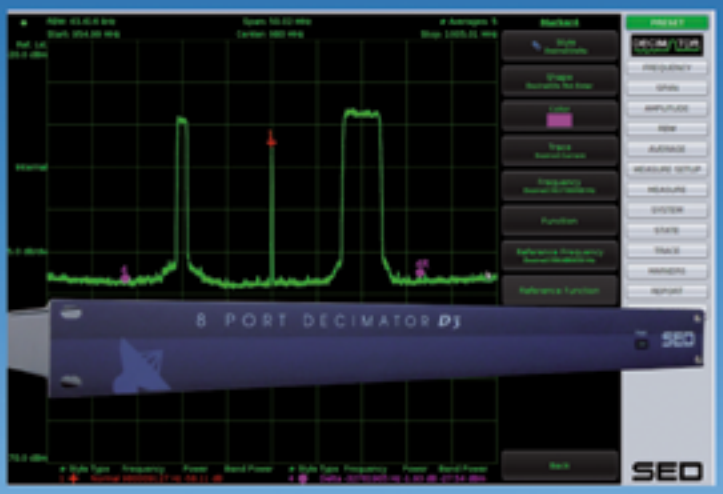

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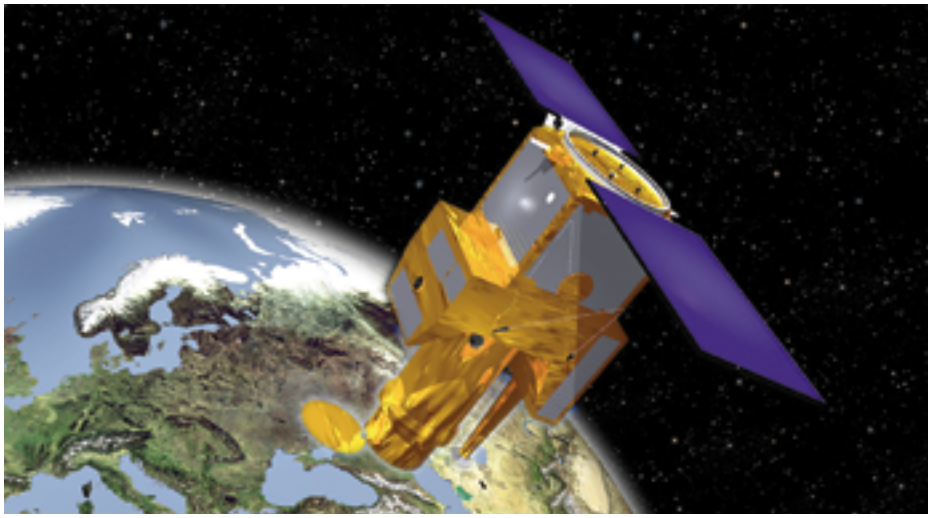
Turkey's Göktürk-1 Satellite Enroute To Ankara AIT Center... For Environmental Tests



Artistic rendition of the Göktürk-1 EO satellite.

Thales Alenia Space, Telespazio and SSM, have announced that the Göktürk-1 observation satellite for the Turkish Ministry of Defense has been shipped to Ankara AIT center to start environmental tests.

The global contract, signed by Telespazio as the prime contractor and the Turkey's Ministry of National Defense, comprises an Earth Observation (EO) satellite equipped with a high-resolution optical sensor, a satellite integration and test center to be built in Turkey, and the complete ground segment, in charge of mission control, in-orbit operation, data acquisition and processing.

Local industrial partners include TAI, Aselsan, Tübitak UEKAE, Roketsan and TR Teknoloji.

Thales Alenia Space built the satellite and developed the integration and test center in Turkey. Telespazio is the Prime Contractor and system integrator and, in addition is responsible for the ground segment, the satellite launch service and launch insurance procurement, the operations of the system including the Launch and Early Orbit Phase, In Orbit Test phase and the Integrated Logistics Support to the End-User.

Turkish industry has been involved in the system design and development, as well as supplying some Göktürk-1 system components: TAI provided elements of the satellite payload structure, Aselsan is in charge of the ground segment components image data reception and processing, Tübitak UEKAE in charge of the telecommand and telemetry ciphering devices and TR Teknoloji of the AITC building.

Derived from the Proteus platform developed by Thales Alenia Space, the Göktürk-1 satellite is now assembled and integrated and has been shipped to the new satellite integration and test center in Ankara, which has been designed to be able to integrate several satellites concurrently.

Thales Alenia Space, in the frame of the Gokturk-1 contract with Telespazio, will be the first company in the space industry to deliver a turnkey integration and test center.

The Class 100,000 clean rooms, spanning more than 3,000 square meters, will house all the latest-generation equipment needed for satellite integration and testing.

Systems include a mechanical vibration test bench (shaker), a 950 cubic meter acoustic test chamber, a thermal-vacuum chamber measuring over 350 cubic meters, a compact antenna test range and supports for the deployment of solar panels and antennas.

Other resources include the system to test the satellite's physical properties (weight, center of gravity, inertia) and electromagnetic compatibility (EMC) test systems.

Prof. Dr. Ismail Demir, Undersecretary for Defence Industries (SSM), said, "Göktürk-1 Program is a very important milestone for Turkish space and satellite road map. So far, RASAT and Göktürk-2 satellites were manufactured indigenously, launched into the space and operating perfectly.

"Building on these heritage coupled with the experience gained over Göktürk-1 program, Turkey now intends to manufacture new Earth observation and communication satellite systems in Turkey within the state-of-the-art Assembly Integration and Test Center (AITC) facility in Ankara. AIT Center which is going to be operated under responsibility of TUSAÅž is intended to be used both for domestic and international programs."

Luigi Pasquali, CEO of Telespazio said, "Thanks to its wealth of experience in the Earth observation sector, Telespazio plays a leading role in the major international programs and, together with its partner in the Space Alliance can offer a wide range of state-of-the-art solutions to its customers.

"This was reflected in Göktürk-1, as prime contractor, in managing the entire system and allowing, through the involvement of Turkish Industries, the development of their expertize, thus paving the way for future cooperation in the export market."

Jean Loïc Galle, President and CEO of Thales Alenia Space, said, "Thales Alenia Space will be the first satellite manufacturer to have built a high resolution optical observation satellite to an export customer and to have delivered an AIT center abroad.

"This important milestone reflects both a new success of the Space Alliance offer and the capacity of Thales Alenia Space to be the natural partner to countries they want to expand their space program."

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InfoBeam

Speedy Ka-Band Satellite Internet Provisioning With New STMicroelectronics Demodulator Chip

STMicroelectronics (NYSE: STM) has announced the world's first 500Mbaud High-Symbol-Rate (HSR) satellite demodulator chip.

The STiD135 enables significantly more efficient bandwidth usage and increased throughput in satellite Internet provisioning when deployed with transponders aimed at using the higher frequency bands to send data via Ka-band communication satellites.

Compliant with DVB-S2, DVB-S2X and DVB-S2 Annex-M1, this chip has been designed as part of the French Space Agency (CNES) THD-SAT 2 program, fostering the development of cost-efficient, fast broadband Internet access via High Throughput Satellite (HTS) at a performance equivalent to fiber-optic, ADSL, and 4G networks, taking advantage of the universal accessibility of satellite signals.

"The Digital Divide has been clearly identified as an important-to-address societal problem by National and Regional studies such as the European Union's 'Digital Agenda'3," said Eric Benoit, Head of Product Line, Headed Platforms, Consumer Product Division, STMicroelectronics.

"A fruit of our collaboration with CNES, the new satellite demodulator chip can deliver useful data throughput of up to 600 megabits per second in the Ka-band. This represents a valuable step change to what has been available, while simultaneously optimizing the bandwidth efficiency that can be achieved in the lower-frequency Ku-band. Together, this will help pave the way towards our common goal of 'broadband for all'."

"With THD-SAT our ambition is to bring a 10X cost reduction of bandwidth with High-Throughput Ka-band Satellite to distribute fast Internet services at 100/10 Mbps downlink/uplink that would complement, in a cost-efficient way, Fiber To The Home (FTTH) deployment outside densely populated areas," said Jean-Philippe Taisant, Telecommunication Senior Project Manager, CNES. "The availability of STMicroelectronics' STiD135 demodulator chip is key to enabling the development of affordable satellite broadband modems."

www.st.com/web/en/home.html

Honeywell Aerospace Boosts Connectivity On Ground + In The Air...

Honeywell Aerospace has released the new CNX-250 multifunction router, enabling aircraft to connect to a cellular network while on the ground and transition to a satellite connection while in flight.

The new router enables connection to a variety of network sources, giving operators and maintenance personnel the flexibility to always stay connected while in the air or on the ground for maximum operational efficiency.

Honeywell's CNX-250 router provides all necessary cabin network functions such as onboard Wi-Fi and telephone systems to keep passengers connected and productive while traveling at 40,000 feet.

The CNX-250 improves on the existing CNX-200 and will gradually replace it when its aircraft installation certification is complete.

Like all CNX Cabin Gateway products, the CNX-250 eliminates the expense and inconvenience of purchasing separate hardware components.

Lightweight and purpose-built, it meets the demanding hardware certification requirement while delivering exceptional cabin communications to passengers via Wi-Fi and Ethernet for laptops, smartphones and other personal electronic devices.

"Passengers worldwide are hungering for better connectivity and more expanded services through all phases of flight, and Honeywell is continually developing new solutions to meet this demand," said Rebecca Sidelinger, senior director, Marketing and Product Management, Honeywell Aerospace.

"In addition to consistent in-flight Wi-Fi, the new CNX-250 router means an aircraft doesn't have to taxi outside the hangar for connectivity when Wi-Fi is required for ground maintenance operations."

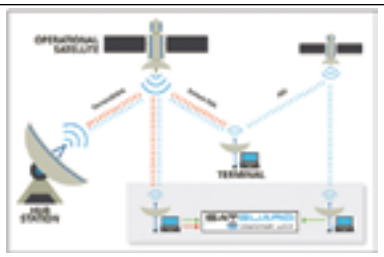
Honeywell will be working with TrueNorth Avionics to provide the new CNX-250 product to business jet operators around the world.

The new product will be available through Honeywell's global network of authorized dealers and service centers. Honeywell's connectivity products have the largest air transport installed base and are onboard almost every aircraft with current broadband solutions.

https://aerospace.honeywell.com/en

InfoBeam

VeriSat's SatGuard Is OnGuard Against Annoying Satellite Interference



VeriSat will be presenting its unique interference analysis tool, SatGuard, as part of the Satellite Interference Reduction Group's Tour at CommunicAsia, from June 2-5 at booth #BG5-06.

SatGuard is a unique tool with patent-pending technology for identifying the source of adjacent satellite interference (ASI) and cross-polar interference (XPOL) caused by Burst Mode, TDMA VSAT terminals.

The company is also part of the Interference Reduction Tour, will also include VeriSat's GSM Interference Demodulation tool (SatGuard-GSM) and SatScan, which enables blind classification of satellite carriers and services.

"VSAT interference is widely reported as causing the majority of downtime, compared with other interference types," said Petter Amundsen, CEO, VeriSat. "Our solutions give satellite operators the tools and technology to determine the source of VSAT interference in a matter of minutes, and will drastically amend that statistic."

"This year's tour goes beyond just Carrier ID, as we were keen to highlight the amazing technology advancements made in recent months," said Martin Coleman, Executive Director, the Satellite Interference Reduction Group.

The IRG tour will give participants practical advice and guidance on the tools available, and what steps they need to take to become as interference-freevas possible. With the amazing amount of technology advancements made in recent months in dealing with interference, the Tour will focus on how IRG Member's technology base is a formidable weapon in reducing interference.

The use of smart modulation methods, better detection algorithms and reusing old methods with new thinking to really make future satellite products robust.

verisat.no/satirg.org/communicasia-interference-tour/

InfoBeam

CASBAA Satellite Industry Forum Asks "Is The Satellite Game Changing?"

CASBAA's annual Satellite Industry Forum is once again being held in Singapore at the beginning of June.

The conference explores the latest developments and issues affecting the satellite industry in the Asia Pacific. Taking place on June 1st at the Grand Hyatt Singapore, the CASBAA Satellite Industry Forum 2015 is a one day event that brings together industry experts to examine a variety of hot topics and to exchange and discuss information critical to the development of the communications sector and related services across the Asia-Pacific. Register to attend this event at ***http://www.casbaa.com/ftpdir/Emailblast/2015/SIF2015/SingSIF2015Registration_form(Regular).pdf***.

The conference continues to grow from strength to strength with an impressive lineup of speakers and a good mix of Asian and global players in attendance. Last year approximately one hundred companies were represented with almost half of the delegates coming from the U.S. and Europe—with most of the balance coming from Asia.

"Satellite services are instrumental in delivering television signals to the bulk of viewers across the region, and the satellite sector is an integral component of the multichannel TV industry in Asia." said Christopher Slaughter, CEO, CASBAA. "The annual CASBAA Satellite Industry Forum is an extremely important event in our calendar, a fact that is reflected by our very active Satellite Industry Committee, as well as by the number of satellite-related companies that are CASBAA members."

This year's welcoming Keynote speech will be delivered by Houlin Zhao, Secretary-General of the ITU. "Zhao only took office in January of this year so for many this will be the first opportunity for people to see him in this capacity," said Kevin Jennings, Program Director, CASBAA.

Houlin Zhao, Secretary-General of the ITU.

In addition, CASBAA announced that Stephen Spengler, Chief Executive Officer of Intelsat is delivering the Industry Keynote. Spengler is a satellite and telecommunications industry veteran with experience in the media, broadband, government and Internet sectors and is a driving force behind Intelsat's next generation of satellite solutions.

The Deputy Minister of Communications and Information Technology Myanmar, U Thaung Tin, will also speak at the Forum and discuss Myanmar's plans to launch its own satellite and the results of how a sovereign satellite will impact the country.

The theme for 2015 asks "*Is The Satellite Game Changing?*" in acknowledgement of the ever-evolving industry landscape. The agenda for this year's forum will touch upon the challenges the industry is facing as the very definition of television changes to embrace new technologies, delivery methods and consumer habits. Review the program here.

As well as speaking with game changers and new kids on the block, the forum will discuss whether high throughput satellites are the answer to reducing costs for customers.

Another panel session is provocatively titled "*Staring the Future of TV in the Face—A Watershed for the Satellite Industry?*"

The roster of speakers encompasses the entire value chain of the satellite industry including:

- *Mitsutoshi Akao, Exec Officer Space & Satellite Bus Group, SKY Perfect JSAT*
- *PJ Beylier, CEO, SpeedCast*
- *Terry Bleakley, Regional VP, Asia Pacific, Intelsat*
- *Paul Brown-Kenyon, CEO, MEASAT*
- *Thomas Choi, CEO, ABS*
- *Gregg Daffner, CEO, GapSat;*
- *Gonzalo de Dios, Associate General Counsel, Intelsat*
- *Michel de Rosen, CEO, Eutelsat*
- *Dr. Ali Ebadi, SVP, Space Systems Development, MEASAT*
- *Vern Fotheringham, CEO, LeoSat*
- *Yvon Henri, Chief, Space Services Department, ITU*
- *Huang Baozhong, EVP, APT Satellite*
- *Erwin Hudson, Programme Manager, ViaSat*
- *Ferdinand Kayser, CCO, SES*
- *Ethan Lavan, Director of Orbital Resources, Eutelsat,*
- *Deepak Mathur, SVP Commercial, Asia-Pacific and Middle East, SES*
- *Barry Matsumori, SVP, Commercial Sales and Business Development, SpaceX*
- *Deepakjit Singh, MD, Asia, Encompass Digital Media*
- *Soo Yew Weng, MD, Globecast Asia*
- *Dave Ulmer, SVP& GM Asia, SeaChange International*
- *Bill Wade, President and CEO, AsiaSat*

The CASBAA Satellite Industry Forum 2015 also recognizes the generous support of the sponsors for this year's event:

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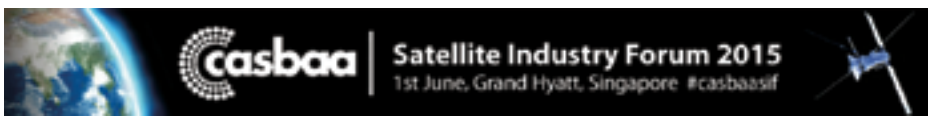

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A Story Of Determination... Supported By Inmarsat

Two stalwart soldiers are on a mission to navigate around the Greenland ice cap.

Inmarsat will be supporting the 65 Degrees North adventure team with critical communications as they attempt the world's first unsupported crossing of the Greenland ice cap by an amputee.

The six strong team, led by amputee Peter Bowker, a former member of the British Armed Forces, will cover the near 600 km crossing of the ice cap from Kangerlussuaq in the West to Kulusuk in the East. While battling temperatures as low as -37 degrees Celcius, they will be pulling all of their equipment unassisted. It is estimated that this world record attempt will take between 24 to 30 days.

Inmarsat will be supplying vital satellite communication services for the crossing of the ice cap, including two IsatPhone 2 satellite phones. Inmarsat partner Cobham Satcom is providing two ultra-portable Explorer 510 BGAN terminals, which are smaller than a standard laptop and weigh less than 3 lbs (1.4 kg.).

Explorer 510 is one of a new generation of BGAN terminals, which provides end-users with wireless connectivity for their smartphones, tablets and other devices. The user controls the BGAN terminal via a downloadable App that is available for IOS and Android devices.

The team will also be taking with them solar panels and wind-up batteries for recharging the devices and a tracking platform to enable authorized users to see real-time position information as they cross the ice cap.

The extremely lightweight solar panels have been provided by Bren-Tronics Inc and can be used to provide power to the Explorer 510 and IsatPhone 2 while on the move. The GRC Tracking platform, carried over the Inmarsat network, will allow the progress of the 65 Degree North team to be monitored in real-time through position information delivered via a user friendly GUI.

The adventurers will use the state-of-the-art communications equipment for medical and emergency back-up and to share their journey in real-time with the media and supporters. The team can be followed on Twitter - @65degnorth, Facebook or via their website, ***www.65degreesnorth.co.uk***.

Andy Start, President, Global Government at Inmarsat said, "This is an extraordinary challenge and we are very proud to be part of such a unique adventure. Effective communications will be key to the team's success and we know our technology is perfectly suited to help support the 65 Degrees North team on their challenge, no matter what the conditions."

Senior Patron of 65 Degrees North, Major General Andy Keeling, said, "On behalf of the whole 65 Degrees North Team, I would like to thank Inmarsat for their wonderful support. The timely and generous state-of-the-art communications equipment has guaranteed us peace of mind on all fronts.

"Families, supporters and donors will now be able to track us and talk to us, and of course our ability to deal successfully with any unexpected medical problem is hugely enhanced. Inmarsat has also massively enhanced our safety, and undoubtedly significantly reduced risk, and increased our chances of success. We are all very grateful."

The IsatPhone 2 and BGAN will enable the team to maintain consistent and reliable contact with the outside world, even when the weather and conditions reach their most extreme. This will ensure they can communicate with their families and support teams at all times during the trek.

Crucially, team doctor Meinir Jones will be able to use one of the ultra-portable Explorer 510 BGAN terminals to liaise with medical specialists, if she has any concerns about the effect 10 hours a day on skis and the harsh conditions have on Peter's amputated limb, sending images or conducting live video consultations.

The robust IsatPhone 2 handset is specially engineered for the toughest environments, and has an unrivaled battery life of eight hours; 160 hours on standby. It also offers reassuring safety features—an emergency assistance button which sends GPS location data and a text message to a pre-set contact number, and a tracking capability which transmits location information.

Peter, who served in Iraq and Afghanistan before being injured and medically discharged in 2012, is making the record attempt to raise funds for the UK charity Help for Heroes.

65 Degrees North is supported by the Endeavor Fund, set up by the Royal Foundation of the Duke and Duchess of Cambridge and Prince Harry to support sporting and adventure challenges undertaken by wounded, injured and sick service personnel or veterans.

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Blackbridge Keeps An Eye Out With RapidEye For The Climate Corp. + Farmers...

BlackBridge has entered into an agreement with The Climate Corporation to provide RapidEye imagery of the major agricultural areas across the U.S. for use in The Climate Corporation's products and services for farmers.

This imagery is part of the BlackBridge Monitoring Program for Agriculture that has been running in North America since 2013.

BlackBridge uses the RapidEye constellation of five identical satellites to regularly collect high-resolution imagery over the major North American agricultural areas throughout the growing season.

The Climate Corporation uses this imagery, along with imagery from previous seasons, to extract in-season and historical field information for farmers to evaluate crop health and identify issues before they impact yield.

Clint Graumann, director of North America, the U.K., and Ireland at BlackBridge, is glad to see the company's high-resolution imagery being used to help farmers through The Climate Corporation's products and services. "It's exciting to see the work that The Climate Corporation is doing with our imagery," said Graumann. "The company's decision-making tools put an incredible amount of information extracted from our imagery into the hands of the farmer."

The Climate Corporation's director of product management, Evin Levey, reinforced the value of high-quality satellite imagery in the company's services. "We use satellite imagery as an essential foundation for our predictive models and are pleased to be working now with BlackBridge as a provider of that imagery," said Levey.

"By combining agronomic data with RapidEye satellite imagery, we can produce field information to help farmers better understand how their crop is performing through the season. With that better understanding, farmers can make decisions to address issues early and maximize their crop production."

www.blackbridge.com/
www.climate.com/

Euroconsult Reports Impressive EO Data Growth Forecast For LATAM

According to Euroconsult's newly released report, ***Earth Observation Requirements & Solutions in Latin America*****, the Latin American Earth Observation (EO) market is undergoing significant expansion brought about by growing demand for Earth observation data and services, and governments' growing investment into the application to support this demand and help to develop national Earth observation industries.**

In this regard, the region is considered one of the most dynamic markets globally. As of 2014 combined national investment into Earth observation systems developed is $193 million. This number is expected to increase substantially as further countries in the region are expected to invest in the application, and current investing countries expand their satellite portfolios. Consequently, the number of Earth observation satellites launched from Latin American programs is anticipated to grow to more than 25 over the coming decade, compared to just six launched in the last ten years. Demand for Earth observation data has also increased significantly. "The data market in Latin America is estimated at $145 million in 2014; nearly half of all data sales are attributed to the defense sector, with natural resources monitoring, infrastructure and engineering, and energy following," said Ricardo Topham, Consultant at Euroconsult and editor of the report. "Brazil represents the largest national market, totaling a third of all data sales, followed by Mexico."

Demand is foreseen to continue to grow strongly, with a 10 percent CAGR forecast over 2014-2024, leading to a $355 million commercial data market. Multiple factors are expected to support this growth:

- *Robust demand from defense. Although impacted by the gradual increase of national proprietary systems, this supply is not expected to fulfill all regional demand for image intelligence solutions.*
- *Demand in natural resources mainly related to national forest monitoring programs, especially in Brazil and Mexico.*
- *Infrastructure and engineering demand driven by Brazil and Mexico and their plans to invest billions of dollars in development projects over the next decade. Colombia and Chile are also foreseen to undertake projects to update road networks and public transport infrastructure.*
- *Demand in the energy (oil, gas, minerals) sector, mainly in Brazil, Mexico, and Chile. Countries will be effected in the short to medium term related to the drop in oil prices; however the region remains resources-rich with new ventures expected to emerge.*

www.euroconsult-ec.com/shop/

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EUMETSAT's MSG-4 Ships To Kourou For July 2nd Launch Date

EUMETSAT's MSG series of geostationary satellites is vital to ensure the safety of lives, property and infrastructure, through its critical value for the nowcasting of high impact weather.

They are operated as a two-satellite system providing both full disc imagery over Europe and Africa every 15 minutes and rapid scan imagery over Europe every five minutes.

MSG-4 will be stored in orbit after launch and commissioning.

As Meteosat-11, it will ultimately bridge the gap between Meteosat-10 (launched in 2012) and the first MTG satellites, expected to be launched in 2019 and 2021.

Once operational, MSG-4 (Meteosat-11) will also expand the 35-year climate records accumulated by the Meteosat series since 1981.

MSG-4 is the last of the MSG satellites resulting from the successful cooperation model with the European Space Agency (ESA), which is responsible for the development of satellites fulfilling user and system requirements defined by EUMETSAT and for the procurement of recurrent satellites on its behalf.

EUMETSAT develops the ground systems required to deliver products and services to users and to respond to their evolving needs.

EUMETSAT also procures all launch services and operates the full system for the benefit of users.

All MSG satellites are manufactured by a European consortium led by Thales Alenia Space.

www.eumetsat.int/
www.thalesgroup.com/en/worldwide/space

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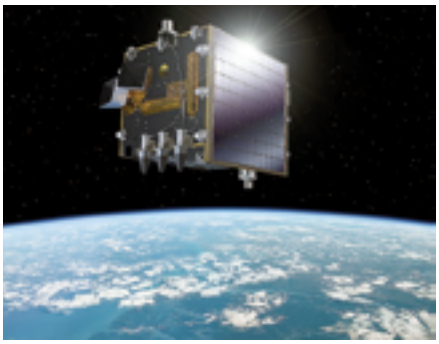
Anniversary Of ESA's Proba-V Picks Up 25 Million Aircraft Positions + Monitors Veggies



Artistic rendition of the Proba-V satellite. Image is courtesy of European Space Agency.

As ESA's Proba-V works quietly on its main task of monitoring vegetation growth across Earth, the minisatellite is also picking up something from a little higher altitude—signals from thousands of aircraft.

Launched two years ago, Proba-V has picked up in excess of 25 million positions from more than 15,000 separate aircraft.

This is a technical world-first, demonstrating the feasibility of follow-on orbital constellations now being readied for operational aircraft monitoring.

"We stay operational 24 hours per day, seven days per week, apart from occasional maintenance or upgrading," said Toni Delovski of the DLR German Aerospace Center, overseeing the experiment. "We've shown that detection of aircraft can work from space with no showstoppers, despite the fact that these signals were never designed to be picked up from so far away.

"In fact, the signals are beamed sideways from their host aircraft rather than omidirectionally, making them harder to detect from orbit. With a single satellite, our detection footprint is relatively small, about 1500 x 750 km, but for an operational service a constellation of satellites is envisaged to provide worldwide coverage."

Smaller than a cubic meter, Proba-V is nonetheless carrying several technology experiments as well as its main wide-swath Vegetation camera, which tracks changes in plant growth across the entire planet every two days.

An Arianespace Vega launch vehicle lifts off with Proba-V aboard from Kourou, French Guiana. Photo courtesy of Arianespace.

DLR and Luxembourg's SES company added an experiment to detect Automatic Dependent Surveillance Broadcast (ADS-B) aircraft signals from space.

These signals are regularly broadcast from aircraft, giving flight information such as speed, position and altitude. All aircraft entering European airspace are envisaged to carry ADS-B in the coming years.

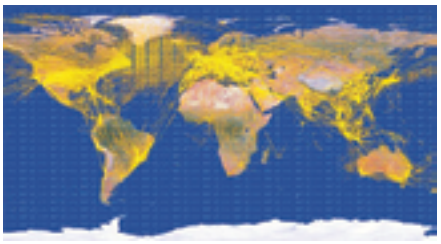
DLR contributed the receiver carried aboard Proba-V, while SES has provided the experiment's ground segment, encompassing the processing needed to decode the signals, including compensating for factors such as frequency-shifting caused by the motion of Proba-V relative to the aircraft.

"The focus of the experiment is on the large parts of the world without radar and less dense air traffic," said Toni.

"In the event, we have also had very good detections in the much more densely trafficked airspace of the U.S., Western Europe and Southeast Asia."

In those parts of the world with radar coverage, air traffic controllers can shepherd aircraft very precisely, with separation distances down to 5.5–9 km.

However in the rest of the world, such as over the Atlantic, minimum separation distance goes up by a factor of 10, to 93 km.



Proba-V detecting aircraft. Image courtesy of ESA.

Space-based ADS-B offers a method of safely reducing separation distances everywhere, increasing global air traffic capacity while improving safety.

DLR and SES are working with national air navigation service providers in Australia, Iceland, Portugal and Namibia to check Proba-V observations against the facts on the ground.

"We are still working to improve the system, with ongoing software upgrades, and investigating anomalies," Toni adds. "Right now, some makes of aircraft are more easily detected than others, which typically comes down to the age and make of their ADS-B systems."

An operational ADS-B detection system is being hosted on the IridumNEXT constellation, while SES is working with ESA to determine the market for a European version.

"If ADS-B from space is going to enter use on an operational, internationally certified basis, then we will certainly need a minimum of two systems," Toni concludes.

"We couldn't have a situation where the sole service suddenly goes down, and aircraft in the middle of the ocean need to spread out."

www.esa.int/Our_Activities/Space_Engineering_Technology/Proba_Missions

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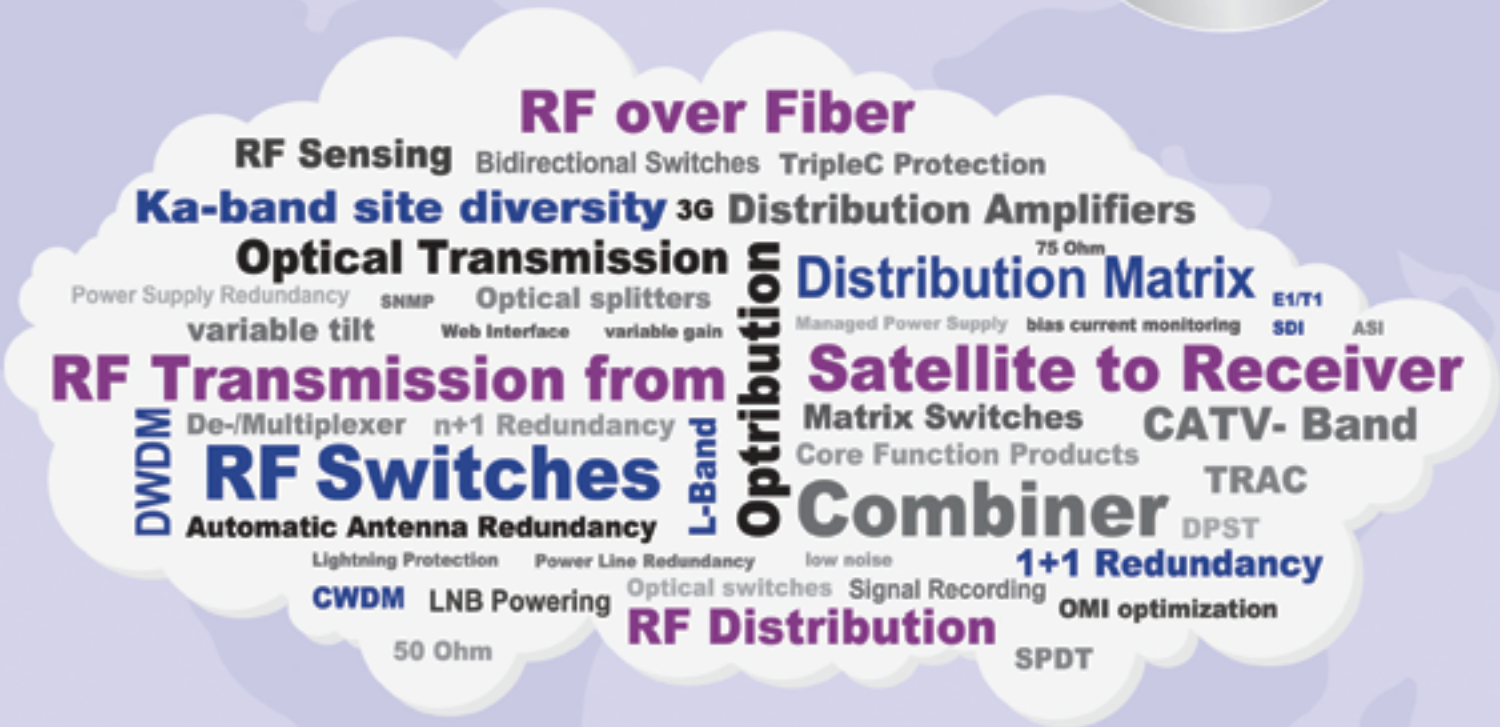

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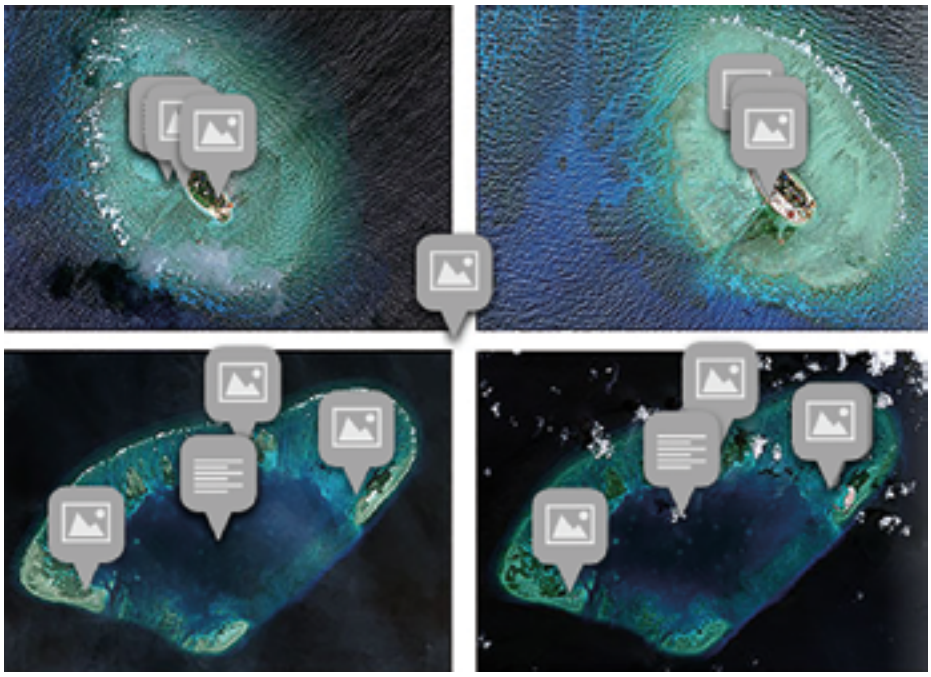
Center For Strategic + Int'l Studies Reveals Land Reclamation Dispute Between Vietnam + China



Sand Castles of their own—Vietnamese expansion in the Spratly Islands, Satellie imagery is courtesy of DigitalGlobe.

Mischief Reef is no misnomer considering these circumstances.

Vietnam has carried out significant land reclamation at two sites in disputed South China Sea waters, recent satellite pictures reveal, but analysts say the scale of the work is dwarfed by reclamation work being done by China.

The images, taken late last month by DigitalGlobe and shown on the website of the Washington-based Center for Strategic and International Studies (CSIS), reveal land expansions at Sand Cay and West London Reef, both part of the Spratly Islands.

"Between August 2011 and February 2015 significant upgrades were made to (Sand Cay)," CSIS said, noting the island's land mass had expanded from 41,690 to 62,970 square meters.

Vietnam also appears to have added "defensive structures," including trenches and gun emplacements, it said.

At West Reef, which is part of the London Reefs group of western Spratly Islands, some 65,000 meters of land have been reclaimed with new structures, including a harbor, being added, the organization said.

The work appears to have started in August of 2012, CSIS said, long before Beijing launched a flurry of reclamation projects last year.

The Spratlys are considered a potential Asian flashpoint. The United States and claimant nations have expressed alarm as China has embarked on massive and speedy reclamation activity.

China claims nearly all of the South China Sea, locking that nation into disputes with several Southeast Asian neighbors.

China's claims overlap those of Brunei, Malaysia, the Philippines, Vietnam and Taiwan. China has undertaken major reclamation work on seven Spratly features in the last year.

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"Chinese activity is clearly on an entirely different scale," said Vietnam expert Jonathan London of Hong Kong's City University.

"Vietnam appears to be now trying to strengthen its position with added urgency," London said. "Not only is there a sort of regional arms race but a rush to claim maritime areas, rock features and things of this nature," in disputed waters in the region which is a key global trading route, he added.

Some $5 trillion of sea-borne trade passes through the area each year. China's island-building in the Spratlys has been seen as part of an attempt to assert its territorial claims by establishing physical facts in the water.

Fiery Cross in the Spratly Islands was little more than a reef until last year when China began reclamation work.

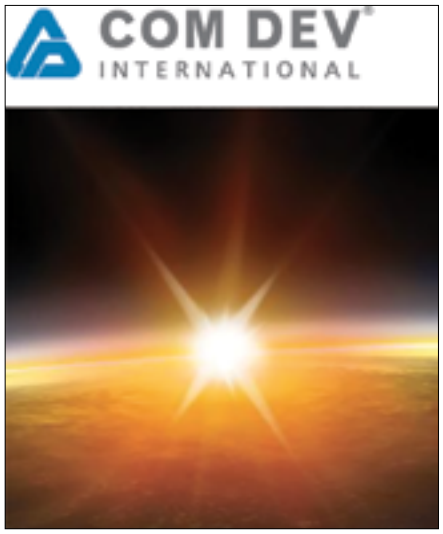
China has now partially-finished airstrip with a 3.1 kilometers (1.9 miles) runway. The country also appears to be undertaking work at a feature known as Mischief Reef, just 100 kilometers (60 miles) from the southwestern Philippine island of Palawan.

Vietnam has an airstrip on the largest Spratly Island it controls, which was renovated in 2000 and can accommodate helicopters or small planes.

csis.org/

InfoBeam

COM DEV Int'l Unlocks Key Technology Access With Investment In Anokiwave



COM DEV International Ltd. (TSX:CDV) is making a US$500,000 investment in Anokiwave Inc., a radio frequency integrated circuit (RFIC) designer and supplier.

COM DEV is participating in Anokiwave's recent financing raise and has secured access to Anokiwave's advanced technology. Under the agreement, the two companies will collaborate and jointly pursue opportunities in the space market.

The satellite industry is experiencing rapid innovation that is enabling satellites to achieve improved flexibility, higher functionality, reduced mass and lower costs. COM DEV has helped drive this innovation, and continues to invest in an R&D roadmap that will help its customers take advantage of the emerging applications envisioned for satellites.

Anokiwave is a technology leader in the development and supply of microwave and millimeter wave active electronically scanned array (AESA) and silicon core integrated circuits for commercial terrestrial and government systems.

COM DEV has an established heritage in the space industry and will become Anokiwave's strategic partner for that market.

"Anokiwave has developed some very advanced technology that nicely complements our own product roadmap," said Michael Pley, CEO of COM DEV. "We are pleased to be able to support their continued growth, and look forward to working with them to develop the next generation of products for the satellite communications market."

"Anokiwave is proud to partner with COM DEV, a market leader in satellite communications equipment manufacturing," said Robert Donahue, CEO of Anokiwave. "We look forward to a long-term successful relationship on the eve of what is expected to be a rapid expansion of commercial space deployments."

www.comdev.ca/
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The Demand For Mobility SATCOM In APAC

By Chen Xun, Executive Vice President, APT Satellite Company, Ltd.

The ongoing demand for broadband connectivity stretches from land to every corner of the Earth. There is no doubt that satellite communication will play a significant role in providing services to regions where terrestrial technology can't reach—especially for mobility applications, such as in-flight entertainment (IFE) and maritime connectivity.

As is true with other regions around the globe, we see demand for mobility picking up and this market section will continue to experience strong growth in the Asia Pacific (APAC) region. Currently, APSTAR has been providing capacity via conventional satellite capacity for both IFE and maritime connectivity services.

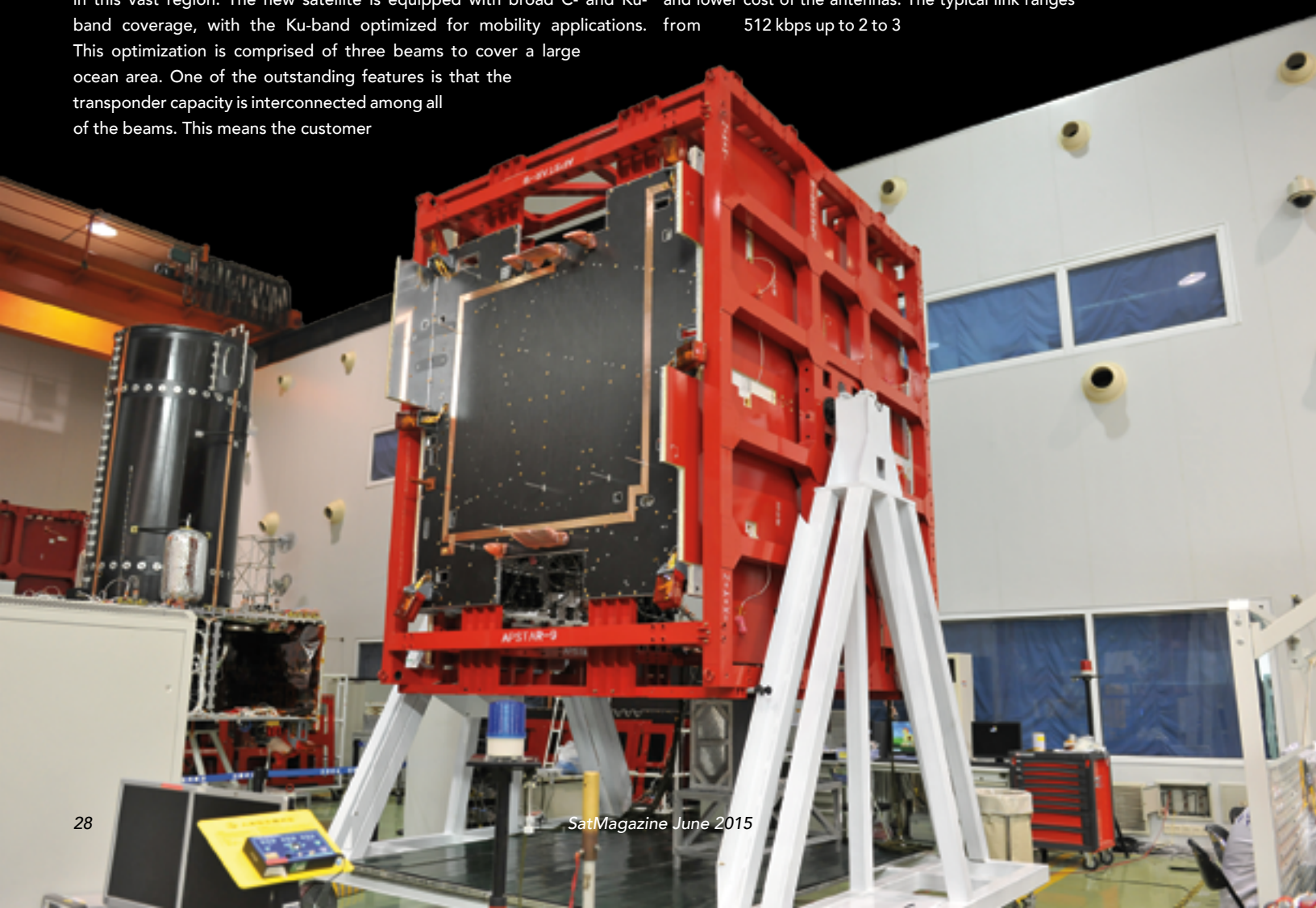
The launch of the APSTAR-9 satellite in October of this year will further expand APSTAR's coverage for mobility applications to a much broader region, from the east Indian Ocean to the western Pacific Ocean. In APAC, especially in China, there is a huge potential due to the demand for mobile broadband connectivity as this region has the busiest maritime shipping routes and fastest growing airplane market in the world.

APSTAR-9 Satellite is designed to meet the increasing demand for coverage in this vast region. The new satellite is equipped with broad C- and Ku-band coverage, with the Ku-band optimized for mobility applications. This optimization is comprised of three beams to cover a large ocean area. One of the outstanding features is that the transponder capacity is interconnected among all of the beams. This means the customer will be able to use their existing teleport facility, even if the vessels or airplanes are located in the coverage of other beams.

For the maritime market, the main demand in APAC is derived from large vessels, such as cruises, luxury sailing ships, large cargo vessels, with the bandwidth requirements being driven by the crucial need for crew and operational communication, fleet management, real-time surveillance, remote diagnostic maintenance, and so on. The demand our company is experiencing is also derived from the fishing industry, with the emphasis here being on the pricing for equipment and affordable bandwidth subscriptions.

VSAT is now playing the major role in this market. More and more newly-built vessels are fully equipped with VSAT equipment as the default configuration during their builds. Even though installation of VSAT equipment is still considered expensive for many ship owners, crews have already come to expect reliable, high throughput and flat rate communication services offered via maritime connectivity.

The fastest growing demand is for Ku-band, mainly due to the smaller size and lower cost of the antennas. The typical link ranges from 512 kbps up to 2 to 3



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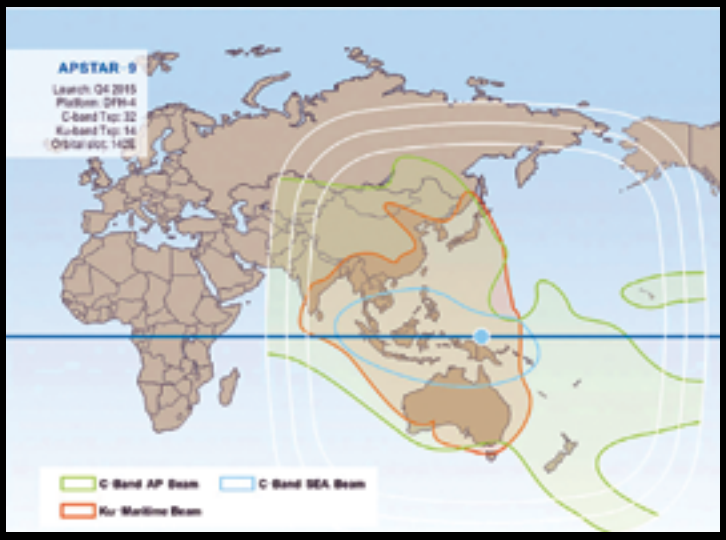
Ku-band stabilized antennas. C-band remains a welcome technology as the frequency is highly reliable and offers more throughput applications, such as passenger communication and government applications. In addition to connectivity and crew welfare, more ICT applications are implemented, and many of them are running on crew's mobile devices.

For the energy industry, satellite communications prevail as reliable and real-time connections are provided, monitoring is fully enabled, and offshore platforms for remote areas are more easily implemented. Advanced development of the digital oil field is occurring, thanks to real-time communications via satellite for such facilitates, which results in more efficient decision making and immediate asset management. Today's advanced technology enables the extraction of more data for transmittal to shore sites for comprehensive site analysis and three-dimensional simulation modeling.

"Big Data" and rich content also require more bandwidth. Other emerging applications, such as telemedicine, real-time video as well as recreation for staff (telephone, email and the Internet) also highlight the need for satellite communications in the offshore market.

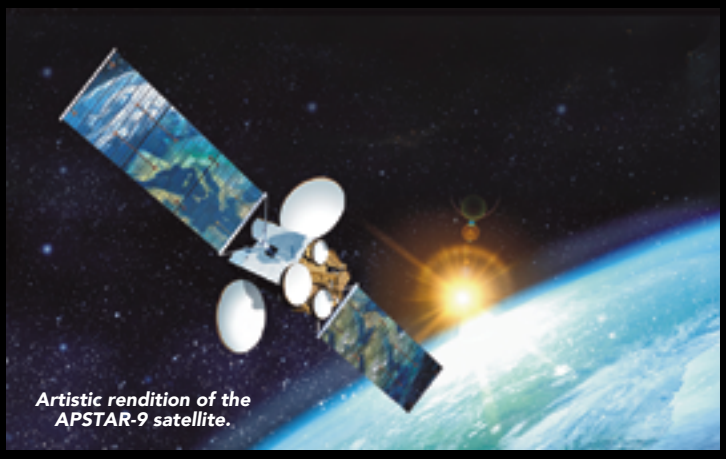
APT Satellite estimates enormous potential for in-flight connectivity applications. This demand is currently being driven by airline companies who are listening to passenger demands for IFE and other SATCOM services while in the air. The expectation is that more and more regulators will be revisiting their restrictions in regard to the use of mobile devices during flight and more and more licenses will be issued for in-flight Wi-Fi applications.



APSTAR-9's coverage beams.

We have observed that many investors and service providers are already actively involved in this market segment. Currently, the typical bandwidth per airplane is 8 to 12 Mbps. In the future, this bandwidth is expected to reach 50 Mbps or more. A satellite's capability to handle such bandwidth demands will be one of the key elements for business growth in this area. Satellite operators need to design and build suitable and expandable capacity to meet this ever growing demand for in-flight connectivity applications.

APT Satellite believes that, with new innovation in equipment and technology, the reduced cost of satellite connectivity will attract more customers to engage in satellite based mobility applications. The launch of APSTAR-9 Satellite is just one step of our overall plan. The company has commenced with the procurement of the next generation of APSTAR satellite, which will carry wider beam footprints in order to extend our coverage for flight and maritime routes. The new satellite will also carry High Throughput Satellite (HTS) capacity for several strategic regions and will serve land and mobility applications with lower cost structures with higher throughput solution. APT Satellite has also discussed with partners a capacity collaboration with other satellites to take advantage of on-orbit APSTAR satellites. In this manner, we can provide comprehensive regional as well as global coverage to meet our customers' growing demands for connectivity.

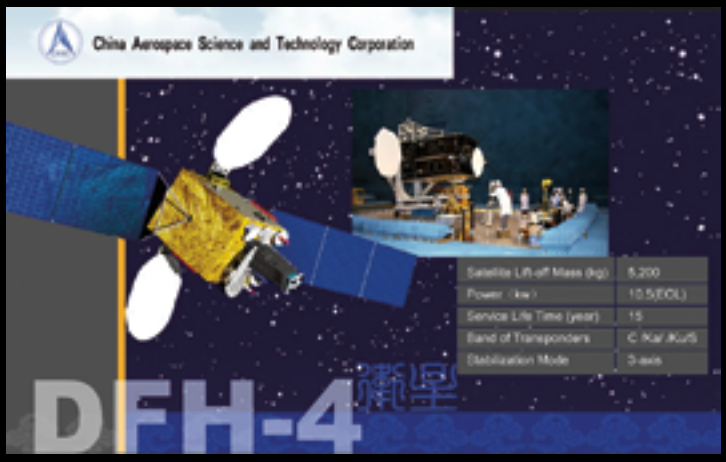


Artistic rendition of the APSTAR-9 satellite.

Since October of 2014, the APSTAR-9 satellite entered its assembly, integration and test (AIT) phase. The manufacturer CAST carried out AIT in its High Bay located in Beijing. The components for platform have all been installed and SPT1 (Satellite Performance Test) started, mainly verifying electrical interfaces between each on-board subsystems and ground testing equipment. In parallel, payload units are mounting on COMM panels and the satellite's End-to-End test ended early in 2015. Launch service progressed as scheduled, with launcher structure, main engines and electrical system being manufacturing normally the AIT was started in March. As of this writing, all the milestones of the APSTAR-9 satellite program are in line with the schedule and the satellite will be launched in the second half of 2015.

APSTAR-9 is a DFH-4 series platform provided by CASC (China Aerospace Science and Technology Corporation). APSTAR-9 will be located at 142 degrees East and will replace the APSTAR-9A satellite. APSTAR-9 is equipped with 32 C- and 14 Ku-band transponders. The C-band transponder consists of one broad beam for the Asia Pacific region and one enhanced beam for South East Asia, suitable for video broadcast, VSAT networks, and cellular backhaul services. The Ku-band will cover the West Pacific and East India Ocean region providing DTH, VSAT, maritime and inflight connectivity services.

More info: ***www.apstar.com/***

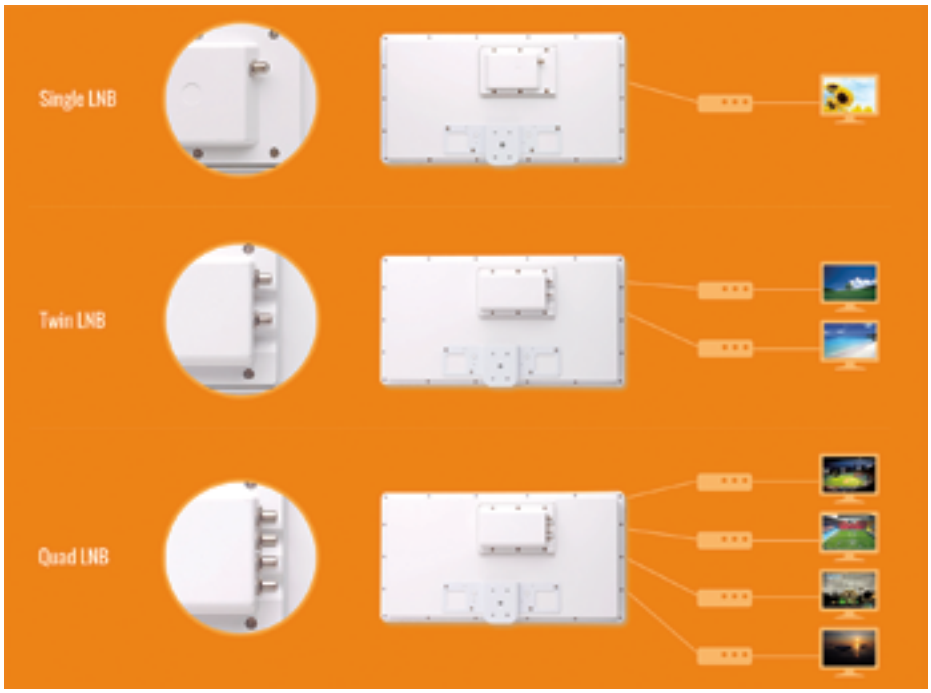


Editor's note: The photo on the first page of this article shows APSTAR-9 during the Assembly, Integration and Testing (AIT) process, and is courtesy of APT Satellite.

Mr. Chen is responsible for technical operations and engineering of APT Satellite. In 2000 he joined the Company and has over 22 years' experience in both the satellite and telecommunications industry. Mr. Chen holds a Bachelor's degree in computer and telecommunications from Chongqing Institute of Post & Telecommunications and an MBA degree from the University of South Australia. Before joining APT Satellite he worked for China Telecommunications Broadcast Satellite Corporation.

InfoBeam

SES Partners With I DO IT—A Ku-Band Flat Antenna Goes Where Others Cannot...



SES S.A. showcased the first commercially manufactured Ku-band flat antenna with integrated IP-LNB at the company's annual Industry Days.

The antenna is produced by Korean manufacturer I DO IT Co., LTD., and will soon be available in major European markets. The small size of 566x300mm means that this new antenna can be discreetly installed where standard parabolic antenna may not be suitable, such as apartment blocks in cities.

Versions with an integrated Wi-Fi router are also available for the camping market.

The SELFSAT>IP antenna is compliant with the SAT>IP communications protocol and incorporates eight satellite tuners. It enables the distribution of live HD and UHD satellite broadcasting through an in-home Wi-Fi network and can serve up to eight different displays (smartphone, TV, table PC, laptop computer, etc.) simultaneously. With two legacy coaxial outputs in addition to its IP output, the antenna can also be connected to existing satellite receivers.

"For several years I DO IT has pioneered the development and mass production of high performance consumer Ku-band flat antennas for worldwide markets," said Seung Joon IM, CEO at I DO IT. "Thanks to the collaboration with SES, we are now able to integrate the SAT>IP technology into our antennas. This enables live satellite television distribution via WiFi to tablets and smartphones, an important product feature especially for the camping market."

"Today over 40 manufacturers are developing products that are compatible with the SAT>IP standard and we are very pleased to support I DO IT in their endeavors," said Thomas Wrede, Vice President, Reception Systems at SES. "These developments were strongly driven and supported by the annual SES Industry Days and would not have been possible without joint industry efforts. We continue to leverage the advantages that satellite communications offer, shaping our industry and creating a high performance, sustainable ecosystem."

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A Pioneering, Australian Satellite Builder

An Interview with Stuart McAndrew by Senior Contributor Jos Heyman

Some years ago, I made an argument for affordable nanosats, which are also referred to as CubeSats.

This argument was based on the involvement of non-renumerated participants, such as students, educational leaders, volunteers or do-it-yourselvers, and would include the use of off-the-shelf hardware for the satellite build. When combining these aspects, the cost of nanosat construction was seen to be quite affordable. Following a successful construction process, the only major cost item would then be the actual launch of the satellite into orbit.

With respect to this, I noted that there would be many components of the launch vehicle cost that are fixed and would have to be paid for by the owner of the primary payload (for instance, a communications satellite). These costs would not be directly related to the mass of the primary satellite and are fixed for the satellite mass +/- a few hundred kilograms. Other components of the launch vehicle are, however, variable with the mass of the payload. Additional costs would be limited to the installation of the launch deployment pod on the framework that would support the principal satellite (or some other part of the launch vehicle) and the additional fuel required to lift the additional 1 kg for the satellite plus approximately 1 kg. that would represent the launch pod, *i.e.*, 2 kg. additional hardware to be lifted. A suggestion was made that the launch vehicle provider and/or the commercial satellite-to-be-launched owner might wish to offset this cost in exchange for the generation of goodwill.

I found an example of a do-it-yourselfer satellite builder almost directly on my own doorstep, that being Western Australia

Stuart McAndrew, who calls himself an "amateur satellite builder," is creating his own 5x5x5 cm "pocketcube" in his suburban shed and he is certainly one of a pioneering group of satellite aficionados in what is becoming a new growth technology hobby branch.

Stuart McAndrew and his OzQube-1

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Antenna Weight	42kg	26kg	45kg	70kg	65kg
Frequency Range	19.7~20.2GHz (Rx) 29.5~30GHz (Tx)	12.25~12.75GHz (Rx) 14~14.5GHz (Tx)	12.25~12.75GHz (Rx) 14~14.5GHz (Tx)	12.25~12.75GHz (Rx) 14~14.5GHz (Tx)	12.25~12.75GHz (Rx) 14~14.5GHz (Tx)
Antenna Gain	41.9dBi@19.95GHz (Rx) 45.3dBi @29.75GHz (Tx)	35dBi@12.5GHz (Rx) 36.2dBi@14.25GHz (Tx)	38.3dBi@12.5GHz (Rx) 39.9dBi@14.25GHz (Tx)	35.5dBi@12.5GHz (Rx) 36.5dBi@14.25GHz (Tx)	37.2dBi@12.5GHz (Rx) 38.2dBi@14.25GHz (Tx)

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Jos Heyman

Please tell the SatMagazine readers about your background and your interests.

Stuart McAndrew

Ever since my childhood, I've had an interest in finding out how things worked. Originally this meant pulling apart toys to see how they worked, but fortunately that evolved into the construction of various electronic kits, and eventually, in my late teens, I undertook a project to transplant the entire Electronic Fuel Injection from one car into another.

I went to university to study a Bachelor of Science (Aviation), but due to the high cost of hiring an aircraft in order to obtain a Commercial Pilots License, I wasn't able to complete the course. I did finish several units in IT related subjects, so I eventually pursued a career in that field. I'm currently an IT Systems Administrator for a local Western Australian company and have worked in the IT field for about 11 years.

Jos Heyman

How did you become involved in your satellite project?

Stuart McAndrew

After catching the space bug a few years ago, I started following the smallsat "revolution." Late in 2013, there was a Kickstarter crowd-funding campaign for the PocketQube Shop, which was to fund the establishment of an online store for the mechanical structures of a new form factor of nanosatellite called a "PocketQube." November 2013 was also the time when the first PocketQubes were launched into orbit aboard a Russian Dnepr rocket.

One of those PocketQubes, "$50SAT" or "Eagle-2", was transmitting telemetry on the 70 cm HAM radio band, and the satellite builders had called out to radio amateurs for reception reports. They provided information using PC software that could decode the telemetry from the audio output of the radio signal.

At the same time, I'd started looking at the capabilities of using a USB TV tuner dongle as a Software Defined Radio (SDR). Putting the two together, I was able to receive the telemetry information from a chair in my lounge (much to the displeasure of my wife). This was a defining moment for me that showed what the PocketQube platform was capable of accomplishing.

Following the Kickstarter, I traded emails with the creator of the PocketQube project. We discussed the need for the establishment of a standard for the internal PocketQube components. Such would allow anyone creating board level systems for a PocketQube to enable their design to interoperate with other systems, much like the PC/104 used by CubeSats.

OzCube-1

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I became involved in discussions with various people around the world to establish the PQ60 standard. At the same time, I had become interested in using PCB design software to make an electronics project, as well as starting to tinker around with ***Arduino.com*** projects [*Editor's note: Arduino is an open-source electronics platform based on easy-to-use hardware and software and is intended for anyone involved in creating interactive projects.*] I could see the potential of the PocketQube form factor and thought that building one would be a unique way to develop such skills for myself as well as demonstrate that a satellite could be built by someone who doesn't have access to the resources that universities or government organizations often have available to them. After thinking about what kind of payload I'd like to have and finding the camera modules, I decided that I would create an Earth Observation (EO) satellite.

Jos Heyman

Why are you undertaking the OzQube-1 project? What are your objectives and motivation for this effort?

Stuart McAndrew

One reason was purely for the fun of the project. Space is cool, so making something to travel into space sounded like a really fun idea. However, it turned out that this kind of fun involves lots of work and learning about subjects that I didn't have any formal training in!

Another reason is because of the potential of the form factor. Even though CubeSats offer a significant cost reduction compared to full size commercial satellites, the price of hardware and launch is well over $100,000—far beyond the reach of most organizations. The concept of building a satellite whose hardware cost is under $1,000 has the potential to open up the industry. A huge number of students studying STEM subjects at high school or university would be able to have the opportunity to learn about the space industry in a highly practical way.

Jos Heyman

Please describe the OzQube-1 design. What are the individual components and the actual payload. Are you using commercial-off-the-shelf products in your CubeSat build? Please explain what products you have decided to use, and why.

Stuart McAndrew

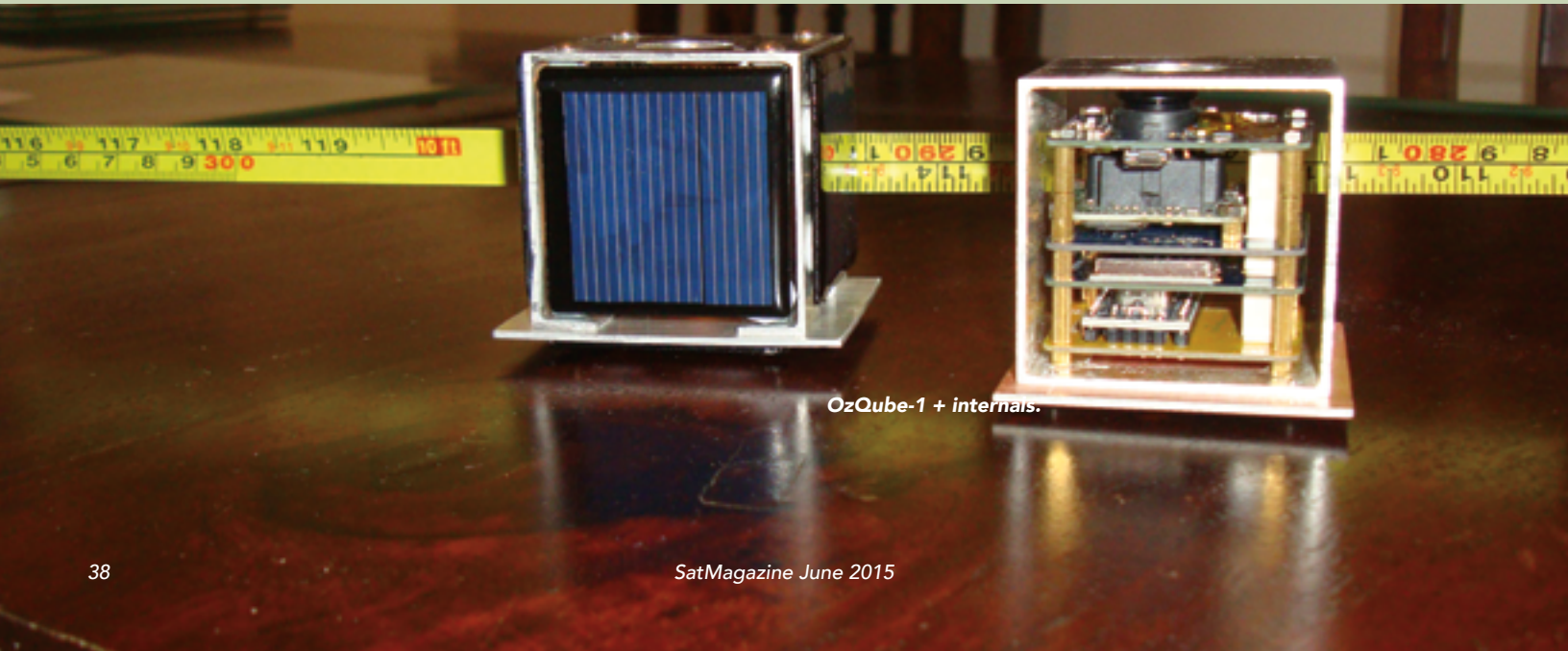
OzQube-1 is logically structured like many CubeSats and other small satellites. Solar cells are used for power generation, an EPS to charge the onboard battery and manage power to the other subsystems, a CDH module, a radio module and a payload module. Each subsystem is a separate PCB that I have designed for the project, with all of the internal PCB's conforming to the PQ60 standard. [*Editor's note: The PQ60 standard is a community developed standard that defines the internal mechanical and electrical interfaces for a PocketQube satellite.*] All of the electronic components are COTS (Commercial-Off-The-Shelf) parts, generally rated from -40 degrees to +85 degrees, with a few exceptions.

The main payload is a camera module. Small cameras have flown before on many CubeSat missions, but they are often low resolution VGA cameras. The camera I'm using is of similar design, but has an upgraded 2 Megapixel sensor. Only small changes are required to make it ready for space.

The EPS board is unique in that it is required to have a hole in the middle to clear the camera lens. This has made fitting all the components on the board a bit more difficult, but still quite manageable. The board contains 4 channel MPPT solar inputs, temperature compensated Li-ion battery charging, separate battery and 3.3V rails, both with current limiting switches as well as a separate switched circuit for the payload with its own current limiting switch.

The radio is a pre-built module based on the Silicon Labs Si4463 chipset and possesses a massive 1W RF power output, so it will only be performing burst radio transmissions in order to conserve power. This chipset was chosen so that the reception of the signal would be easy to accomplish with a basic antenna and a USB dongle. The radio module's predecessor, the Si4432, was used in $50Sat.

The CDH module is based around an Atmel Atmega 328p microcontroller, the same as the one used in an Arduino Pro Mini and also contains a Micro-SD card, a 9 axis IMU (inertial measurement unit) and a RTC (real time clock).



OzQube-1 + internals.

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Jos Heyman

How far are you into the project at this point in time?

Stuart McAndrew

To date, hardware for the first prototype is about 75 percent complete. I have completed boards for the radio, the EPS and the payload. I have developed an adapter for the CDH board to enable software development using a regular Arduino. This will be used until I can complete the final CDH board.

Two of the three different solar panel boards are on their way, with the last board still in the design phase. The EPS will soon get a second revision to rectify errors found in the first version and will provide some improvements.

While not being flight ready, most of the components have been designed with this in mind—only the assembly process needs to be revised for the construction of a flight version. Once the hardware is done I'll be able to work on the software requires to get everything co-ordinated and functioning.

Jos Heyman

What cost factors have you experienced and what is your budget to complete OzQube-1? Do you have any partners working with you on the project and, if so, what expertise do they bring to your work?

Stuart McAndrew

Starting a new hobby from scratch involves the procurement of the required tools of the trade, so to speak. As I was only just starting to get into electronic prototyping, I had to obtain some of the necessary tools and components to perform surface mount soldering. Staying with the low cost theme, I only purchased the minimum amount required to perform the task.

I don't really have a budget for the project. I'm confident that the hardware cost per satellite will be well under $1,000 when completed. The project has been completely solo from day one. I have various contacts in other countries that I have had engineering discussions with, but apart from that, I have had no outside help.

Jos Heyman

How will you fund OzQube-1? Have you considered a "crowd sourcing" appeal to aid in financing?

Stuart McAndrew

So far, the project has been self-funded. The raw cost of components, PCBs and structural hardware required for a single satellite, as stated, will be below $1,000, not taking into account development time. Developing a flight version will require investment in a proper testing regime, in conjunction with more carefully selected components.

In addition, the cost of launching a satellite such as the OzQube-1 into orbit is prohibitive for an individual without strong financial backing, so there is a high probability that I'll be using some kind of "crowd sourcing" to fund the flight versions and the launch costs—any donations are more than welcome!

Jos Heyman

How will OzQube-1 be launched? Given the size of your PocketQube, the most appropriate factor seems to be as a ride share payload—have any launch companies expressed interest in assisting in this endeavor?

Stuart McAndrew

Currently, the only way to get a PocketQube into orbit is as a tertiary payload. The only deployer developed so far for PocketQubes is the MR-FOD (Morehead Rome Femtosatellite Orbital Deployer.) The upcoming Italian "UniSat-7" small satellite has several of those deployers onboard. The UniSat-7 satellite will be a secondary payload on a Dnepr launch vehicle. Gauss Team are the launch services provider for the Unisat satellite and are offering the space in the deployer on commercial terms, which is currently about 15,000 euros.

It is my hope that once the many dedicated CubeSat launch vehicles complete their development, the number of low cost launch opportunities for PocketQubes will increase.

Jos Heyman

Once OzQube-1 is on orbit, what are the next steps? What do you plan to do once OzQube-1 has been launched?

Stuart McAndrew

Making contact with OzQube-1 and validating the operation and performance of the subsystems is the first goal. Once that has been achieved, the second goal will be enabled—to obtain imagery of Australia and to communicate that imagery back to the ground.

The imagery will be transmitted using a variety of radio formats and modulations. I hope to enable the reception of images using low cost hardware and home-made antennas. This, in turn, may inspire others to try their hand at receiving data, or even try and build a satellite of their own.

Jos Heyman

Do you see yourself continuing to work within the small satellite environs in the future?

Stuart McAndrew

I hope that the experience I have gained throughout this project will position me to be part of the SmallSat movement in the future, whether such is via direct involvement with other missions, or whether it's by enabling others to develop their own missions through the commercialization of the OzQube-1 design. I have a list of potential mission ideas for PocketQubes that require some more R&D and other specialist skills.

Jos Heyman is the Managing Director of Tiros Space Information, a Western Australian consultancy specializing in the dissemination of information on the scientific exploration and commercial application of space for use by educational as well as commercial organizations. An accountant by profession, Jos is the editor of the ***TSI News Bulletin****.*

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A Primer On The Language Of... LNB + BUC

By Sheri Morita, Senior Product Manager, Norsat International, Inc.

The satellite industry is full of people, myself included, who do not have backgrounds in Engineering. For those of us who fall into this camp the specifications for radio-frequency (RF) devices can be mysterious and intimidating—arcane symbols and abbreviations we do not understand and numbers whose significance eludes us.

If these challenges sound familiar to you then read on—the goal of this article is to review commonly-used specifications; to explain what they are and why they truly matter.

Before we move on, a comment on decibels (dB). A decibel is not really a unit of measurement like watts or volts or degrees. Rather, this is a unit used to quantify the ratio between two things (usually power or intensity) on a logarithmic scale.

The use of a logarithmic scale allows us to compare large and small numbers without a bunch of annoying zeros getting in the way. As a reference, 0 dB equates to 1, 10 dB equates to 10, 50 dB equates to 100,000 and 100 dB equates to 10,000,000,000. The key element to remember is the difference between two numbers that are both stated in dB can be quite a bit larger than such appears at first glance. This is a good to keep in mind when you are comparing specifications for different products. I recommend the Wikipedia article on decibel if you would like to read more information on this topic.

Let's begin our adventure by looking at an attribute that I have found particularly challenging: voltage standing wave ratio (VSWR). A quick Google search defines VSWR as the ratio of the maximum RF voltage to the minimum RF voltage along the line. I'm sure this is meaningful to the Electrical Engineers in the crowd, but I do not find it to be a particularly illuminating explanation of what is going on.

For me, the easiest way to think about VSWR is as a way to quantify the efficiency of power transfer through a system. A perfectly efficient system would have a VSWR of 1:1—all of the power that enters the device would exit. This, of course, is not what happens. A certain amount of the power is always lost to inefficiencies.

The goal, of course, is to minimize this loss in order for as much power as possible to be delivered. VSWR is also a logarithmic scale; the difference between 2:1 and 4:1 may not seem that large, but in reality, 2:1 is pretty good and 4:1 would be practically unusable. VSWR is specified both at the input and output interfaces of a device.

Once you know what the VSWR is, you can use that ratio to calculate return loss, which is the loss of power caused by a discontinuity, such as the connector between two components, reflecting a portion of the power backwards into the system. Return loss is measured in dB, and counterintuitively, the greater the return loss is in decibels, the better. Note that for historical reasons, return loss is sometimes shown as a negative number. When this is the case, the measurement should be called reflection coefficient instead.

Conversion gain is a measure of the difference between the power of an input signal and the power of an output signal. Gain is given in dB, and larger numbers are better. Gain between 50 dB and 60 dB is generally considered sufficient for most satellite communication purposes.

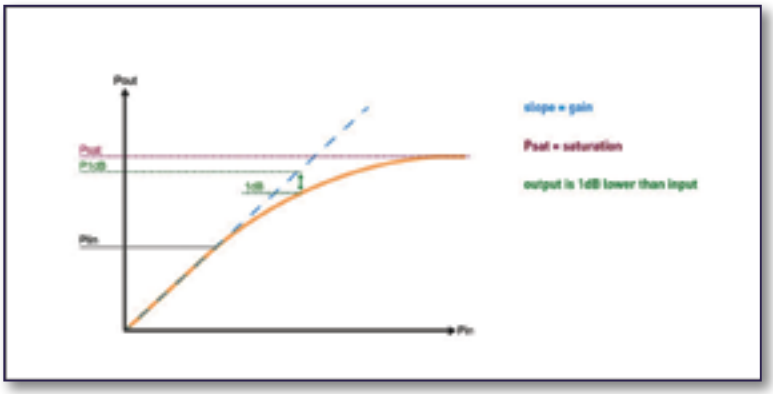
In the case of LNBs (Low-Noise Block Downconverter), this means amplifying the very weak signals received from a satellite approximately 500 to 1,000 times so that they are sufficiently strong enough to be deciphered by a modem. In the case of a BUC or SSPA this means amplifying the power that is received into the device by approximately 500 to 1,000 times in order for the outgoing radio waves to have enough energy to reach their targeted satellites.
As you can imagine, this results in a great deal of energy and explains why it is unwise to stand in the path of a transmitting antenna.

In a perfect universe, gain would always be linear; the power coming out of a system would continue to increase at the same rate as the power going in and higher gain would always be better. Unfortunately, this is not the case. At some point, the output power begins to drop off relative to the input power and trying to increase gain past this point ultimately leads to distortion, saturation and ultimately damage to the device. A bit more on this topic will be presented later in this article.

Gain variation, or gain flatness, is a measurement of the difference in gain across the output frequency of a product and is measured in decibels peak-to-peak (dB p-p), either across the entire operating band of the device or over any 40 MHz (40 MHz is generally the bandwidth of a single satellite transponder). This can also be measured across a temperature gradient or over time. The closer this number is to zero, the better, as very low numbers mean you will witness consistent behavior of the device across its operating parameters.

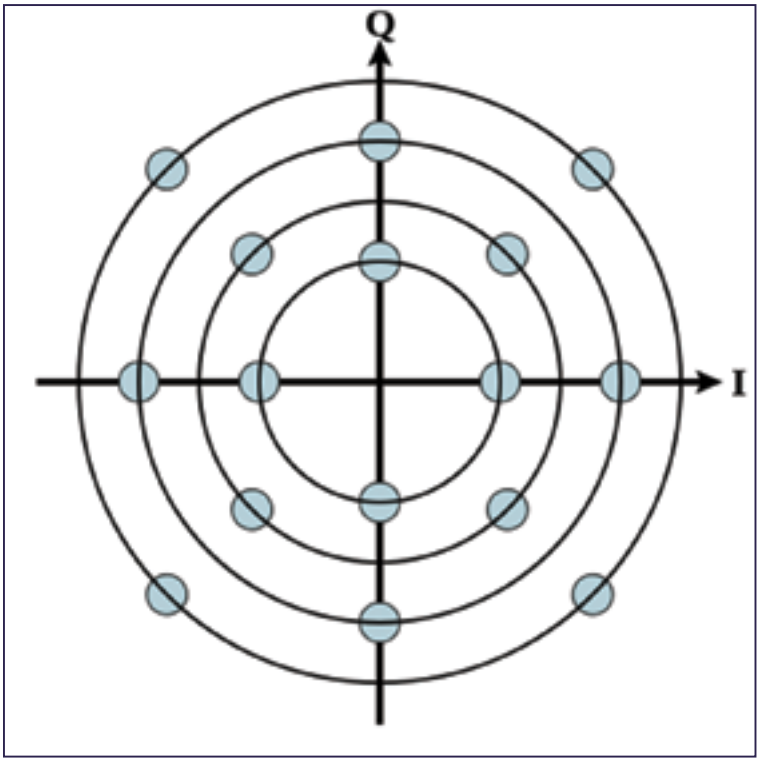
Output power is one of the primary specifications for BUCs and SSPAs, which makes perfect sense as higher wattage products provide higher data rates and higher throughput. The cost of products increases as wattages get higher, and those costs can be quite high indeed for higher power units.

Unfortunately output power is also one of the most unclear specifications for these devices, mainly due to a lack of standards. Sometimes, especially for high-power Ku-band and for Ka-band products, power is specified at the amplifier's saturation point: Psat. Sometimes power is specified at the point where there is a 1dB difference between the theoretical linear gain and the actual gain: P1dB. Sometimes power is specified at the point before gain deviates from linear: Plin.



There is no easy way to convert the output power at one of these points to output power at a different point. Any time you are comparing BUCs and SSPAs, read the specification sheets carefully to understand what the output power is at these three points. If this information is not in the spec sheet, ask the vendor to tell you; this is the only way you can be certain you are comparing apples with apples.

Note that power is not specified for LNBs. This is because the signal strength coming into the LNB is so very low that is not possible to saturate or over-drive the device during normal operations.



Circular 16QAM (Quadrature Amplitude Modulation)

Local oscillator (L.O.) stability is also an important figure in LNB specifications as it determines what types of systems the LNB can be used in. To go back to basics, the function of an LNB within a system is to extract a signal of interest from the microwaves collected by the antenna, and then to amplify that signal and mix it with the L.O. frequency to create the output frequency that is then sent to the modem. If an LNB has a very high stability, for example +/- 2 kHz, the output frequency will not vary much at all. This means that the modem will reliably receive a very narrow band transmission, leaving adjacent frequency bands available for other uses.

Applications such as voice communications rely on this level of stability. If an LNB has a low L.O. stability, for example, of +/- 2000 kHz (2 GHz), the output frequency will vary considerably. In broadband applications such as HDTV transmission, this is not a problem, as the resulting output frequency will still be acceptable to the modem. Note that products with high L.O. stability are more expensive than those with low L.O. stability. External reference LNBs, which use a "locked" external signal that does not vary at all, are even more expensive. Which L.O. stability is "best" depends on the input requirements of the modem and what the intended use of the modem.

Noise is measured in dB and is caused by the unwanted electrical contributions of a device's components. As one would guess, the closer to zero the noise figure is the better. This is especially important in LNBs as the strength of the signal received from the satellite is low enough that too much noise can completely overwhelm the signal. As an aside, there is an interesting challenge in RF design relative to noise: input circuits that are designed for low noise frequency tend to have higher VSWR and vice versa.

Phase noise is a particular subset of noise. It refers to random fluctuations created in the phase of a waveform, and can destroy the orthogonality (being at right angles to one another) of the signals. If this occurs, the polarization of the microwave path between a satellite and an antenna can be destroyed, making it impossible to determine which of the data streams a particular bit belongs to. Phase noise is measured in decibels relative to carrier per hertz (dBc/Hz), and large negative numbers are better than those closer to zero. Note that phase noise is more of a problem for low data rate transmissions such as voice than for high data rate transmissions such as HDTV as there is less ability for the modem to correct for lost bits.

Last, but not least, we have spurious. Spurious is my favorite specification, as it is a measurement of the strange things that happen as gain begins to go non-linear and power begins to misbehave. This misbehavior results in unwanted, in-band frequencies being generated within the system, causing distortion.

Spurious is measured in decibels relative to carrier (dBc) at the rated power for the product. A negative number, the further from zero the db is, the better. Note it is important you understand if the rated power is P1dB or Psat when you are looking at the spurious specifications that the difference between the theoretical linear gain and the actual gain curve is smaller at P1dB than it is at Psat, so there will be fewer peculiarities occurring at lower power levels.

There are, of course, other RF specifications that I have not covered, but I hope that this information I have provided will serve as a good base upon which you can build your knowledge and make wise product decisions.

www.norsat.com

InfoBeam

Exelis + DigitalGlobe—Two Companies Create A Single Platform

Exelis and DigitalGlobe, Inc. have agreed to provide a new commercial offering of cloud-based ENVI Earth science analytics for the DigitalGlobe Geospatial Big Data (GBD) platform.

ENVI is the industry-leading remote sensing analytical software used by government, academic and private industry organizations to extract meaningful information from imagery and sensor data.

The agreement will enable all imagery users and customers of Exelis and DigitalGlobe to easily combine powerful ENVI geospatial analytics with the vast DigitalGlobe image library to solve challenging environmental, natural resource, and global security problems.

"This agreement between Exelis and DigitalGlobe creates a single platform that customers can effectively use to solve challenging problems and define new market opportunities," said Chris Young, president of Exelis Geospatial Systems. "This platform removes the logistical challenges that have inhibited this sort of innovation such as processing power, data storage and hardware cost."

Designed and built by Exelis, ENVI image analysis software has been used for more than 25 years to extract meaningful information from geospatial data.

ENVI software helps users make better decisions regarding mineral exploration, precision agriculture, environmental degradation, national defense and more.

DigitalGlobe's cloud-based GBD offering is a PaaS (Platform as a Service) model designed to create a new ecosystem in which partners and developers can leverage their expertise and an application programming interface, or API, to create new customer solutions at a global scale.

www.exelisinc.com/
www.digitalglobe.com/

And Speaking Of The SSPI... Is Satellite Winning The Talent War?

By Robert Bell, Executive Director, Society of Satellite Professionals International (SSPI)

"The global war for talent" is how, in 1997, McKinsey & Company described the emerging competition among companies for a resource vital to their success—but one that always seems in short supply. The consulting company predicted that the ability to identify, recruit and retain the best and brightest would become a major competitive advantage in a global economy.

Events have proved McKinsey correct beyond the company's wildest dreams. The most obvious example is the new class of companies—from Netflix and FaceBook to Google—whose major asset is talent. Those companies are relevant to the satellite business because some have announced blue-sky satellite projects as well as because they form part of the competition for talent faced by the satellite industry.

In March of this year, the Society of Satellite Professionals International published the first multinational, multi-company study of talent in the satellite business. *Are We Winning the War for Talent?* asked how well the experienced incumbents of our industry are stepping up to the challenge laid down by McKinsey, and started a dialogue about collective actions to improve performance.

The End Of An Era Of Stability

The human resource executives of satellite companies know what they are up against. "Particularly in the Washington DC area," one executive told us, "the challenge is competition from other technology companies. It is tough to match the salary and benefits they offer."

The challenge is particularly acute as the industry is used to having a workforce that does not change. "We have had a stable workforce with low turnover for decades," said another executive.

On the macro level, the stability of the workforce seems set to continue. Drill a bit deeper, however, and the macro numbers mask significant transitions in the business. "Our company has typically had a lot of long-term contracts which required little change in our workforce," said an executive. "It's different today."

Nearly 70 percent of the executives in the sample group reported difficulty filling specific job roles. "We don't have a robust pipeline," said an HR executive with one of the largest satellite operators. "Our workforce is aging and we struggle to find candidates with the right skills sets, particularly for entry-level positions."

Another executive framed the issue even more starkly. His major concern is "protecting the talent pipeline in our company. We lose five to six people every year to other companies because we can't match their offer. We focus on protecting managerial and technical expert positions."

It would be hard to find a better description of a company, and perhaps an industry, on the defensive in terms of talent attraction, recruitment and retention. Defense is important, of course—but no one ever won a war with it.

Filling The Pipeline

While protecting its existing talent, the industry faces the need to replace a significant chunk of its workforce over the next

decade. Forty-two percent of our multinational sample of employees was 55 or older, and a surprising 10 percent have exceeded the standard retirement age of 65 and continue to work full time. However, the graying of the industry may also be an overhyped story. Thirty percent of our respondents were age 44 or younger and 28 percent were in the 45 to 54 range where employees typically reach their peak in earnings and responsibility. Work on replacing the pending group of retirees appears to be already underway.

The larger companies in the space already have significant talent attraction programs focused on youth. "We have a successful internship program," said one HR leader, "and we are working to enhance it with job-shadowing opportunities and more advanced work-study programs."

When you get past the largest companies in the industry, however, there is much less of a structured approach. A remarkable 56 percent of human resource executives reported that their companies have no formal internship or work-study program.

What some of them have instead is an informal program, typically led by a self-appointed individual with a passion for mentoring young people. When the self-appointed leader leaves or retires, however, the effort typically falls apart because it has not been institutionalized within the organization.

Lack Of Recognition

That is not how global tech companies get the job done. And it is particularly short-sighted, given how little recognition our leading-edge industry has among people entering the workforce. "We have difficulty in attracting graduates," said a respondent to our survey, "because our industry is not as well known as others. There are a lot of graduate opportunities in other industries that offer higher pay."

Even students passionate about space know shockingly little about the only industry that does business there. SSPI presented a workshop in 2014 for attendees of the annual Students for the Exploration and Development of Space (SEDS) conference. The young people in the room were mostly graduate students in engineering involved in space activities at their schools. At the end of the workshop, the most common comment from the audience was "I had no idea what the satellite industry does or how big it is."

At a recent trade show in Washington, DC, the current Chair of SEDS put the matter starkly in front of the attendees during a panel session on education. "The software and IT firms are coming onto campus and recruiting aggressively. But I never see satellite companies there." If Woody Allen was correct, that 80 percent of life is just showing up, the satellite industry so far may be missing out on 80 percent of the talent it needs to power growth in a more competitive and demanding future.

Robert Bell is the executive director of the Society of Satellite Professionals International (www.sspi.org) and author of ***Are We Winning the Talent War?*** *Robert can be reached at rbell@sspi.org. The report may be downloaded at no cost for SSPI members and sponsors, and purchased by non-members at* ***www.satelliteworkforce.com****.*

InfoBeam

The Global Navigation Satellite Systems' Market Offers Some Promising Possibilities

Global Navigation Satellite System (GNSS) is a technology that allows any user having a compatible device to determine their position, velocity and local time by processing signals from satellites in space.

GNSS signals are provided by a variety of satellite positioning systems, including GPS, Galileo, Glonass, BeiDou or regional SBAS. The GNSS market comprises both products (receivers and devices) and services using GNSS-based positioning as a significant enabler. The global core GNSS market is forecasted to grow at a CAGR of 9 percent during 2015-2020.

In their latest research study *Global Navigation Satellite Systems Market Outlook 2020*, RNCOS' analysts have identified and deciphered the market dynamics in important segments thus clearly highlighting the areas offering promising possibilities for companies to boost their growth.

The report studies the market by its major application and location based services, transportation (further divided into road navigation, rail navigation, air navigation and marine navigation), surveying activities and agriculture. The GNSS application market is further studied by region viz. North America, Europe, Asia-Pacific, and RoW.

The report provides a complete overview of the GNSS market globally. All the current trends and drivers coupled with potential growth areas of the GNSS industry have been evaluated in the report.

Furthermore, the report provides a profound knowledge of opportunities in the industry for different companies in the chapter named 'Opportunity Assessment.'

Additionally, to provide knowledge of the prospects for GNSS players on the geographical front, our report provides a comprehensive knowledge of 10 of the most worthwhile GNSS markets around the world:

- ***U.S.***
- ***Canada***
- ***U.K.***
- ***France***
- ***Germany***
- ***Russia***
- ***Japan***
- ***China***
- ***South Korea***
- ***India***

The report includes information about the present state and future outlook of the LBS and Telematics market in these countries along with information about their personal navigation systems such as U.S.' GPS, China's BeiDou, Europe's Galileo, Russia's GLONASS, Japan's QZSS and India's IRNSS.

Finally, the study looks into the competitive landscape covering business overviews, key financials, product analyses, recent developments and strengths and weaknesses analyses of each of the players.

All in all, the report would help clients analyze the driving forces and understand the opportunities existing in this industry.

Additional info
www.reportlinker.com/p02770661-summary/Global-Navigation-Satellite-Systems-Market-Outlook.html

Eutelsat's KA-SAT Access Being Replaced With tooway™ Business Solutions Services

Eutelsat Broadband has a new, improved range of tooway™ Business satellite broadband services designed to meet the needs of SOHO, SMB and large corporates located across Europe, North Africa and large parts of the Middle East.

The new services, which will replace the current KA-SAT Access business offering, are faster, more flexible and packed with additional support features to benefit business customers. tooway™ Business offers broadband packages with a wide range of data allowances up to 200GB a month and a host of flexible B2B features including Public IP addresses, Business Hour Protection and a full array of customizable options including guaranteed bandwidth speeds.

tooway™ Business is ideal for organizations based in locations where fixed-line services are slow or unavailable and for businesses that need an alternative to fixed line broadband for critical
applications such as disaster recovery or back-up. tooway™ Business is available today via Eutelsat Broadband's range of authorized distributors across Europe, North Africa and the Middle East. tooway™ Business broadband includes a range of solutions:

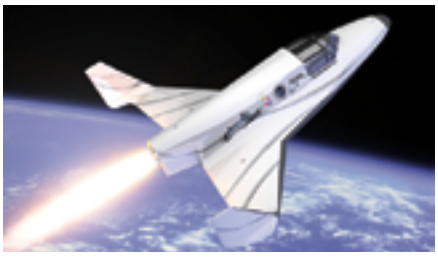
- *"tooway™ Business 25" offers a 25GB monthly data allowance and is ideal for Prosumers or*
- *Small Office & Home Office users.*
- *"tooway™ Business 40" offers a 40GB monthly data allowance and is ideal for small and medium size enterprises.*
- *"tooway™ Business 100" and "200" offer 100GB and 200GB monthly data allowances respectively for larger corporates.*
- *"tooway™ Telemetry" with a 2GB monthly allowance for businesses that need machine to machine or simple data communications with a 2Mbps up-and-down-link will continue to*
  be available.

tooway™ Business 25, 40, 100 and 200 offer Europe's fastest satellite download speeds of up to 22Mbps and upload speeds of up to 6Mbps. A host of additional, optional chargeable features are available for businesses to help make the most of their service.

eutelsatbroadband.com/

InfoBeam

XCOR Aerospace Integrates Strakes To Lynx Mark I



XCOR Aerospace, Inc. has bonded the XCOR Lynx Mark I strakes to the Lynx spacecraft fuselage.

The Lynx Mark I manned suborbital spacecraft is currently being assembled at XCOR's Hangar 61 in Mojave, California.

Integrating the strakes to the Lynx Mk I was a critical step, noted XCOR President and Chief Executive Officer Jay Gibson. "Today marks another solid milestone in our progress toward first flight, clearing the path for a series of important moments that will accelerate Lynx development," he added.

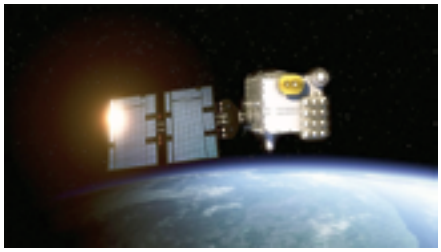
With the strakes bonded to Lynx, "we have an open path toward the integration of a number of subsystems, and this means we will now start electrical wiring, plumbing, installing the control system, and populating the landing gear bays," added Chief Technology Officer Jeff Greason.

The strakes make up a large portion of the Lynx aerodynamic shell. Each strake is partitioned into four independent fuel tanks that are pressurized during flight and supply kerosene to the Lynx engines.

Each strake also houses a main landing gear assembly and two reaction control thrusters that the Lynx will use to make attitude adjustments while outside of the atmosphere.

InfoBeam

SSTL Delivers FORMOSAT-7 To Taiwan



Artistic rendition of the FORMOSAT-7 satellite. Image courtesy of SSTL.

Surrey Satellite Technology Ltd (SSTL) has delivered the first spacecraft for the FORMOSAT-7/COSMIC-2 weather forecasting constellation to the National Space Organization (NSPO) in Taiwan, where it has successfully passed a series of systems checks.

The FORMOSAT-7 spacecraft has been designed by SSTL using heritage avionics and it has been assembled at the Company's cleanroom facilities in the United Kingdom, where SSTL is currently building the remaining FORMOSAT-7 platforms for the constellation.

The payloads for the spacecraft are being supplied by NSPO's mission partner, the National Oceanic and Atmospheric Administration (NOAA) in the United States, and they will be integrated to the platforms in Taiwan where a full set of spacecraft system tests will be performed.

Luis Gomes, Director of Earth Observation at SSTL, said, "The delivery of the first of the FORMOSAT-7 spacecraft to our customer is an important milestone in the program and the satellite has arrived safely and in full working order. SSTL is continuing to work on the assembly of an additional five platforms for the constellation at our cleanrooms here in the UK and at the NSPO site in Taiwan, where our engineers are involved in the next phase of payload integration and testing, so it's an extremely busy phase in the mission for the collaborative team."

The FORMOSAT-7 constellation is a joint civil mission between the Taipei Economic and Cultural Representative Office in the United States (TECRO) and the American Institute in Taiwan (AIT). NSPO and the National Oceanic and Atmospheric Administration (NOAA) in the United States are the designated representatives of TECRO and AIT respectively.

The new constellation will collect atmospheric data at low and mid latitudes and improve both regional and global weather forecasting for over 5000 registered users of the data across the globe. It will also provide scientific data in support of climate studies and ionospheric science. Launch is targeted from 2016.

www.sstl.co.uk/

Thaicom Responds With SATCOM Equipment To Assist With Nepal Earthquake Disaster

Satellite equipment and engineers have been deployed to Nepal to help reconnect the region as disaster recovery continues following the major earthquake.

The 7.9 magnitude earthquake, which hit Nepal's capital Kathmandu and its surrounding areas on Saturday, April 25, has claimed thousands of lives and rescue efforts are underway.

Nepal's telecommunications infrastructure was also destroyed, further hindering relief efforts. In order to assist the recovery operations, Thaicom PLC has now deployed a satellite communications network to be set up in the affected areas, along with an engineering team to get the system up and running so vital communications can be reinstated.

Suphajee Suthumpan, Chairman of the Executive Committee and CEO, said, "Everyone at Thaicom is praying for the victims and their families and we share our heartfelt sympathy and condolences for the massive life losses and damages resulting from the Nepal earthquake, much of which is still emerging.

"During crises such as these, satellite is often the only system available for vital communications and this system will provide the first means of communications since the earthquake.

"We hope it goes some way towards alleviating the suffering and helping with the continued search and rescue efforts, as well as enabling individuals to contact friends and relatives."

This communications network has been delivered in conjunction with partners from various sectors, such as Thaicom's country representatives, business partners and government agencies from domestic and international alliance.

Thaicom has provided assistance after numerous disasters, such as the devastating Japanese earthquake and tsunami in 2011 and both the China and Christchurch earthquakes, among others.

When Typhoon Haiyan struck the Philippines in November 2013, Thaicom provided satellite communications and instigated a support network among various business partners. It sent experts to install communications equipment for victims and officials to use in the affected areas.

THAICOM 4 (IPSTAR), a high throughput satellite, provided critical services such as Internet and telephone communications in the disaster zones.

www.thaicom.net/

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Property Interests[1] In Space: Recent U.S. Policy Developments

By Elizabeth H. Evans, Partner, Dentons

Who owns space? All of us? None of us? These questions are becoming increasingly relevant.

Once considered solely the subject of science fiction, technology has progressed to the point that there is now a distinct need for further regulation of property interests in space. Today there are private companies with plans to set up lunar bases and human colonies on Mars.

Energy companies are being established to invest in technologies to mine asteroids and the moon. China and Japan have completed successful missions to the moon.[2] One of the China missions was to successfully launch technology to return lunar samples, potentially in contemplation of future extraction.[3]

The existing international legal convention with respect to the ownership of interests in space is the United Nations Outer Space Treaty of 1967 (the "Outer Space Treaty").[4] The treaty, signed by more than 100 nations, and ratified[5] by the United States, was designed to ensure that space would be used for peaceful purposes and that no nation could assert a sovereign claim over assets and properties discovered or known to be existing in space.

The United Nations Moon Treaty of 1979 (the "Moon Treaty")[6] states even more specifically that ownership of the moon or other celestial entity by a sovereign nation or a private entity is prohibited. The Moon Treaty also prohibits the harvesting of natural resources from the moon, unless done in accordance with an international regime established to govern the extraction of such resources.[7]

Unlike the Outer Space Treaty, the Moon Treaty was ratified and acceded to by only 13 nations. None of the three primary space faring nations, the United States, People's Republic of China or Russia, signed or supported the treaty; therefore, the Moon Treaty is not legally enforceable against those nations.

Because the Moon Treaty speaks directly to the private ownership of extraterrestrial property and the Outer Space Treaty does not, some commentators suggest that, by failing to sign or ratify the Moon Treaty, the United States has not relinquished private ownership rights in respect of the moon and other space assets (*i.e.*, ownership claims without national sovereignty).[8] The Outer Space Treaty, however, specifically provides for the regulation by the sovereign nations of the outer space activities of its private entities: "The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty."[9]

While it is clear that this international framework is completely inadequate for the future commercial landscape, recent legislative and federal agency action evidences that the process of regulating, and incentivizing, private companies to explore and profit from resources in space has begun in the United States.

On July 10, 2014, H.R. 5063, the ASTEROIDS[10] Act, was introduced to the 113th Congress. The ASTEROIDS Act specifically directs the President through the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA) and other appropriate federal agencies to: (i) facilitate the commercial exploration and utilization of asteroids resources to meet national needs, (ii) discourage government barriers to the development of economically stable industries for the exploration and utilization of asteroid resources in outer space in a manner consistent with the existing international obligations of the United States, (iii) promote the right of United States' commercial enterprises to explore and utilize resources from asteroids in outer space and to transfer or sell such resources and (iv) develop the frameworks necessary to meet the international obligations of the United States.

Once introduced, the bill was referred to the House Committee on Science, Space and Technology and a hearing was held, where the ASTEROIDS bill was considered along with appropriations for the national space program.. Congressmen considering the bill made comments evidencing that they are ready to pass the baton from national, sovereign programs to private programs, as "the private sector and scientists" represent the "best way to maximize limited resources."[11] HR 5063 died in the 113th Congress with no further action, but it has been reintroduced into the current Congress as HR 1508 on March 19, 2015.

In December of 2014, the FAA took additional action with respect to the regulation of private commercial space activities. In response to a launch request by Bigelow Aerospace, a company which is developing inflatable habitats for outer space, the FAA issued a policy letter in which the federal agency made statements recognizing "the private sector's need to protect its assets and personnel on the moon or on other celestial bodies."[12] The letter permitted Bigelow Aerospace to proceed with its contemplated commercial activities on a "non-interference basis."[13]

While the FAA policy letter does not purport to grant ownership rights on the moon, the FAA has bestowed upon Bigelow Aerospace certainty of knowing, as the founder, Robert Bigelow, explained, "that somebody else isn't licensed to land on top of you or land on top of where exploration and prospecting activities are going on, which may be quite a distance from the lunar station."[14] Prohibiting others from landing on Bigelow's licensed portion of the moon (whether or not adjacent to the lunar stations) gives Bigelow de facto ownership of that lunar land (at least in respect of other US companies).

Both the ASTEROIDS bill and the December FAA policy letter have tremendous implications for international space law. They show that the United States is ready to support (and allow) private companies to invest in, and profit from, space assets[15] in a manner that is directly contrary to the provisions of the Moon Treaty. While the Moon Treaty is not binding on the United States, and does not have the force of international law, it is important to remember that the Moon Treaty is not binding on China or

the Russian Federation or many other countries which may sponsor private companies seeking properties on the moon or in space.

Accordingly, other sovereign nations could grant licenses and incentives directly in conflict with those established by the United States, and it is easy to see how messy it could get. We can only hope that these proposed U.S. regulations and policy statements in support of commercial space companies will be the catalyzing ingredient to establish a much- needed international dialogue with other sovereign nations with respect to reworking the international treaties currently governing property interests in space.

The need for unified, international regulation is immediate, before the technology to mine and inhabit space is fully achieved and the conflicts become acute.

Footnotes

[1]*This article will speak only to legal property interests that are not intellectual property interests. Another article will need to address intellectual property rights for items constructed and created in space.*

[2]*ASTEROIDS Act: Who Owns Space?, Monica Grady,* ***http://www.science20.com****.*

[3]*Id.*

[4]*Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 27 January 1967, 610 U.N.T.S. 205.*

[5]*Once an international treaty is ratified, the treaty has the same force and effect as a federal law. Like federal law, the treaty remains in effect unless Congress passes a statute to negate it, if the United States officially withdraws from the treaty or the treaty is determined to be unconstitutional by a federal court.*

[6]*Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 18 December 1979, 1363 U.N.T.S. 3*

[7]*The Moon Treaty: Failed International Law or Waiting in the Shadows?, Michael Listner, The Space Review,* ***http://www.thespacereview.com/article/1954/1***

[8]*Could Legal 'Loophole' Lead to Land Claims on Other Worlds? Cosmic Log, NBCnews.com, April 9, 2012. The loophole for private companies could not, however, apply to companies organized in, or citizens of, countries which had ratified or acceded to the Moon Treaty.*

[9]*Article VI, The Outer Space Treaty of 1967.*

[10]*The full name of the act is the American Space Technology for Exploring Resource Opportunities in Deep Space Act.*

[11]*Id.*

[12]*One Small Step for Man, One Giant Step for the Commercialization of the Moon, Dominic Basulto, February 12, 2015, The Washington Post.*

[13]*To the Moon! FAA Boosts Commercial Lunar Ventures, NBC News.com, March 11, 2015*

[14]*Id.*

[15]*In furtherance of this goal, NASA also signed a Space Act Agreement with Bigelow Aerospace to encourage private ventures to contribute to human missions in space and on the moon. See To the Moon? Bigelow Aerospace and NASA Look at Private Exploration, Cosmic Log, NBCnews.com, April 19, 2013.*

Upcoming: A Special Conference Event

SPACE LAW: CURRENT AND FUTURE ISSUES

Tuesday June 9, 2015

"This conference will address a wide variety of issues and practice areas that are part of commercial space activities. They range from long-established activities like remote sensing to the new challenges of cybersecurity to the emerging issue of mineral rights in Space.

"Each panel will consist of recognized authorities and industry experts, including preeminent private and government lawyers, industry leaders, and key government decision makers. We will have a keynote address by Dr. George C. Nield, Associate Administrator for Commercial Space Transportation, Federal Aviation Administration, Washington, DC.

"In addition to a first-rate program, there will be lots of time for networking with other practitioners in the space and legal community, including a reception after the conference that will be hosted by the Forum on Air & Space Law."—Robert Span, Chair, Forum on Air & Space Law

The Program Planning Committee is comprised of:
Karen Dacres, Planet iQ — Elizabeth Evans, Dentons —Joanne Gabrynowicz, Ole Miss — Indra Hornsby, Space Flight Industries — Sabrina Jawed, FAA — Sagi Kfir, Deep Space Industries

SCHEDULE

8:00 a.m.—*Registration and Continental Breakfast*

8:45 a.m.—*Welcome & Program Overview*

9:00 to 10:15 a.m.—***From Here to Ubiquity: The Current and Future State of Commercial Remote Sensing Law***—*This panel will focus on the evolving state of remote sensing law and policy, in light of the tremendous growth in the remote sensing space industry, advances in technology and changing business models.*

10:15 a.m.—*Coffee Break*

10:30 to 11:45 a.m.—***Building Blocks of the Frontier: Legal Aspects of Space Resources Utilization***—*This panel will focus on clarifying the status of space mineral rights law on a national and international level, and discuss the political and policy considerations that may shape the development of a space mineral rights legal regime.*

11:45 a.m. to 1:00 p.m.—***Post-Export Control Reform Challenges: To Go Where No One Has Gone Before***—*A panel of experts will look at how export control reform has (or has not) changed the legal, regulatory and commercial landscape for the space community and its suppliers.*

1:00 to 2:30 p.m.—*Networking Lunch with speaker Dr. George C. Nield, Associate Administrator for Commercial Space Transportation, Federal Aviation Administration, Washington, DC*

2:30 to 3:45 p.m.—***A Cosmic Threat: Cybersecurity Issues in Space***—*Panelists will discuss steps they are taking within their organizations to address cybersecurity issues, including adequately protecting classified and customer information. The current legal framework and regulations will be examined.*

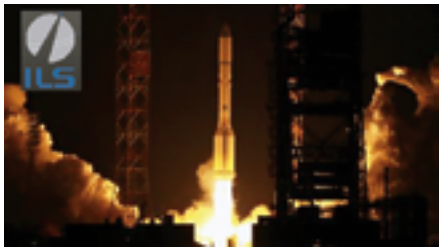
3:45 to 5:00 p.m.—***The General Counsels Panel: What Issues Keep You Awake At Night?***—*General Counsel from some of the leading companies in our industry will discuss the significant legal challenges facing their companies and the industry, future trends and what keeps them up at night. Their valuable insights will inform and stimulate your thinking.*

5:00 to 6:00 p.m.—*Reception*

For additional details, please visit
www.americanbar.org/groups/air_space.html

InfoBeam

Togetherness—Dauria Aerospace + ILS Planning Dual Launch Projects



International Launch Services (ILS) and Dauria Aerospace (Dauria), of Moscow, Russia, have signed an agreement to collaborate on opportunities to launch spacecraft using an ILS Proton or Angara launch vehicle beginning in the 2017 timeframe.

The agreement, signed by ILS President, Phil Slack, and Dauria CEO, Sergey Ivanov, states that both companies will mutually cooperate on identifying spacecraft that can be dual launched in a stacked configuration—with the

lower Dauria spacecraft supporting the upper spacecraft—on an ILS Proton or Angara launch vehicle.

With this agreement, ILS would identify spacecraft that could be paired with Dauria's ATOM spacecraft and together, the companies would assess the technical feasibility.

The ATOM spacecraft weigh between 1050-1500 kg and provide satellite TV, telephone and broadband communications.

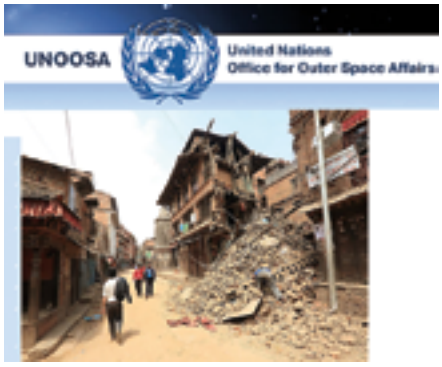
ILS and Dauria officials will meet on a regular basis to evaluate the commercial environment and any mutually beneficial joint initiatives that would serve the global satellite industry.

Phil Slack said, "This agreement establishes an excellent foundation for our partnership with Dauria for dual launched spacecraft. This is an innovative approach that will benefit satellite operators who want a cost effective solution to launch their smaller spacecraft."

"This agreement with ILS will allow Dauria satellites to be launched in a timely manner with competitive pricing for the companion spacecraft. This also represents another positive example of U.S.-Russian cooperation in space activities. We look forward to further collaborating with ILS and providing outstanding access to space," said Sergey Ivanov.

www.ilslaunch.com/#

United Nations Opens Satellite Resource For Emergency Response Teams In Nepal



In response to the devastating earthquake in Nepal, the United Nations Platform for Space-based information for Disaster Management and Emergency Response (UN-SPIDER), a program under the United Nations Office for Outer Space Affairs (UNOOSA), is supporting the disaster response efforts by making openly available all satellite-based resources.

The earthquake, with a magnitude of 7.8 and a depth of 15km, resulted in the deaths of more than 3,500 people and injured a further 7,000.

Officials have reported that around 100,000 people have been left homeless. To support the rescue efforts, several agencies are involved in producing satellite-based information. UN-SPIDER has now compiled this information into an easily accessible format.

Satellite-based information is vitally important to help aid agencies target their relief efforts, by showing the areas and roads destroyed by the earthquake so they can reach people in need more quickly.

How can space technology be applied to disaster risk management and disaster management? The Space Application section contains information on those space-based mechanisms established by space agencies of various countries and services, on their application, sources and access options. It is worth noting that this information covers the full disaster management cycle, all Earth-directed space technology, and all types of major natural or man-made hazards.

The Emergency Mechanisms section provides an overview of the most relevant mechanisms such as the International Charter "Space and Major Disasters". The understanding of these mechanisms, their procedures and workflows is a prerequisite to ensure rapid access to the products and other relevant information generated by these mechanisms.

In the Space Application Matrix, the user finds guidance on space applications and how disaster management can benefit from their use. Scientific and technical articles, guides and case studies outline the underlying principles, methodical workflows and best practices, advantages, restrictions, and accessibility of data and services are offered to inform the user and to support his decision making.

UN-SPIDER staff can be contacted for updates at ***un-spider@unoosa.org***.

InfoBeam

AsiaSat 5 Bringing BBC World Service To APAC Via BT

Artistic rendition of the AsiaAt 5 satellite. Image is courtesy of SSL.

Asia Satellite Telecommunications Company Limited (AsiaSat) has reached an agreement with BT to deliver BBC World Service Asia feed of 33 radio channels in 21 languages.

These services are being distributed in C-band on AsiaSat 5 from the orbital location of 100.5 degrees East to BBC's short and medium-wave transmitter sites, as well as to FM partners and re-broadcasters in Asia and Australasia.

The services, which are tailored to the region, constitute an essential part of BBC's global distribution service. With AsiaSat 5, the BBC services are reaching an ever-growing audience in Asia.

William Wade, President and Chief Executive Officer of AsiaSat said, "BBC's commencement of service has significantly expanded our portfolio of information and entertainment services on AsiaSat 5.

"This partnership between AsiaSat and BBC offers a diverse range of high quality content from one of the world's leading public service broadcasters to a broad Asian audience."

Mark Wilson-Dunn, Vice President BT Media & Broadcast, said, "Our successful partnership with AsiaSat enhances our distribution services to BBC in terms of service performance and audience reach in Asia."

www.asiasat.com/

Why, After Ten Years, HTS Remains More Relevant Than Ever Before...

By Nile Suwansiri, Chief Marketing Officer, Thaicom

Due to the emergence of High Throughput Satellites (HTS), the satellite market has significantly changed. Ten years on and HTS have proven their worth—they are here to stay—however, have the systems reached their full potential, or is there yet more to come?

Making History

First launched ten years ago, the impact of HTS tends to be summed up by a few frequently-seen phrases; more throughput, lower cost per bit, multiple narrowly focused spot beam technology, all of which enables frequency re-use, increased efficiency, admirable payback and a threat to conventional satellite operators. Of course, describing them in this arguably limited way does not do justice to the game-changing innovation HTS have proved themselves to be. With the launch of the first system—Thaicom's IPSTAR—in August of 2005, a massive shift in our industry and in satellites' capabilities was kick-started.

Designed for high-speed, two-way broadband communication over an IP platform, IPSTAR provides coverage over most of South East Asia via multiple, narrowly focused, spot beams. As is typical of HTS, IPSTAR is capable of maximizing the available frequency for transmission and increases bandwidth by a factor of 20 when compared to traditional Ku-band satellites, which results in more efficient operations.

With the advent of this new technology came new capabilities, revolutionizing service providers' respective offerings. The provision of broadband is a prime example—whereas, before, connectivity could only be provided to urban areas, HTS have enabled previously underserved and unserved areas to receive the same sort of high-speed broadband as urban areas. Meanwhile, the satellite manufacturing landscape has been transformed, with traditional equipment manufacturers competing with their previous customers by becoming satellite operators and satellite service providers.

The Rise + Rise Of HTS

Fast-forward to 2015 and HTS have proven their staying-power with widespread use in consumer broadband applications. As the systems grew in popularity, the debate over the effectiveness of the so-called 'closed' and 'open' business models has continued, with the industry yet to agree a defined architecture for HTS. This is not a bad thing, with constant discussion often spurring innovation.

Currently, systems take the form of either 'closed' or 'open' architecture, with the former giving satellite operators complete control over the entire chain of service to sell almost directly to the end customer, and the latter providing a greater degree of personalization and flexibility for the end customer, with VSAT providers being able to package the space segment with the terminal hub and equipment of their choice. In the future, we believe we will see even more variation on infrastructure as different technologies continue to emerge.

The different variations of HTS architecture has seen the range of applications it is used for begin to expand. Traditionally, broadband via HTS was targeted at consumers in rural and remote areas. While this remains a key area, the last few years have brought about an increasing

Artistic rendition of Thaicom's IPSTAR satellite. Image courtesy of Thaicom.

trend of HTS being used to provide connectivity in schools, on trains and buses and even for maritime crews and airline passengers.

With HTS having grown so popular, then, the question industry experts' express is: Have these satellites now reached their full potential, or will the satellite market continue to be influenced further by the technology?

New Horizons

In short, the latter seems more likely. According to a 2014 Euroconsult report, ***High Throughput Satellites: On Course for New Horizons***, use of HTS will continue to increase, with global capacity usage on HTS systems expected to grow from 107 Gbps in 2014 to more than 1,300 Gbps in 2023. This is, in part, due to the satellite operators' continued quest to reduce OPEX. This means that a satellite being used to deliver just one service is being seen far less frequently. For HTS, an even greater broadening of horizons to move beyond consumer broadband and into new applications will be experienced.

According to Euroconsult's report, additional applications which offer the most potential for HTS use include Civil Government and Enterprise Networks, Cellular Backhaul and Trunking, MILSATCOM and Video Services. The opportunity for satellite operators to move into the Cellular Backhaul market, for example, has come as a result of increased use of 3G and 4G cellular technologies, which require higher bandwidth backhaul channels to support traffic.

When providing this kind of coverage in ex-urban and rural areas, the distance between cellular base stations makes it cost-prohibitive to pursue terrestrial means. This opens up the prospect for satellite backhaul to be used, instead. While 4G services will be limited to urban centers, where fiber is readily available, for the foreseeable future, mobile operators will continue to extend 3G services to ever more remote areas, making HTS ideally positioned to support the backhaul of 3G data services. Even markets such as the oil and gas industry, which requires high capacity as well as highly reliable services, can benefit from HTS' lower bandwidth costs when combined with high capacity but smaller terminals.

Even after ten years, HTS continues to represent the next generation of satellite services, providing cost-effective models and higher service levels. In the future, demand for these qualities will only increase, with service providers increasingly looking to run more than one service with the same capacity and new technologies continuing to emerge to support this and HTS.

Thaicom is pleased to have made such a significant contribution to this new era of satellite communications and the company remains committed to supporting what appears to be a bright future for HTS—for the next ten years... and beyond.

www.thaicom.net/

Smaller + More Powerful SATCOMs? It's Possible... With GaN

By Garth Niethe, Technical Design Lead, Ka-Band SATCOM Products, EM Solutions

Gallium Nitride (GaN) FETs boast significant benefits over their Gallium Arsenide (GaAs) based counterparts. Higher efficiency, wider bandwidth, improved reliability and higher output powers are just some of their features. Their higher output impedance also means that it is easier to achieve broader bandwidths.

GaN Power Amplifier (PA) Microwave Monolithic Integrated Circuits (MMICs) are finally available at Ka-band and are now generating a wave of new Block Upconverter (BUC) designs for use in satellite communication transmitters. Such designs seek to maximize the advantages of GaN devices by making more powerful and reliable units in smaller footprints.

Higher Linear Power

Traditionally, SATCOM based FETs (Field-Effect Transistor) and MMICs have operated in class-A. In class-A, the output FET is biased so that both the current and voltage are able to swing from rail to rail. This gives the best linear performance. However, the maximum theoretical efficiency of the output FET is only 50 percent. This efficiency only occurs at the maximum output power. Considering Ka-band FETs only produce about 7-8 dB gain per stage and that all these FETs run off the same input voltage, the total overall efficiency of a BUC (Block Up Converter) is less than 15 percent.

GaN FETs have been designed to operate closer to class-B or "deep AB." That is, they operate with the gate voltage biased closer to the off condition so that the current is essentially clipped when the voltage reaches a peak. This mode of operation improves the efficiency but comes with some trade-offs.

The first is increased harmonic content. In class-A operation, the ideal FET produces no harmonic content when operating within its voltage limits. As the FET is moved from class-A through to class-B, it uses less DC power. However, the spectral content increases, which leads to higher harmonic and intermodulation distortion products. There is another point close to class-B where both the third and fifth harmonics reach a minimum. At this point, if a short circuit is applied to the second harmonics, then it is possible to produce an amplifier with higher efficiency and less harmonic output power.

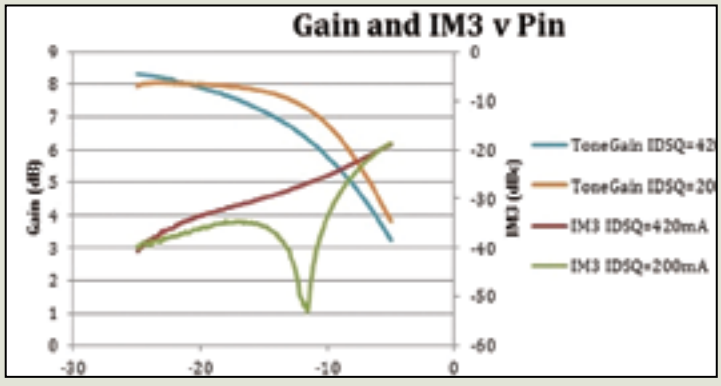


Figure 1. Ka-band GaN PA under different drive conditions.

Another downside of operating in class-AB is that Pout (Push Out) no longer increases linearily with Pin (Push In). In other words, the amplifier exhibits "soft" gain compression over a wide input power range. This effect is exacerbated in GaN PAs where the device characteristics add further to the slow gain roll-off. However, it is possible to bias the GaN device deep in class-AB such that the soft gain compression somewhat corrects itself.

Figure 1 (*left column, bottom*) shows a comparison of the gain response of a GaN MMIC biased in class AB (IDSQ=420mA) and deep class AB (IDSQ=200mA). As the curve shows, the gain versus power response for the latter case is much flatter. The harmonic content of the amplifier operating deeper in class-AB is also lower, as seen by the dip in the third-order intermodulation distortion (IM3) response.

Now, linear power is often defined as the total power in two tones when the IM3 products are -25 dBc relative to the total power, or -22dBc relative to the power in each tone individually. Using this definition, it can be seen from *Figure 1* that a Ka-band GaN PA biased deep in class-AB will reach this linear power when the gain drops by 2dB with respect to the small signal gain. Also evident is that as the gain is higher and the IM3 products are the same, the achievable output power should also be higher than in "mild" class AB. Measuring the output with a power meter confirmed that it was actually about 1dB higher.

Such improvement by adjusting the bias suggests that further improvement may also be possible by introducing a predistortion linearizer. A predistortion linearizer can be modeled in one of two ways. One way is to think of the linearizer as correcting the power transfer curve, so ideally an amplifier should exhibit a linear power transfer function—the gain and phase should both remain constant until the amplifier hits its saturation point. An ideal predistortion linearizer would exhibit the opposite gain and phase response to the PA—overall, the responses cancel one another.

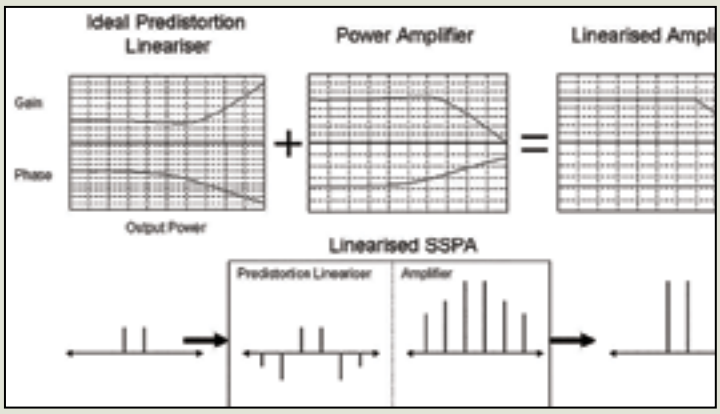


Figure 2. Equivalent ways of conceptualizing the operation of a predistortion linearizer: gain and phase correction (top); intermodulation injection (bottom)

A second way of visualizing a predistortion linearizer is that it actually creates opposite-phase intermodulation products that mix with the intermodulation products of the main PA. Both of these concepts are presented in ***Figure 2*** on the previous page.

One of the most common forms of predistortion in communication systems is to use digital techniques at baseband (Digital Predistortion). Using this technique, canceling the third- through to the seventh-order intermodulation distortion products by more than 30 dB at a particular power level is possible. However, this technique has several drawbacks and is not often used in SATCOM BUCs.

The first and most obvious reason is that it requires access to the baseband signal when it is being generated by the modem. This would mean that the BUC and SSPA (Solid State Power Amplifier) must also be characterized for operation with a particular baseband generator (modem). Also required would be that the IM3 products be largely monotonic with respect to the input power.

Finally, the IM3 products suffer memory effects in the SSPA. That is, the PA responds slightly differently when abruptly changed from low-to-high power as it does when it changes from high-to-low. The digital predistorter is simply not fast enough to compensate for this effect.

The preferred option to linearize SATCOM BUCs is to use analog predistortion. These circuits generally work by driving an active element, such as a diode or transistor, into saturation and coupling the intermodulation products, at some predetermined phase, back onto the main signal path. Due to their inherit nature, analog circuits are able to respond much more rapidly to changes in power level and are not as susceptible to memory effects.

EM Solutions has developed an analog linearizer that specifically targets GaN PAs and incorporates it into their latest generation of Ka-band upconverters. ***Figure 3*** below shows a comparison of the spectral regrowth with the GaN PA biased at 420 mA and operating 2dB below saturated output power (blue), and the PA with the same bias and output power but with EM Solutions' linearizer turned ON (red).

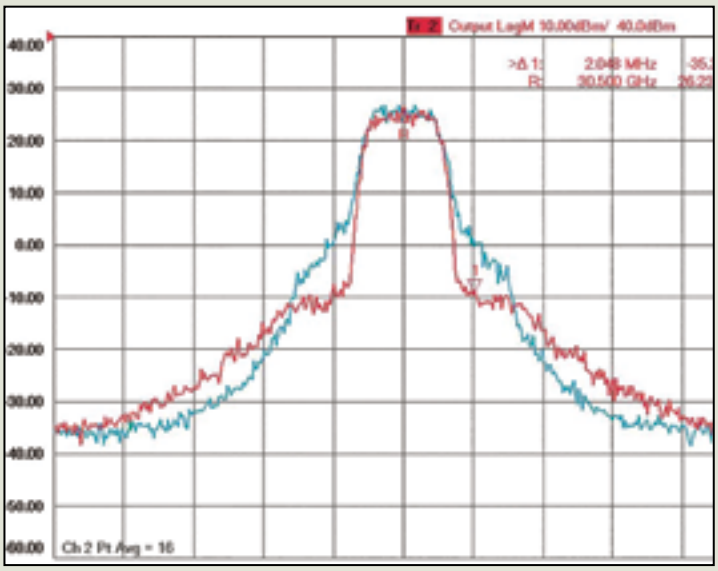


Figure 3. Comparison with the linearizer OFF (blue) and ON (red). (Modulation scheme is OQPSK, 2.048 MBit/s, 1/2 rate Viterbi)

As can be determined from the plot, the spectral regrowth in the adjacent channel has been improved by more than 10 dB. Although the spectral regrowth in the alternate (next adjacent) channel is worse, the transmit spectral masks are usually such that the benefits of increased output power with lower adjacent channel interference warrants use of the linearizer.

Compact Designs

Another benefit of GaN based solutions is the resulting smaller form factor. One of the limiting factors in SSPA designs is the ability to effectively remove heat from the devices. However, as GaN is more efficient than GaAs, it is possible to make higher power units in smaller form factors.

For example, EM Solutions' first generation Ka-band nanoBUC was able to deliver 16W saturated output power in the smallest form factor in the market. Using GaN, EM Solutions' Ka-band multiband nanoBUC can achieve 25W saturated power in the identical form factor, using the same DC current consumption and is also able to achieve this result over the entire 28 GHz to 31 GHz bandwidth.

Another example is EM Solutions' top-of-the-range Ka-band multiband nanoBUC, whose GaAs based predecessor was able to achieve 50W linear power with a typical power consumption of just under 500W. The GaN based product is able to achieve the same linear power and draws only 350W DC power. This reduction in DC power compared with its GaAs predecessor means the FETs are running substantially cooler and the whole unit has a higher reliability.

GaN based MMICs are finally commercially available for the Ka-band SATCOM market. Such devices intrinsically offer more linear power across a wider operating bandwidth and with greater efficiency. When coupled with an upconverter and optimized linearizer, higher power densities are made possible, with feature rich performance in small footprints.

Additional information regarding EM Solutions may be viewed at
www.emsolutions.com.au/

Garth Niethe is a technical design lead for Ka SATCOM products at EM Solutions, an Australian designer and manufacturer of advanced microwave modules and systems for satellite and wireless broadcast communications networks.

After graduating from the University of Queensland, he began his career developing components for feedforward amplifiers and other telecommunications applications. He then spent a number of years working for Codan in the design and manufacture of C- and Ku-band and Upconverters. In 2006, he joined EM Solutions to help develop their range of products for the Ka-band satellite market.

Claiming 4G Market Share In Untapped Areas

By Doreet Oren, Director, Product Marketing, Gilat Satellite Networks

When Mobile Network Operators (MNOs) dream of expanding their network into untapped regions, a primary consideration is how to handle the exponential growth of data traffic. Deploying a high-capacity 4G network is inseparable from the challenge of handling massive quantities of data in a rapidly expanding network.

For MNOs to upgrade their existing network with additional cell towers with 4G backhaul capacity is a non-trivial effort; the required infrastructure investment is significant. Maximum network throughput speeds are more than ten times faster in a 4G network than a 3.5G network. This requires a huge boost in capacity. In addition, erecting high-performance cell towers in sufficient proximity to reach new areas, along with installing a backhaul infrastructure, takes time—sometimes more time than MNOs can afford.

Meanwhile, the passage of time works against the MNO's dream. If an MNO cannot enter a new area and set up a 4G network quickly, a competitor will most assuredly do so and reach those potential customers first. This has weighty business implications: the loss of potential revenue, the difficulty of convincing a customer who has signed up with one mobile service carrier to switch carriers, and the ongoing cost of having to pay other carriers high roaming charges in areas where the MNO has no coverage. In this race, there is little consolation for second place—the subsequent carriers to enter a market are at a distinct disadvantage. By providing a connection within days rather than years, MNOs can leapfrog competitors relying on slower-to-deploy backhaul technologies.

To win this contest, rapid deployment is a must. Here, satellite backhauling has a huge advantage. Fiber and microwave backhauling solutions represent substantial CAPEX costs, are time-consuming and often not feasible when spanning long distances or difficult terrain. Satellite, on the other hand, bypasses many of the logistical obstacles to deployment. In a single hop, a satellite solution provides a connection to the core LTE network.

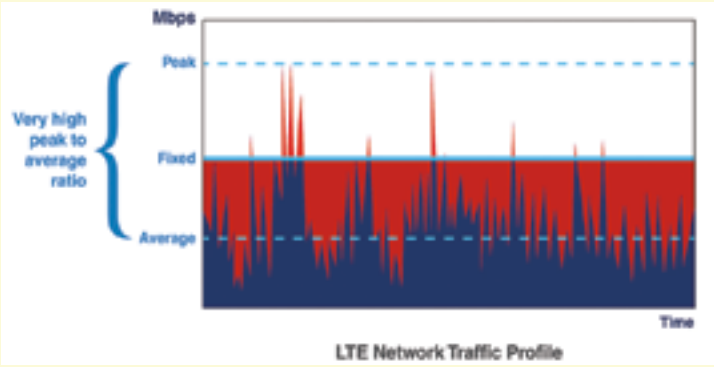
Several factors mitigate satellite backhaul's CAPEX expense. One is the benefit of rapid deployment; the immediate collection of revenue from 4G service helps offset the cost. Another is reusability. As their networks grow, MNOs can relocate equipment purchased and deployed for satellite backhaul elsewhere as needed. Of course, an equally important consideration is ensuring a quality user experience, and here Gilat's satellite backhaul solution shines through, meeting the 4G performance challenge with SkyEdge II-c Capricorn, a TDMA VSAT that reaches the record-breaking speed of 200Mbps. At this speed, this VSAT supports the full capability of 4G handheld devices, a feat that is unique in the satellite industry. An obstacle inherent in satellite communications is the inevitable delay that limits throughput and performance. Capricorn is unique in the industry in having overcome this barrier. Gilat's patent-pending embedded acceleration techniques compensate for the delay, maintaining a user experience that is indistinguishable from terrestrial solutions.

Another important point to consider is that new satellite technologies are lowering the cost of satellite connectivity. According to industry analysts, this trend is expected to continue well into the future. The main reason: High-Throughput Satellites (HTS) that offer significantly increased capacity, reducing bandwidth costs to as much as a twentieth of their previous rates. This breakthrough has helped position satellite communication as a cost-effective alternative for delivering broadband while reducing operating expenses. Another cost variable is the backhauling access scheme. When providing a satellite backhaul link, the question of bandwidth efficiency is crucial. The goal is to save money by using exactly the amount of bandwidth that meets the subscriber's performance needs. For this reason, MNOs must determine which access scheme best fits the download as well as the upload direction: TDM/TDMA or TDM/SCPC.

When data traffic is bursty with a high peak to average ratio, as is the case in an LTE network, the traditional SCPC fixed-speed access scheme suffers from two main drawbacks, those being that SCPC does not meet peak traffic demand and SCPC wastes satellite bandwidth when demand is average. For these reasons, bandwidth sharing is a must in both the upload as well as the download directions. The TDM/TDMA access scheme is a must in LTE networks to reach maximum bandwidth efficiency and realize the full performance potential of handheld devices; other options are not economically viable.

The way forward for rapid 4G deployment is shifting. As solutions that may have seemed peripheral in previous years gain primacy, MNOs are re-evaluating their options. Not only is satellite backhauling a viable option—it is also an option backed by a clear-eyed business case.

www.gilat.com/SkyEdge-II-c-Capricorn



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Innovative Antenna Alignment On Vessels

By Alvaro Sanchez, Sales and Marketing Director, Integrasys

Over the past several years, the maritime SATCOM industry has grown significantly, forced to do so because of ever-increasing global broadband coverage demands.

In order to fulfill customer needs, new satellites are being launched with much higher capabilities. High Throughput Satellites (HTS) deliver unlimited possibilities for increased satellite services by providers—this requires additional throughput and faster broadband connectivity.

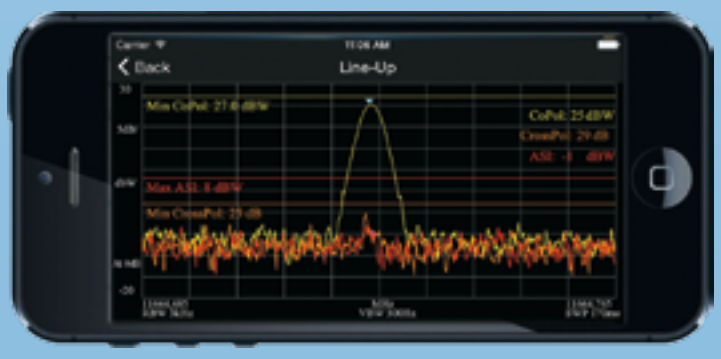
Emerging HTS satellite operators are going to provide these new satellites with global coverage with broad beam coverage. This means an evolution is enroute for the VSAT industry, especially within the maritime segment to provide passengers and crews far better browsing, skipping and downloading experiences.

Passengers enjoying cruises are demanding high speed Internet connectivity for video and audio applications, which consume a great deal of broadband—much faster connectivity is, therefore, required. These new applications must coexist with the ship's existing systems for such connectivity.

VSAT antennas are automatically pointed to the correct satellite, based on GPS positioning and accurate antenna tracking while the ship is moving. Prior to becoming operational, these antennas should be lined-up and commissioned by a certified SATCOM field engineer, who must travel long distances where a ship has been birthed, usually on a tight schedule, to arrange for a call with the NOC for that crucial operational approval. This process is quite time consuming and labor intensive.

Additionally, maritime antennas usually create cross pol interference as the ship moves about the world, especially if the antenna matrix is not correctly aligned with the satellite. Most of the time, the SATCOM installer must also travel to a given port to solve any issues—another expensive necessity. Due to maritime dishes being small, the transmissions from these dishes creates a wider beam width, which may affect the a satellite's close-in angle from the target satellite, which creates ASI (Adjacent Satellite Interference).

Integrasys has developed a highly capable tool for enabling crew members to point peak and pol, while interferences are rapidly minimized. This means no additional SATCOM field experts are required, just the Satmotion Pocket product which guides the crew member regarding the line up for a proper alignment on the correct satellite and pol, without the need to arrange a call or have a certified installer present.



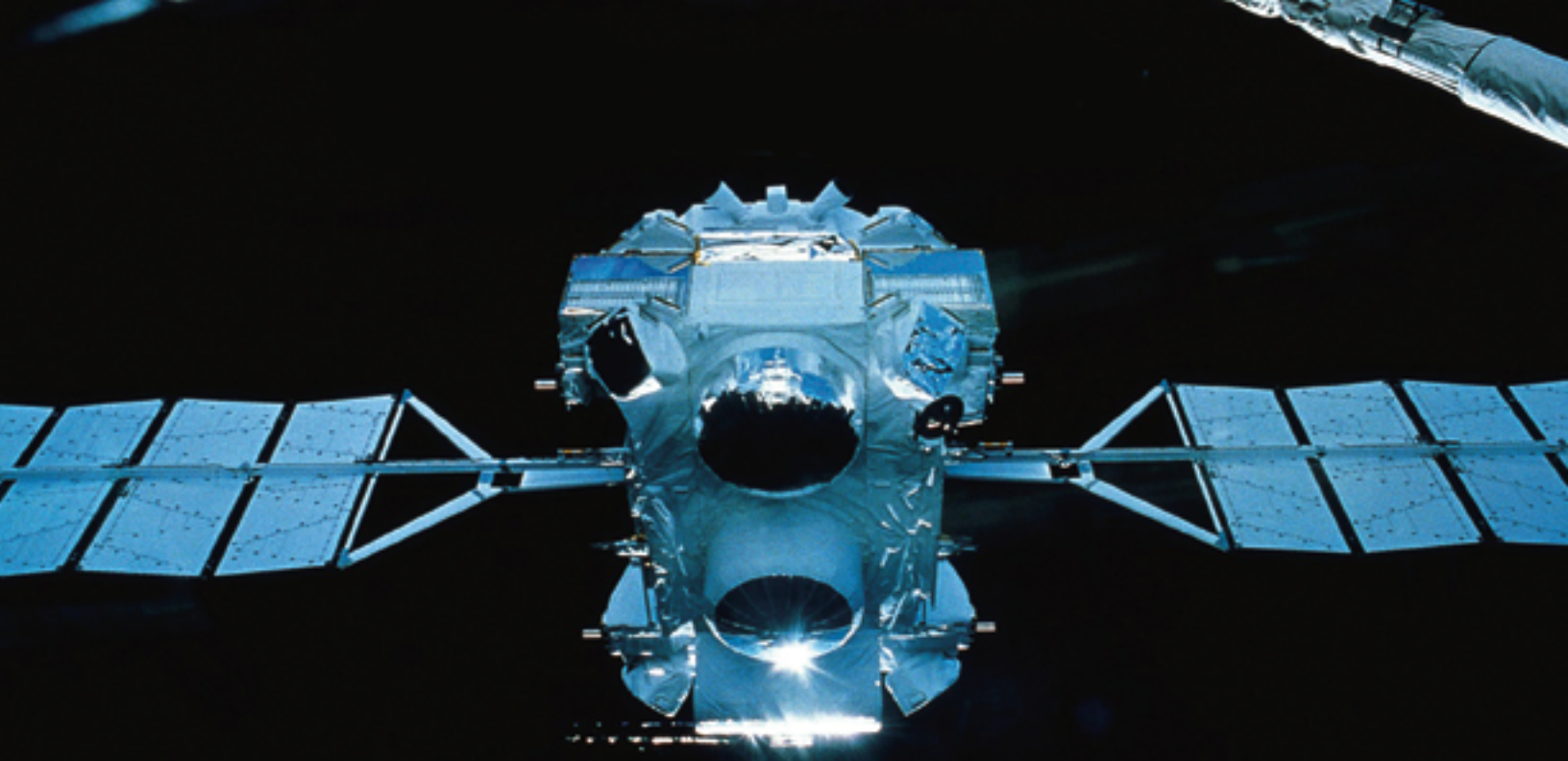
Satmotion running on an iPhone.

Line-up is measured at the hub with a Satmotion server, measuring Copol, CrossPol and ASI simultaneously and displaying the measurements at the ship in an intuitive way, aiding crew understanding of the alignment process. The crew should also have access to the antenna control unit for fine tuning. By controlling and guiding the crew, the line-up is managed and reported to the hub without the need of the previously mentioned third party personnel on the ship or the necessity of a hub or NOC operator call.

This brings a significant cost savings—certified field engineer fees, travel expenses, ship delays, delayed or interrupted passenger experience, and interference penalties are avoided.

Nowadays, most of the stabilized maritime antennas use an open loop approach to align the linear polarization axis to that of the target satellite, continuously computing and adjusting the required angle, all according to

Integrasys Satmotion in use.



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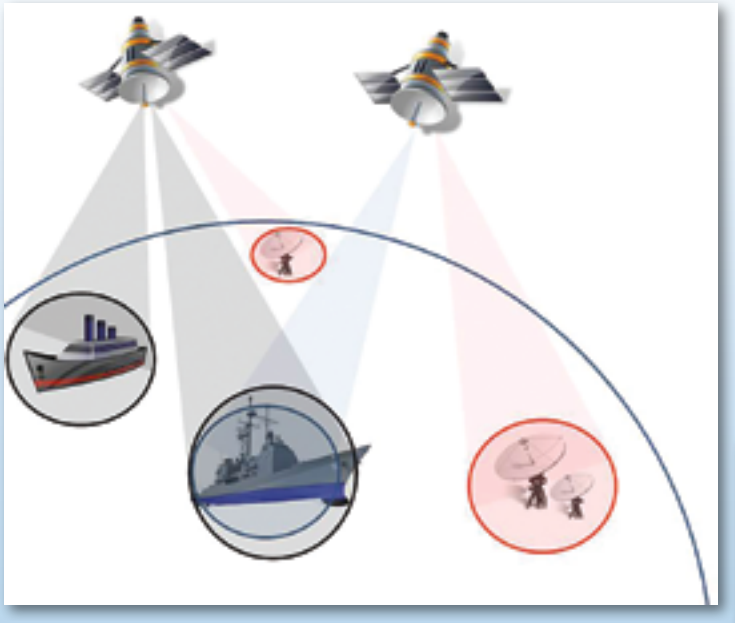


Satmotion maritime scenario.

current ship position and orientation. In order to maintain high alignment accuracy, this process requires low-drift and high-sensitivity inertial sensors and mechanical components, namely feed rotors and positioners.

Inadequate polarization alignment limits pointing tracking accuracy as well as signal acquisition range and speed, eventually resulting in loss of the tracking signal, which usually leads to a halt in VSAT transmission and the start of a rather long initialization procedure. In order to provide proper protection from open-loop polarization errors, preventing intra- and inter-system interferences, the transmitted power is proportionally backed-off, resulting in turns and a decrease of the usable bitrate.

Similar to fixed VSATs, the critical signal direction for polarization alignment in stabilized VSATS remains the uplink path. Achieving high accuracy levels by means of an open-loop adjustment approach requires high-quality electronic and mechanical components.

A second and equally important requirement is the need to perform an initial, accurate polarization alignment of the intended satellite. This is realized with a traditional clean-wave line-up procedure which effectively compensates all of the mechanical and electrical offsets in the end-to-end chain, providing an optimum starting point for the open loop algorithm with minimum error.

This line-up process must be performed for every target satellite that is to be accessed by any given VSAT and must periodically be repeated as a maintenance action to address VSAT component degradation or replacement, both of which reoccur in the harsh maritime scenario.

Line-up polarization adjustment is typically carried out by external qualified installers when the ship is docked in port when possible. However, some satellites may only be properly visible to the VSAT only in open seas. The lack of a high-quality uplink polarization initialization for any given satellite with regular cross-polarization requirements usually prevents the VSAT from using such satellites.

Currently, Integrasys is acquiring the technology upgrades that iDirect has applied to their product line for Velocity and Evolution with iDX 3.3 software release. This allows maritime service providers to experience "powerful capabilities in some of the most demanding environments" for providing customers with "better quality, more resilient service at higher performance." Integrasys actively works with iDirect on iDX 3.3 to help customers achieve far more reliable communications when at sea.

Integrasys is the first company to be able to address and solve major challenges for global maritime networks worldwide with such innovative technology. Satmotion Pocket was awarded with the ***Most Innovative Technology Award*** at SATCON New York.

Currently, Satmotion Pocket supports multiple VSAT platforms from the major manufacturers, allowing most of the service provider to benefit from the use of this unique technology, which produces significant OPEX savings as well as maximizing the quality of service.

Integrasys will be demoing Satmotion Pocket at their CommunicAsia2015 booth 1P6-03 from June 2nd to June 5th at the Singapore Marina Bay Sands.

More info: ***www.integrasys-sa.com/***

Alvaro Sanchez is the Sales & Marketing Director at Integrasys. He is responsible for Satellite Carrier Monitoring at Integrasys and for providing innovative solutions to satellite operators and service providers. Alvaro is the head of the USA office in DC area. Prior to joining Integrasys, he was a signal analysis expert at the CERN European Organization for Nuclear Research.

InfoBeam

MTN Communications Delivers A Big Punch...

Considering that some of the tickets sold for upwards of $80,000 each, these were much more affordable seats, and in the comfort of a luxurious cruise ship as well.

MTN Communications (MTN) (***www.mtnsat.com/***) proved once again you don't have to leave your connected life on the docks when taking a cruise. On Saturday, May 2, 2015, thousands of passengers and crew on 30 ships in the Pacific, Mediterranean, Gulf of Mexico and Atlantic enjoyed the Floyd Mayweather Jr. - Manny Pacquiao boxing match live through high-definition MTN Worldwide TV (MTN-TV HD).

MTN was the only service provider able to deliver the fight offered exclusively to the cruise industry through Global Eagle Entertainment ("GEE") (Nasdaq: ENT). The MTN TV and Broadcast Services Team made this possible through the company's network, designed and managed for maritime, and the ability of the MTN-TV solution to scale at a moment's notice.

While the fight had no official start time, Time Warner Inc.'s HBO and CBS Corp.'s Showtime, which were partners on the telecast, were hoping for the first punch to be thrown no later than 11:15 p.m. Eastern time. Instead, it kicked off about midnight.

"Our team brought the technological wherewithal to quickly deliver this event to ships around the world," said Bill Witiak, general manager, TV and Broadcast Services, MTN. "Our sophisticated, proprietary tools to manage and optimize our network—literally moment-by-moment—and our ability to broadcast with land-like quality enabled our customers to surprise their passengers. This improved their onboard experience and delivered a crew perk—a major investment that paid off. There are just some events you have to watch live, and this historic fight was one of them."

Around the world, 140 ships subscribe to MTN-TV. The service broadcasts 11 channels of sports, news, entertainment and special events. For more than five years, MTN-TV has broadcast 1,795 live special events, totaling 5,486 hours of major sporting events, award shows, operas and ship-specific gatherings.

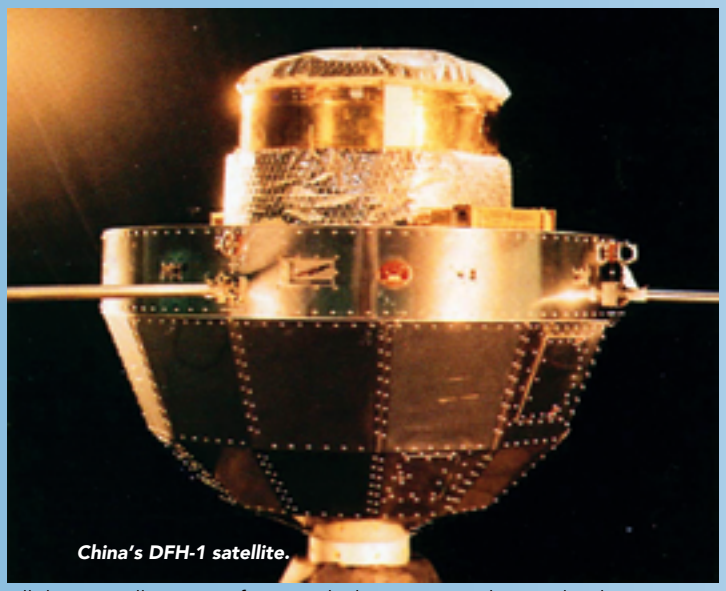
In March 2015, MTN launched live HD service (MTN-TV HD), starting with IMG's Sport 24 Channel. The company has plans for future MTN-TV technology investments, particularly nearing the roll-out of high-throughput satellite services next year.

www.mtnsat.com

The Chinese Space Effort—An Overview

By Jos Heyman, Senior Contributor

Commencing with its first satellite, DFH-1, which was placed in orbit on April 24, 1970, China has placed 222 satellites into orbit for a variety of purposes as shown in the following table.



China's DFH-1 satellite.

All these satellites, save for two which were secondary payloads on Russian launch vehicles, were launched with Chinese rockets and from one of the three Chinese launch sites: Jiuquan, Xichang and Taiyuan. In addition China placed 28 satellites into orbit for other countries, of which eight were for Hong Kong, a British colony that became a special region of China on July 1, 1997.

Objective(*)	Number (**)	First launch
Scientific and technology	69	29 April 1970
Crewed spaceflight	11	19 November 1999
Interplanetary missions	5	24 October 2007
Earth observation	50	6 September 1988
Communications	27	1 February 1986
Navigational	21	30 October 2000
Military	39	26 November 1975
Total	222	

Summary of Chinese launches (as at April 1, 2015)
*(*objective based on author's assessment)*
*(**Excludes Hong Kong satellites)*

The above classification by objectives is rough, as for many of the Chinese satellites the stated objectives are so broadly worded that their true nature is not clear. This approach is reminiscent of the early days of the USSR space program. There is, for instance, a suspicion that many of the Shi Jian (SJ) scientific satellites are nothing more than technology satellites that are tests for military purposes.

The same thought applies to the series of Fanhui Shi Weixing (FSW) recoverable satellites and the series of Yaogan Weixing (YW) Earth observation satellites, both of which include satellites that have the alternative name of Jian Bing, a series that is usually considered as having military objectives.

China, similar to all other space faring nations, went through a process of establishing their technology knowledge before embarking on specific programs. This is especially evident in the developmental process as seen in the field of communications satellites, with the Shiyong Tongbu Tongxin Weixing (STTW) series of communications satellites.

The first satellite in the STTW series, which was placed in geostationary orbit at 125 degrees East and carried two transponders operating in the 6/4 GHz band, was itself preceded by the Shiyuan Weixing (SW) or experimental satellite, that was launched on January 29, 1984. While the latter satellite did not achieve a geostationary orbit, it is not clear whether this was by design or due to a system failure.

The next satellites in the Shiyong Tongbu Tongxin Weixing (STTW) series were fitted with 8 to 10 transponders that operated in the 6/4 GHz bands and, commencing with STTW-3, the spin stabilized satellites were also referred to as Dong Fang Hong (DFH) 2.

The next generation was designated as DFH 3 and carried 24 transponders operating in the 6/4 GHz band. The three-axis stabilized satellites were built by China Aerospace and only two were built.

With the Dong Fang Hong (DFH) 4 series, China obtained a suitable space platform that was used for a wide range of communications, as well as some other, satellites. Built by the China Academy of Space Technology (CAST) with assistance from the European aerospace company Alcatel Alenia, this satellite development started in 2000, while the first launch occurred on October 29, 2006, as Xinnuo-2.

The platform had a mass of 5100 to 5400 kg. and consisted of a payload and a service section. The satellite accommodated as much as 800 kg. of instruments and 3100 kg. fuel and was fitted with two solar wings.

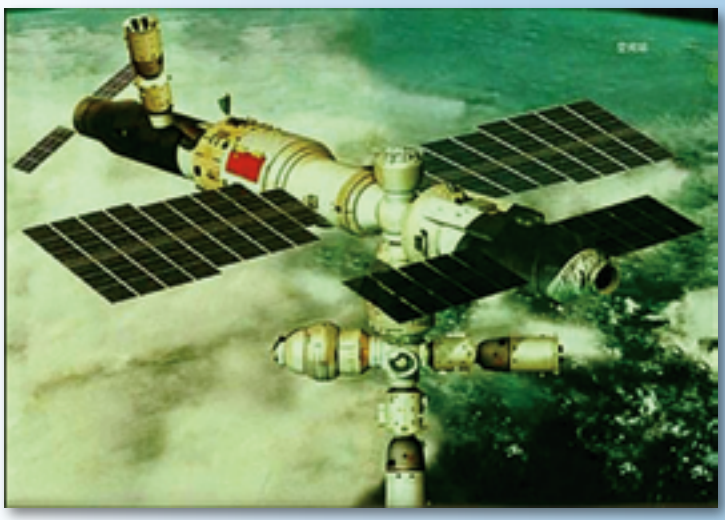
As far as can be determined, to date eight DFH 4 space platforms have been launched as communications satellites. These include communications satellites for Nigeria, Venezuela, Pakistan and Bolivia. However, with the limited information provided by China, there is a distinct possibility that the platform has also been used for other, non-communications satellite missions.

In the fields of crewed spaceflight and interplanetary missions, China seems to, once again, be going through an identical learning process as with their communication satellites. Fortunately, as these programs have a high propaganda value, there is more information available regarding these programs.

In the Shenzhou crewed spaceflight program, four automated flights from 1999 to 2002 occurred prior to the first crewed flight, Shenzhou-5, which took place on October15, 2003. The Shenzhou program development progressed far faster than the crewed programs of the USSR/Russia that advanced through the Vostok, Voskhok and various Soyuz steps, or the

USA's Mercury, Gemini and Apollo pathways. Clearly, China has applied the experiences of those programs to its own development efforts and that is quite evident in the broad similarities between the Shenzhou and Soyuz spacecraft.
In fact, China fast tracked to a space station concept by docking Shenzhou-8 with the Tiangong-1 docking module, itself apparently a precursor to a space station. Simultaneously, China openly admits that they intend to send a crewed mission to the Moon during the 2020s.

Future Chinese Space Station



Artistic rendition of the Chinese space station.

In the field of interplanetary missions, China has embarked on the Chang'e program—this witnessed the 3800 kg. Chang'e-3 lunar spacecraft release a Lunar Landing Vehicle that descended to the lunar surface on December14, 2013, followed by the deployment of the Yutu vehicle.

Following initial tests, the vehicle captured photos of its surrounding and conducted a few scientific measurements before closed down for the lunar night on December 23, 2013.

On January 11, 2014, the lander as well as Yutu were re-activated until, on January 25, 2014, Yutu suffered a communications failure. Communications were not re-established until February 13, 2014, but the rover vehicle continued to encounter electrical problems that prevented it from moving its solar panels into an insulating position during the lunar night as well as from traveling around on the Moon's surface. In spite of these problems, Yutu's instruments managed to operate, although at ever-reducing capacity. In October of 2014, the rover became immobile and the instruments continue to degrade, but the rover was still capable of communication with ground controllers. In December of 2014, all contact was lost.

As far as other celestial bodies are concerned, China's Yinghuo-1 hitched a ride on Russia's Phobos-Grunt Mars mission that was launched on November 8, 2011. The vehicle was intended to separate from the main spacecraft to orbit Mars, but Phobos-Grunt failed to move into the trans-Martian trajectory and, instead, burned up in the Earth's atmosphere.

The Chinese navigational satellite system began on October 30, 2000, when the Beidou-1A experimental geostationary navigational satellite was launched as part of the Compass Navigation Satellite System (CNSS) system. The satellite was based on the DFH 3 satellite platform and provided a location accuracy of 10 m. This experimental system consisted of four satellites. The operational system, for which the first satellite was launched on April 13, 2007, was comprised of five geostationary satellites and 30 Medium Earth Orbit (MEO) satellites with the DFH 3 platform used.

To date, the five geostationary satellites and 11 of the additional satellites have been launched. The system has been providing services in the Asia-Pacific (APAC) region but it appears that the remaining MEO satellites may never be launched due to the introduction of the third phase of CNSS.

The first satellite in this third phase of the system was launched on March 30, 2015. This phase, also referred to as Compass I, will use three slightly different applications of the DFH 3B space platforms:

- *Beidou 3M, comprising 27 satellites placed in a medium Earth orbit*
- *Beidou 3I, comprising three satellites with a mass of 4200 kg. in inclined geosynchronous orbits*
- *Beidou 3G, five 4600 kg. satellites in geostationary orbi*

Artistic rendition of the Beidou constellation.

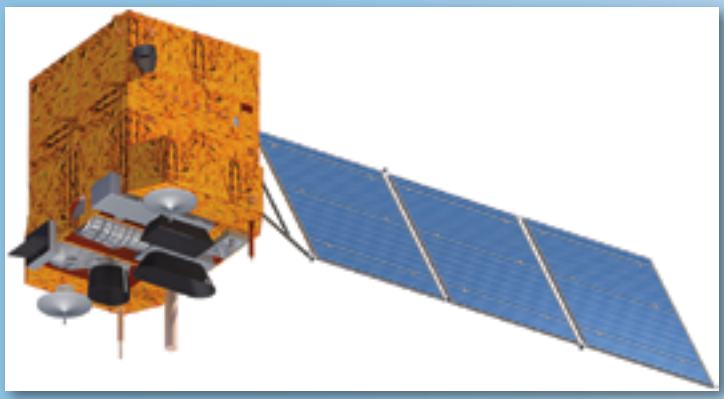
The satellites will carry a phased array antenna for navigation signals, a laser retroreflector and two deployable dish antennas.

Beidou Third Phase Constellation

In the field of Earth Observation (EO) satellites, two operational systems are in use as well as the Feng Yun meteorological satellites.
The first satellite in the Zi Yuan system was launched on October 14, 1999. Also known as the Chinese/Brazilian Earth Resources Satellite (CBERS)-1 as Brazil has a 30 percent share in the program, this was a 1400 kg. satellite equipped with a high resolution CCD camera, an IR multispectral scanner, a wide field imager, a data collection system and a space environmental monitor. This was followed by another two CBERS satellites.

However, not all satellites in the Zi Yuan system are shared with Brazil and the belief is that some of the satellites are for military use under the alternative satellite name Jian Bing.

CBERS-3



Artistic rendition of CBERS-3.

The Yaogan Weixing EO satellites series commenced on April 26, 2006. The satellites had been developed by the Shanghai Academy of Spaceflight Technology and were fitted with a variety of equipment. The official stated objectives included land and agricultural surveys, disaster monitoring as well as associated scientific experiments. However, once again, the belief is that there were also military applications designed into the satellite.

China has developed its own range of launch vehicles. These vehicles started in October of 1956 when it acquired two obsolete R-1 missiles from the USSR, followed by two R-2 missiles the following year. China subsequently commenced the development of military missiles that culminated in the Dong Feng (DF) series of missiles, some of which formed the basis for the space launch vehicles.

The space launch vehicle development was undertaken by the Chinese Academy of Launcher Technology (CALT) or Zhongguo Yunzai Huojian Jizhu Yanjiuyuan in Chinese, although components were made by a range of other industries. In particular, the Shanghai Academy of Space Technology (SAST) played a significant role as a sub-contractor. The CALT organization consists of 13 research institutes, six or seven factories and some additional management departments.

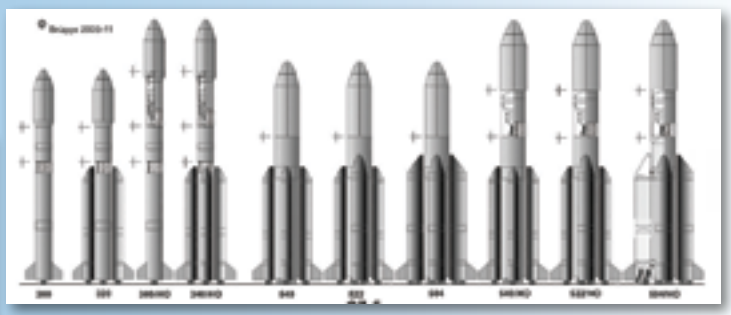
The Chang Zheng (CZ) 1 or Long March 1 launch vehicle used by China was developed from the Dong Feng (DF) 4 missile. The first launch took place on November 1, 1969, and several versions were developed.

The CZ 2 launch vehicle, as well as its derivatives, was based on the CSS-4 missile and was a two-stage vehicle. The first successful orbital launch was on November 26, 1975.

The CZ 3 was a further derivative of the CZ 2 and flew for the first time on January 29, 1984. Again, there were a number of derivative launch vehicles, as well.

The CZ 4 launch vehicle, based on the CZ 3A, had a third stage and is being built in various versions. With the first orbital launch on September 6, 1988, this is the most used launch vehicle in the Chinese rocket stable.

CZ 5



China is currently developing its next generation of launch vehicles that will be known as CZ 5. This launch vehicle will be in the same class as the European Ariane 5 and the U.S. Atlas 5, having a capability to place 25,000 kg. of payloads into orbit.

CZ 6 To 9

The CZ 6 launch vehicle is believed to be a small lift launch vehicle, while the CZ 7 is intended to replace the CZ 3 and CZ 4 launch vehicles.

China is also proposing a CZ 9, a super heavy-lift launch vehicle in the class of the U.S. Space Launch System (SLS). The launch vehicle is still in concept development stage and probably will not fly until after 2025.

There is little doubt that China would like to operate within the international launch market, especially for communications satellites. In the early nineties, several foreign satellites were launched by Chinese launch vehicles, including, for instance, three for Australia. However, in the mid-1990s, the United States stopped issuing export licenses to companies that wanted to launch on Chinese launch vehicles out of fear that such would help China's military.

The foreign launches essentially stopped, although Thales Alenia Space built a satellite for China without U.S. components. For this reason, China offers 'package deals,' *i.e.*, a Chinese built satellite would be launched by a Chinese launch vehicle. Not many countries are prepared to enter into these arrangements.

Should restrictions be lifted, expect that China will become a serious competitor in the launch industry.

China is also excluded from participation in the International Space Station operations. This has forced the nation to pursue its own crewed program. With the budgetary restriction imposed by the U.S. and Russian space programs, this forced 'go it alone' course of action may well see China eventually overtake the other countries with their launch programs. A recent indication by Russia that consideration may be given to China and other countries to participate in ISS missions may soon change all of these dynamics—only time will tell.

Jos Heyman is the Managing Director of Tiros Space Information, a Western Australian consultancy specializing in the dissemination of information on the scientific exploration and commercial application of space for use by educational as well as commercial organizations. An accountant by profession, Jos is the editor of the ***TSI News Bulletin****.*

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Executive Spotlight: Jeff Sare, Vice President, Airline Market Development, Inmarsat

Jeff Sare joined Inmarsat in 2014, bringing his experience in In Flight Entertainment (IFE) and electronics in the aviation sector to Inmarsat.

Prior to joining Inmarsat, Jeff held a number of roles at Thales, including VP positions in sales and marketing, product management and then as VP and GM of IFE Systems before taking on a group role as VP Strategy and Technology for Thales USA. A former Naval officer, Jeff has also worked in sales and marketing roles at Panasonic Avionics Corporation and Continental Airlines.

SatMagazine

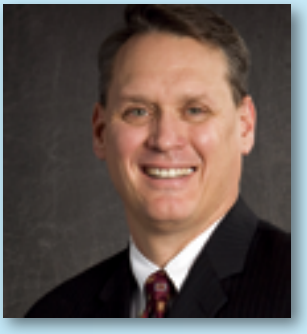
Good day, Mr. Sare. Would you share your background with our readers and also tell us how you initially became involved in the SATCOM Inflight arena? What drew you into satellite communications in the first place?

Jeff Sare

I came into satellite communications from the aircraft systems, specifically IFE business, having worked for Thales In-Flight Entertainment and Communications as well as Panasonic Avionics Corporation.

SatMagazine

In December of 2014, Inmarsat named you as the company's Vice President of Airline Market Development. Please tell us what this role entails?



Jeff Sare

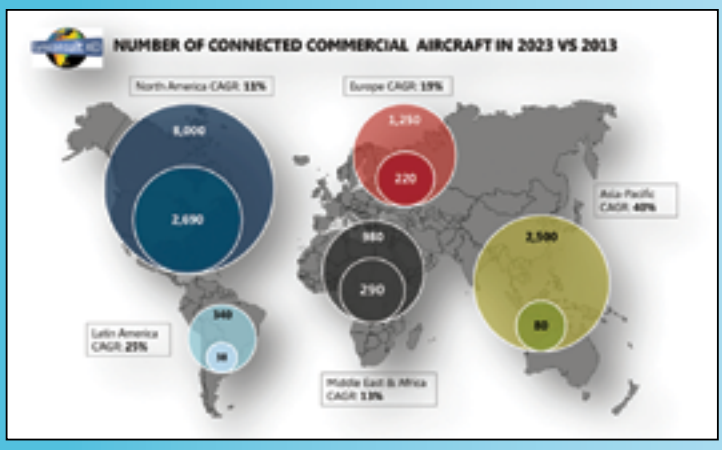
I lead the definition, development and implementation of Inmarsat's strategy for Commercial Air Transport. This includes supporting our airline customers through our regional teams, ensuring our marketing communications are effective and providing direction to our regulatory team to ensure we have the appropriate and necessary market access around the world.

SatMagazine

How will Inmarsat's Global Xpress constellation initiate and/or improve high-speed broadband for inflight consumption?

Jeff Sare

Global Xpress (GX) will be the first global high-speed Ka-band satellite network from one provider. GX Aviation, the service specifically for



commercial aircraft, will deliver a 'true' broadband service to passengers and crew. The same 3G experience available on the ground will be accessible inflight, all through one consistent and reliable service.

SatMagazine

Mr. Sare, what do you predict the take up of Ka-band will be in comparison to Ku-band and how is the airline market responding to your offer?

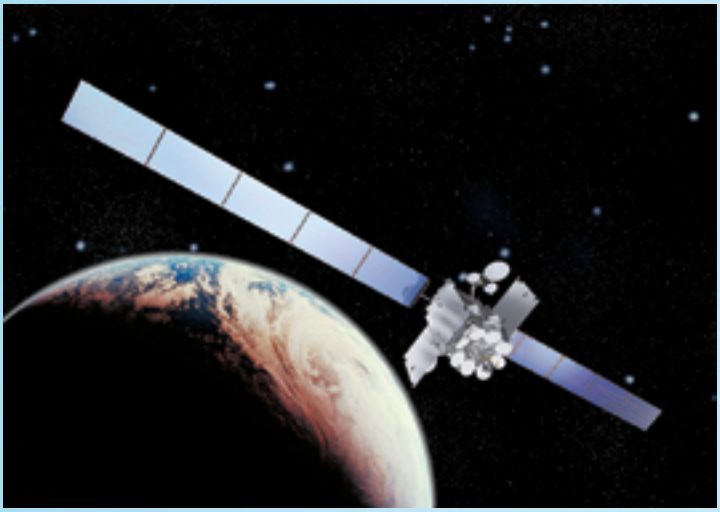
Jeff Sare

Ku-band is a relatively saturated spectrum. Existing Ku- networks were developed to service the terrestrial broadband/fixed satellite TV market. They are wide beam with varying power across the beam which means quality of service varies between the middle and outer edges of the beam. The aviation market has quite different requirements; it needs stable connectivity to high capacity, wherever aircraft are flying. Demand from land-based users has soaked up much of the capacity in existing Ku-beams to the point where there is no spare capacity at all in some beams over high-use areas. These high-use areas are, unfortunately for airlines, the same as aviation hot spots—airport hubs and high traffic route areas.

New generation high-throughput Ku-band satellites will address some of these issues but won't be in operation until around 2018. And the additional capacity offered by these satellites is only available in some areas, which means that passengers will experience an inconsistent Internet experience as they fly—such as moving from 4G to 2G.

GX is a high-throughput Ka-band service which will provide more capacity, particularly over high demand areas—later this year. As demand for enhanced connectivity from crew members grows, the inflight Internet service will need to respond to the increasing connectivity consumption; whether it is the optimization of the cockpit with specific applications like Electronic Flight Bags or fuel tankering, the possibilities of digitalizing the work environment will be numerous. The same applies to the cabin, where passengers will expect a seamless service wherever they are located. We are confident that the opportunity to offer a consistent, global broadband service from one single provider will appeal to many airlines, particularly those looking for a global solution to outfit their entire fleet.

GX will cover 98 percent of all global air traffic routes and being wholly owned and operated by one company ensures that the quality is consistent wherever the aircraft is flying. Inmarsat's ownership of these global networks guarantees the reliability that is expected.



Artistic rendition of Inmarsat-5 F3.

SatMagazine

How many years will it be before all aircraft are equipped with Wi-Fi?

Jeff Sare

The number of medium and small body aircraft is expected to more than double between 2013 and 2033 and 55 percent of all wide-body aircraft are expected to be connected by 2023 according to the '***Prospects For In-Flight Entertainment And Connectivity***' 2014 Euroconsult report. (*See the Euroconsult graphic chart on the following page.*)

Single-aisle aircraft numbers are also expected to double between 2013 and 2033; 40 percent of these aircraft are predicted to be connected. Combined, the number of connected aircraft is likely to grow by 300 percent between 2013 and 2023.

SatMagazine

What is your stand on the growing competition for this market segment and the new entrants into this growing environment?

Jeff Sare

The aviation connectivity market holds much potential. The challenge is for providers to differentiate themselves and for customers—the airlines—to first define their specific requirements and then to be able to see beyond the rhetoric and understand the different offering in the marketplace. We encourage competition and our approach is to be as honest as possible with our claims to ensure our customers get what we promise with no surprises.

SatMagazine

What are the current expectations of airlines in terms of in-flight connectivity, costs, and timing for implementation?

Jeff Sare

We believe the market will follow the consumer mobile broadband market and that passengers will expect more from airlines. They want a consistently high quality broadband offering with no black spots, not dropping off the network; an always-on service which they can access using their own device. Which means airlines must choose connectivity partners that can meet expectations for a guaranteed, consistently high quality, service—now and for the future, no matter where they are flying or what device their

passengers are using. Implementing new technology for any airline takes time, from launch of the service to certification of equipment to installation on the aircraft, airlines face the challenge of making decisions now based on their predictions of customer demand up to ten years' in the future.

As we move towards the world of the Internet of Everywhere, increasing M2M communication from the aircraft to the ground, and for safety and operational services, means even more capacity is going to be required. As a provider our focus is to ensure we are investing in infrastructure and technology now that will deliver sufficient capacity to meet the needs of customers in the future. Inmarsat is doing this and we have the ability to continue to invest in additional satellites and ground networks to meet the growing demand of our customers.

SatMagazine

Can you comment on the timeline for the launch of I-5 F3? When will the service be globally available?

Jeff Sare

Inmarsat-5 F3 is expected to launch within a matter of weeks and we remain on schedule to achieve full global coverage in the second half of 2015. Plus, we are happy with our progress toward gaining the necessary licenses and authorizations to build out the ground network and we are currently in discussions with potential terminal and hardware partners. The S-band-based EU Aviation Network is possible due to unique circumstances whereby spectrum was homogenized and set aside for aviation communications across the EU specifically. This situation does not exist elsewhere, but we are always open to opportunities that will lead to delivery of the best possibly quality service to airlines and their passengers.

SatMagazine

Once the European Aviation Network is implemented, do you expect to see a global rollout of this particular inflight technology?

Jeff Sare

The EU Aviation network is our response to increasing passenger demand for quality connectivity. The technology is the same as how we deliver broadband via satellite but uses a terrestrial network to complement the satellite which enables us to offer more capacity, an even better quality broadband experience, and able to meet the needs of aircraft traveling in the high density traffics routes of Europe, at a very competitive price. It is part of our vision to offer a fully integrated, fit for purpose suite of connectivity solutions to meet the needs of all aircraft in any geography. We're not afraid of thinking differently, and investing (in networks, terminals and new technology) to do what it takes to meet the growing industry need.

SatMagazine

What differentiates the Inmarsat IFE experience from others? What partnerships have been developed for your business expansion?

Jeff Sare

Focus, quality and partnerships—for a start, we're a dedicated connectivity provider. All others in the industry are IFE sellers who have added connectivity to their offering, but whose primary business remains IFE and whom have to purchase spectrum and satellite capacity from a third party.

Because we own and operate our own fleet of satellites, we eliminate one step in the value chain, so one less margin to the added on. We focus on ensuring the best connectivity solution for the airline and are committed to investing and thinking innovatively to meet the exploding demand for quality broadband in the sky. We're also the only company that guarantees the quality of the service to the passenger. We're totally committed to delivering an experience to the passenger that meets their expectations based on what they are used to on the ground, and that will add value to the airline.

We differentiate ourselves by being the best partner for the airlines. We provide the best service to the airline, with an eco-system of partners that can deliver quality solutions, tailored to meet the needs of each airline. We have strategic relationships with Honeywell, Thales, and a range of Value Added Resellers (VARs) and Distribution Partners (DPs) to deliver a tailored solution.

SatMagazine

As a U.S. Navy aviator veteran, the move from a military career into one with a commercial airline would certainly be challenging—what military-developed talents did you bring to the commercial environs?

Jeff Sare

I think the move back into the "real world" is a challenge for most veterans and it was no different for me. However, on most days, the operational challenges in the military are very similar, if not identical, to the civilian world; that is making sure that you have the right people and that those people have the proper tools, systems, and training to deliver your product or service (even if the service is of a more serious nature).

Therefore, since I continued in the same specialty, aviation, much of my technical training has been useful if not directly transferable. Better yet, people are people regardless of the mission. It has been the leadership and management training I acquired that I have found to be of greatest value.

SatMagazine

Looking back on an already impressive career, what projects or programs truly bring a sense of satisfaction to you?

Jeff Sare

I'm not sure I can name one specific project or time in my career that has been the most satisfying. I am certainly proud of my service to our country, and I'm proud of the progress that two small businesses I helped to start continue to make. I'm honored to have been a part of some truly impressive teams over the years, but a real and lasting sense of satisfaction? I guess I'm just not satisfied yet.

SatMagazine

Where do you expect to drive Inmarsat and the Global Xpress business within the coming year?

Jeff Sare

Toward becoming in the cabin what Inmarsat already is in the cockpit—the standard by which the others are measured.

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A Business Uplink: STN—Always Taking A Step Further

By Andrej Lovsin, Chief Executive Officer, Satellite Telecommunications Network (STN)

Last year, STN had the pleasure to host Satnews Publisher's CEO, Silvano Payne, and toured him around this teleport facility, while explaining our amazing growth since the facility's foundation in 2004.

At that time we had very good reason to celebrate and be proud that STN had become a strong global competitor within the teleport industry in such a relatively short time.

Now we are able to inform *SatMagazine* readers that STN is continuing its traditional yearly growth in double digits, as another successful year has closed with a growth rate of 15 percent, with a similar prediction for 2015.

Clearly, broadcasters appreciate the quality of STN's three tier playout system (Gold, Silver, Bronze) and the value added opt-out-service—these technologies have resulted in a healthy increase of more than 30 percent for these services.

STN is also a one stop emporium of worldwide broadcast over satellite solutions and fiber connectivity, which also include channel distribution, turnaround, equipment co-location, time delay and telemetry tracking and control, all of which are just a sampling of the premium teleport services offered.

"We really want our clients to feel confident in our services. We want to give them the best solution for the specific project—not simply what we would like to sell to them," said Mitja Lovšin, the Sales and Marketing Director for the company.

Although it would appear that there is a strong demand for add-on services such as OTT (Over The Top) and IPTV (Internet Protocol Television), the core of STN's business is the satellite distribution of content—these efforts remain a strong driver of revenues and the client base continues to increase.

STN's range of expertise is diverse. This allows the company to facilitate single channel start-ups as well as the ability to transmit multiple, top-tier, Direct-To-Home (DTH) satellite platforms, as well as serving other requests for teleport projects.

Transmitting more than 500 channels for clients, with platforms on 17 satellites and extensive coverage for Europe, the MENA region, Asia, Africa, Australia, North America and South America, STN also manages a fiber network with 17 POP to connect clients from major global and Eastern Europe metros.

"Our client's give us their trust and they deserve the best, and this is what we deliver," said, Tomaž Lovsin, STN's Managing Director.

STN continues to experience huge success in the Middle East region and, over the last few years, Africa has experienced strong growth, with further potential on the horizon.

STN never stands still and has completed stages one and two of new developments in the purpose built facility that is based in Slovenia—STN is actually running out of dish space! With new and exciting projects on the horizon, this has required further expansion for the company. What was, five years ago, a long term dream, has now become a fast moving reality and the early stages of expansion are underway.

"If you stop at the shore too long, you will miss the next tide," said Andrej Lovsin, the Chief Executive Officer of the company.

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Ka-Band Capacity Planning

By Russ Palmer, Business Manager, SATCOM Planning and Management Systems, SED Systems, a division of Calian Ltd.

Ka-band is changing the face of satellite communications. Enabled by satellites having significantly higher capacity, Ka-band is delivering on its promise of low cost highly efficient communications.

Ka-band used to deliver satellite broadband to home users and enterprises, the applications for Ka-band also extend into the maritime, aerospace, and defense sectors. Widely referred to as third-generation broadband, or High-Throughput Satellite (HTS), these systems are capable of delivering more than 100 Gbps of data and servicing over one million users. This is 10 to 100 times the capacity of traditional wide coverage area systems. This is a significant increase in capacity; the primary motivator for HTS is to provide more bandwidth at a lower price per bit.

What is different about these Ka-band systems? First, the contiguous Ka-band spectrum reserved for satellite services is significantly wider than it is for Ku- or L-band. This provides larger bandwidths and inherently higher data rates. Additionally, Ka-band HTS are typically designed with payloads that have many narrow spot beams and high frequency reuse, as compared to the wider coverage areas and low frequency reuse of Ku-band payloads. These aspects, combined with the use of today's most modern modulation techniques, result in a system with much higher capacity.

The Need For Capacity Management

Whether you are a satellite operator, service provider, or network operator, you know that the satellite resource is your largest expenditure and that the ability to maximize performance and utilization of that asset is the key to a profitable venture. To accomplish this task, you must dynamically

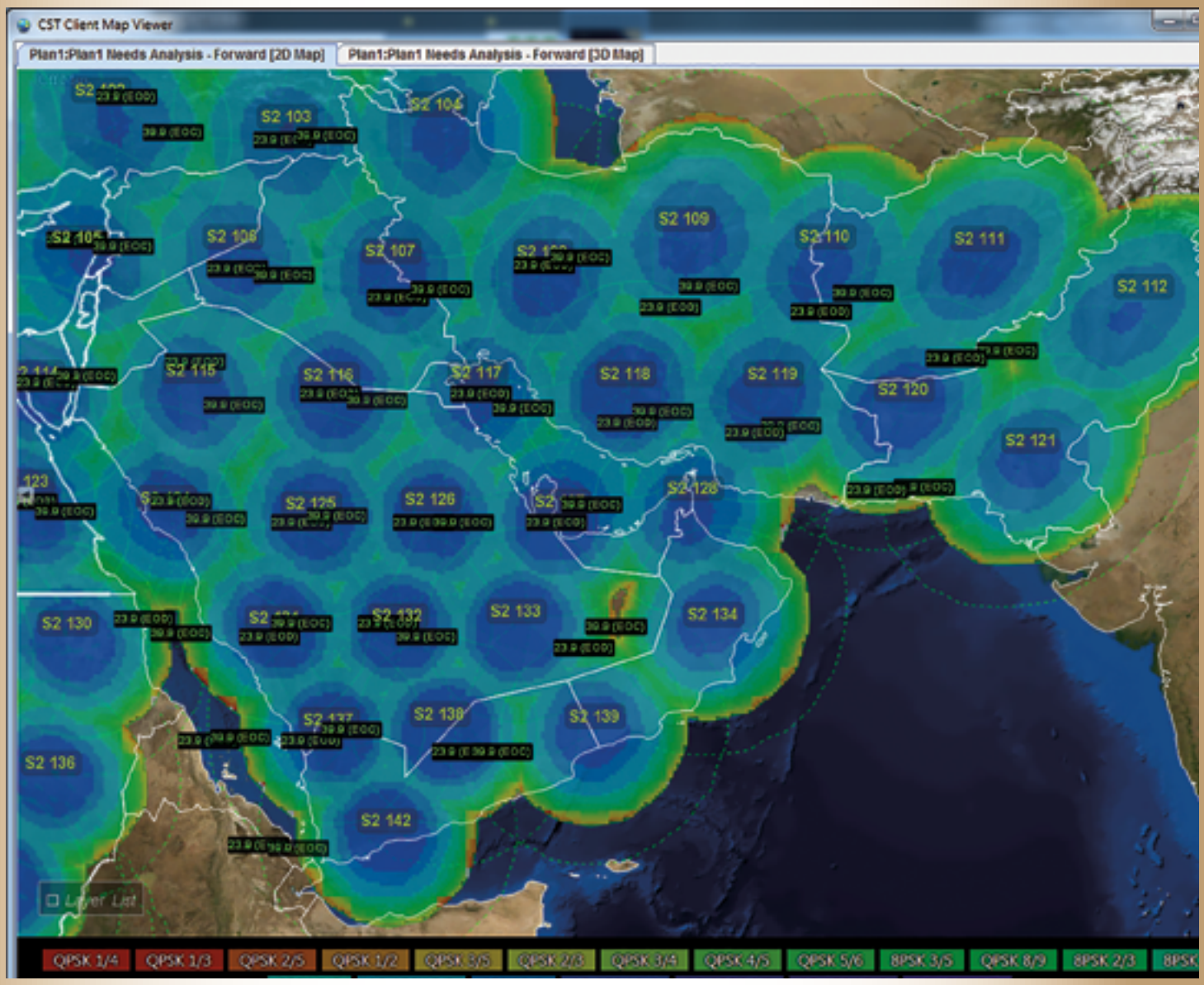

Figure 1. Sample HTS coverage area.

manage your satellite resources initially and as capacity increases. Ka-band systems bring larger bandwidths, more spot beams, higher throughputs, and new gateway and payload designs. This is demanding new and innovative capacity management and planning toolsets that address the complex issues associated with Ka-band and high capacity systems.

Deep Rain Fade Impacts @ Ka-Band

Higher frequency bands such as Ka- are more susceptible to weather effects than lower frequency bands. The most significant weather effect concerning Ka-band is rain, with the largest attenuations occurring during relatively short periods of intense rainfall (up to 30 dB, in some cases). To compensate for weather effects, Ka-band systems are designed to mitigate deep rain fade. Generally, the overall system is designed such that the forward link performance is dominated by the terminal downlink, while the return link performance is dominated by the terminal uplink. The idea here is that the gateways can be designed for operation at specific locations, whereas terminals are required to operate where needed.

The result is a gateway segment that provides a highly available feeder link. Techniques used to accomplish this including planning the gateway locations in dry areas, using redundant gateways to add site diversity, implementing uplink power control, and using transponder automatic level control (ALC) when practical.

Accurately modeling Ka-band propagation impairments and rain fade mitigation techniques are essential to planning capacity and designing robust satellite links. Without this it will be difficult to deliver the availability requirements to meet your company's service level agreements (SLA).
As more Ka-band systems come into operation, more experience and knowledge regarding the frequency is being acquired and studied. This is leading to revised propagation models, updated climatic data, and new system designs for rain fade mitigation.
Consequently, the propagation models are changing—much more rapidly

Latest ITU-R Propagation Models	
Attenuation due to Atmospheric Gases	P.676-10
Rain Attenuation, Scintillation, Depolarization due to Hydrometeors	P.618-11
Rainfall Rate Maps	P.837-6
Specific attenuation model for Rain	P.838-3

Figure 2.

than in the past. To remain effective, capacity planning tools need to be flexible in accommodating updated models and data files. To assist, SED offers pluggable software modules that implement the latest ITU-R propagation models and software libraries for modeling site diversity improvement, uplink power control, and transponder ALC.

Interference Considerations @ Ka-band

Comparatively, Ku-band is much more widely used with almost all orbital slots occupied. With Ku-, interference to adjacent satellites is often the limiting factor in terms of terminal size for the return link. Ka-band has a better interference environment and its use in practice is limited to small terminals

Additionally, the Ka-band spectrum allocated to satellite communications is not currently allocated to any terrestrial services on a primary basis. Interference with adjacent satellites and terrestrial services can be thought of as external interference, and although important to consider for Ka-band, is not as dominating as it is for Ku-band.

What is more important for Ka-band is the consideration of internal system interference. HTS Ka-band systems employ high-gain narrow spot beams and large amounts of frequency reuse. Adjacent beams use different frequencies, polarizations, or combination thereof.

The number and size of the spot beams vary between systems, but generally the spots cover several hundred kilometers, with the larger systems having upwards of 200 spot beams. Depending on the number of gateways deployed and the amount of bandwidth available in each beam (50 to 600 MHz), frequency reuse can be up to 20 times.

Depending on the satellite antenna technology used and corresponding transponder levels, the isolation between beams reusing the same frequency can vary between 20 and 30 dB and, in some cases, be less than 20 dB. Understanding the impacts of frequency reuse and beam power allotments are critical to operating a multi-spot beam system.

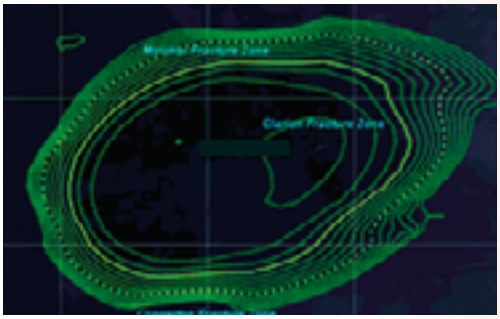

Figure 3. Narrow Spot Beam Coverage Analysis

SED offers software to analyze and visualize beam coverage patterns and beam-to-beam isolation for multi-spot beam systems of varying sizes from a few beams to hundreds beams. Co-polarization, cross-polarization, and combined modes are supported. Coverage analysis functionality displays contours either relative to beam-peak or to edge-of-beam. Isolation values can be displayed as heat maps with a configurable resolution and color gradient. Given a carrier load, the software will compute the level of induced and incurred interference in beams using overlapping frequency. Using these tools, the carrier to interference noise can be effectively managed by trading off interference levels with beam loading.

Adaptive Coding + Modulation

Most Ka-band systems deploy some form of adaptive coding and modulation (ACM) technique to maximize the data rate of the satellite channel while providing robustness during times of weather induced fade. Whether it is DVB-S2 or the recent S2X extensions for the forward link, or

a proprietary variant of multi-frequency TDMA in the return link, the goal is to design the links to maximize the possible data rate while delivering the quality required.

As each terminal's operational environment will differ, these adaptive systems work at the terminal level. In real-time, the system continually evaluates the performance of each terminal link and dynamically changes the modulation and coding techniques (MODCOD) and symbol rates to adapt.

Weather	Target	Base MODCOD	Min. CIR Availability
Annual	99.5%	8PSK 3/4	99.60%
Annual	95%	16-APSK 2/3	99.15%
Annual	99.9%	QPSK 3/4	99.91%
Worst Month	99.5%	QPSK 5/6	99.52%
Worst Month	95%	16-APSK 2/3	97.53%

Figure 4. ACM Analysis for Annual and Worst Month Weather

Most high-throughput satellite systems operate on the premise of a group of terminals sharing one or more satellite channels. The idea is to maximize the number of users serviced. This is done by leveraging the dynamic nature of the individual terminal links and traffic demands. Some terminals will be experiencing rain fade and require the use of more robust MODCODs and, at the same time, other terminals will be in clear-sky conditions and can enjoy more spectral efficient MODCODs. Additionally, not all terminals will be generating traffic demands at the same times—by combining users with diverse traffic profiles, the overall number of users serviced can be increased.

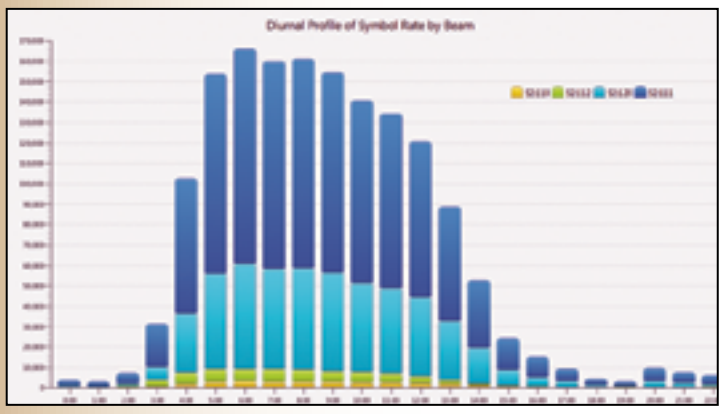

Figure 5. Diurnal Symbol Rate per coverage beam

Many of today's broadband systems are closed. Typically, there is an internal management component that dynamically manages the allocations of the satellite channel bandwidth and power to each of the individual terminals. The goal of the gateway is to balance the required traffic demands and adaptive MODCODs of each terminal within the constraints of the overall transponder capacity in which it is configured to operate. Needless to say, the complexity of these management components can be challenging.

To help meet these challenges, SED has developed a Capacity Sizing Tool (CST). This tool is designed to work in conjunction with today's closed broadband systems. The CST allows service providers and their value added resellers to efficiently design the group service plans entered into the broadband system.

Assisting operators to meet the needs of their customers, the CST takes as input the end customer's requirements, including the number of terminals, type of equipment, terminal locations, and required data rates and availabilities. As the number of terminals increase so to do the variances in link performance.
Some terminals may be located in the center of a spot beam, others closer to the beam's edge. In some cases, a terminal may be operating in a darker area between adjacent beams. Terminals may be located in areas with more significant weather effects, others in drier climates.
Although covered by the same spot beam, terminals may be located in areas within the beam that are subject to higher internal-interference caused by a side lobe of a near-by beam reusing the same frequency. The CST models all of these effects to help determine what can be expected as the "nominal" performance for the customer. Based on this, providers and resellers can set their customer service level agreements and committed and peak information rates.

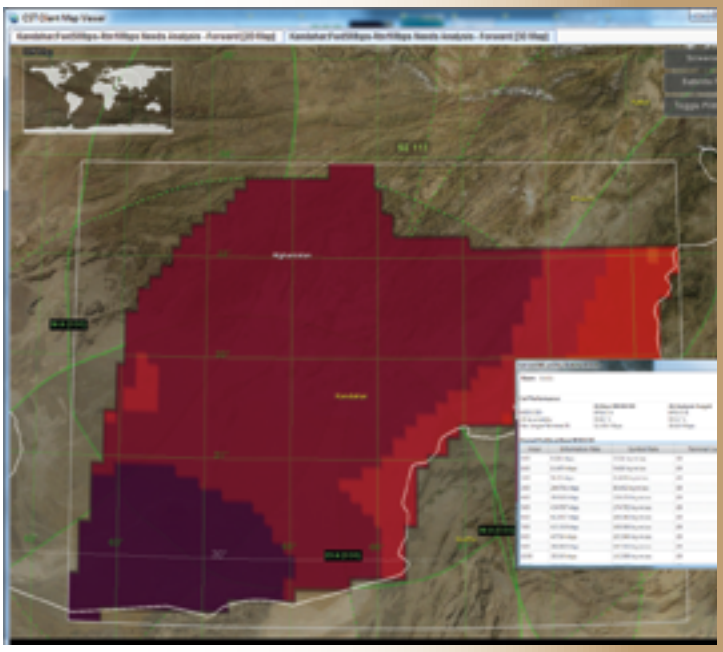

Figure 6. CIR Availability Analysis for a Region Supporting Mobile Terminals

Sizing the service plan for one customer is one aspect of the CST. A second and equally important aspect is combining multiple service plans into a group service plan to maximize the usage of shared capacity. By combining the service plans of multiple customers, the providers and resellers are able to take advantage of fluctuations and differences in the traffic profiles of different types of users.
For example, residential users tend to use more data in the evenings, while enterprise users tend to use more data in the mornings. By being able to combine and evaluate alternate group service plan designs, the SED CST allows service providers and their resellers to maximize the efficiency of their assigned capacity.

To aid in the longer-term aspects of capacity planning, SED provides a Capacity Planning Tool (CPT) that allows service providers and network operators to manage and plan the use of their transponder capacity

over time. The CPT tracks the capacity of each channel on each beam in the system.

As the satellite payload is reconfigured the CPT can adapt to the changes. Usage is tracked either as a managed service plan using group service plans or as a power/bandwidth lease of a portion of a channel. As group service plans and leases transition through their lifecycle, the CPT manages them from time of inception, through provisioning, to implementation on the network.

When considering adding a new service plan or lease for a future period of service, the CPT is used to evaluate the viability of the service. If sufficient capacity is available then the service can be committed. If there is not sufficient capacity, the CPT will highlight the time periods and beams in which capacity is exceeded. The CPT also has the capability to integrate with the network hub in order to collect and analyze statistics on service plan utilization and congestion.

Intermodulation Considerations @ Ka-band

Intermodulation considerations are especially important for Ka-band transponders. Ka-band transponders have a much wider bandwidth than the traditional C-band transponders of 36 MHz and Ku-band transponders of 54 MHz. In the extreme case, Ka-band transponders can be as large at 1 GHz.

To utilize these larger bandwidths, many of these transponders will operate in a multi-carrier configuration and will have to contend with intermodulation effects. Certainly, some systems will use a large TDMA forward carrier, but even with those systems, the return links generally deploy some form of in-route carrier compositions to meet the diversity of the terminal population.

With today's leading edge modem technology, such as DVB-S2 and the recent S2X extensions, higher modulation schemes (64/128/256APSK) and tighter roll-offs (5 percent) are being used. These higher modulations schemes are susceptible to degradations caused by the satellite transponder nonlinearity and filtering impacts, and therefore increase the need for better management of intermodulation effects.

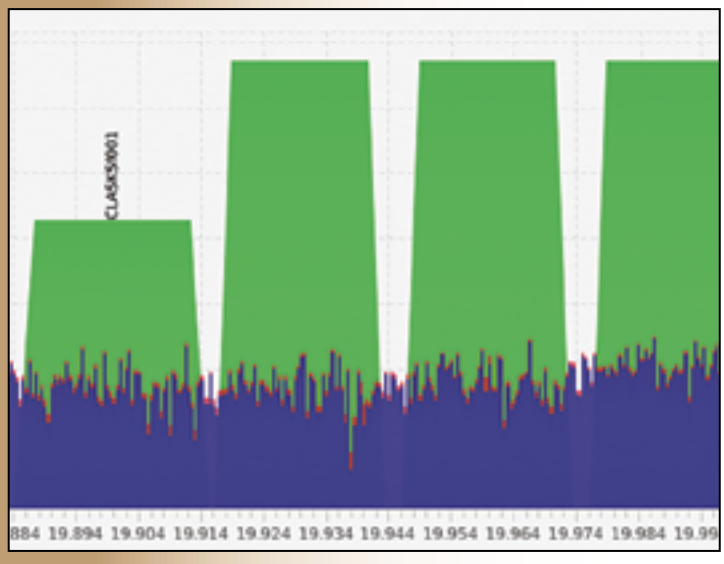

Figure 7. Visualization of Intermodulation Noise Spectra

SED has developed high-performance sophisticated intermodulation analysis software to aid satellite operators and service providers to accurately model and manage the intermodulation characteristics of their satellite transponders. Using a time-domain implementation approach combined with a high-performance FFT library, SED's intermodulation analysis engine provides highly accurate estimates of intermodulation noise while running almost interactively. The engine models carrier waveforms, thermal noise, and interference noise present at the input to the satellite receive chain.

Multiple planning modes also exist to help operators plan for a partially loaded transponder. Using simulated carriers in addition to actual carriers, the tool is able to help the operator estimate the impact of intermodulation noise at a full transponder load and correspondingly plan for an ideal operational point. This allows links to be designed once and then provisioned for longer durations of operation.

Mobility, Military + Movable Beams

Having small terminal sizes, high data rates and narrow beams with concentrated power, Ka-band satellite systems are also well suited for mobility and military applications. Mobile applications of all types in both commercial and military spaces benefit from smaller, more efficient terminals.

However, as spot beams are typically very narrow and terminal routes and locations are varied, terminals will often transition across beams and in some cases satellites. For applications, such as military or emergency response, the satellite payload is often equipped with steerable antennas that allow additional spot beams to be positioned at specific locations. Being able to effectively plan the satellite beam coverage and capacity for mobile and military terminals can be just as challenging as operating a consumer broadband system over fixed spots. Beams move, terminals move, and performance varies by location. (*Please see Figure 8 on the following page.*)

SED's capacity sizing and planning tools support mobile terminals and movable beams. Terminal movement can be specified as routes defined with way points, as a region of possible location, or as a group of beams.

The CST will analyze the routes and/or regions to determine the best beam coverage and corresponding channel capacity. Link performance, along with terminal counts and contention ratios, are used to aid the operator in developing a tailored service plan for a specific fleet of mobile terminals that provides continual service across the coverage area. Beams that can be repositioned via steerable antennas are also supported.

Using the CPT, new beam positions for steerable satellite antennas can be considered and analyzed. Beams need to be repositioned with consideration of many aspects including intra-beam interference, gateway isolation, and regulatory and coordination constraints on geographical use of spectrum. These are all functions supported by SED's capacity planning tools.

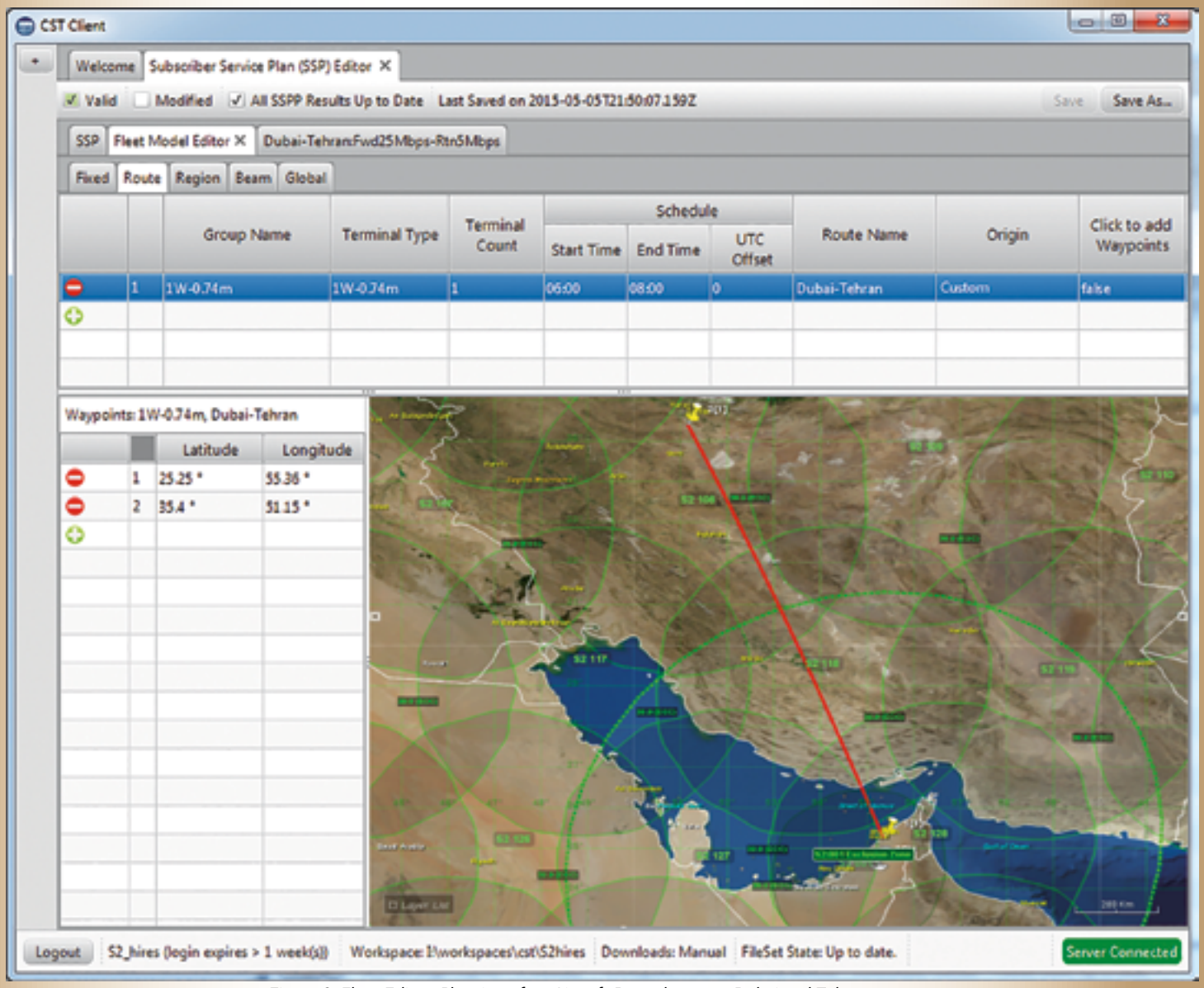

Figure 8. Fleet Editor: Planning of an Aircraft Route between Dubai and Tehran

Maximizing the efficiency of high-throughput Ka- spot beam satellite systems demands new and innovative management and planning tools. Whether service is delivered through a closed network or over raw capacity, for commercial or military applications, SED Systems has the capacity planning and management software to provide flexible and cost-effective solutions for network operators, service providers and value added resellers.

SED Systems provides software systems, tools, and services to assist satellite operators, service providers, and network operators to efficiently and effectively plan and manage the capacity and services of their Ka-band satellite systems. Ranging from sophisticated capacity management systems, advanced link budget tools, capacity sizing and planning tools, and payload configuration tools, SED has the capability to deliver a solution to meet your requirements.

By leveraging existing software components and products, SED delivers tailored software to meet the specifics of your technical and operational environments. Whether you are operating a managed network, leasing raw transponder capacity, or optimizing your transponder loading and payload configurations, SED has the solutions to meet your capacity planning and management needs.

www.sedsystems.ca/

Russ is the Business Manager of Satellite Communications Planning and Management Systems at SED Systems. He is responsible for leading the strategy, growth and direction of the company's Capacity Planning and Resource Management Systems and Services.

Russ has 20 years experience in the satellite communications industry designing and delivering systems for satellite operators and service providers. Russ directs and leads teams of engineers and software developers to deliver and support a wide range of solutions from highly-available ground segment systems to operational and engineering systems and toolsets.



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The Japanese Space Policy: A European Perspective

By Veronica La Regina, Senior Reseracher ASI—Italian Space Agnecy

On Friday, January 9, 2015, Japanese Prime Minister Shinzō Abe's administration approved the new Japanese Space Policy, a 10-year plan[1].

Japan reconfirmed the U.S. as an allied partner in the fields of space and security, particularly for the space debris' monitoring solutions and for the complementarity of the two national navigation systems[2]. This policy plan boosts the security profiles of the public expenditures in space-based technologies against the peaceful purposes of the R&D activities in space sciences. The need to identify a clear role for the European Union (EU) in the space international cooperation is necessary and the industrial collaboration is the most suitable and promising way.

There are numerous industrial concerns related to export control issues because of Japan's deepening relationship with the U.S. Over the last decade, Japan has established a leadership role in the Asia Pacific region through the Asia Pacific Regional Space Agency Forum (APRSAF), which held its 21st annual meeting in Tokyo on December 2-5, 2014. The event gathered almost 580 participants who represented almost 33 states and 12 international organizations[3]. Some nations' more recent participation in the APRSAF, (*e.g.*, Turkey and the United Arab Emirates) shows the substantial achievement of Japan's space diplomacy's actions outside of the Asia Pacific borders. This may pose potential limits to the European Space industry's exports towards areas even closer to Europe.

Details

Since its inception phase in the 1950s, Japan's space program has been R&D oriented. In 2008, Japanese Basic Space Law opened the doors for dual-use space technologies[4]. The related space policy changes effected in 2009[5] and 2013[6] proposed a space utilization-driven approach which sought to stimulate economic activity in Japan after several decades of stagnation.

The space sector was one of the key elements of Japan's developing "social infrastructures" and, in particular, was meant to combat natural disasters and emergencies to which Japan is prone. Developing services was one of the key elements of the space strategy which encouraged the development of Japan's space services sector. This new plan, issued in 2015, switches the focus of the Japanese space policy potentially away from the market and towards the military[7].

Space security is complex. It involves the security of space objects in orbit, the security of access to space, and also the security of people on Earth from various types of satellites. The U.S.-Japan relationship in space addresses all of these dimensions. The alliance will implement a joint data sharing system for monitoring space debris. The complementary function of the Quasi-Zenith Satellite System (QZSS) allows Japan to have independent/sustainable GPS-like services which also act as a back-up option to the U.S.' GPS system in the event of malfunction. The statements for the cooperation in the launch sector are not clearly defined but Japan and the United States signed a series of diplomatic notes[8] that enable U.S. firms to license technologies and allow Japan to develop larger and more capable space launch vehicles (*e.g.*, the N series launching vehicle based on the U.S. Delta one). Nevertheless, the access to space is a key programmatic line enhancing further development of the two launch systems, *e. g.*, the H2-A serving geostationary large-scale satellites and the Epsilon for smaller satellites[13]. In order to raise the technical reliability of Epsilon, the program offers the development of a new concept of mid-size or small satellites. Smaller spacecrafts are more affordable operational responses in case of attacks. Again, the national security objectives are prominent in the choice of the Japanese space activities.

The draft space policy plan has been open for public consultation since mid-October 2014 and has received almost 720 responses. Almost 12 percent of the comments expressed serious concerns about the militarization of Japan's space assets[14]. The main reasons behind the new space policy are the external threats from the North Korea and China in the Asia Pacific and the need to bolster Japan's space industry[9].

The largely military initiated and dominated space programs are becoming important engines of economic growth and productivity improvements. In this regard, Japan's defense corporations have been interested in the changing structures and directions of Japan's space program. Since the Post World War II with the Japanese Diet in 1967 and the 1990 Super 301 trade Agreement on Satellite Procurement, Japanese corporations have been subject to regulatory constraints affecting their business expansion. These constraints have made the commercial space industry unprofitable and pushed allies to encourage the government to develop military space projects.

Dual-use space technologies and applications are, by definition, useful for civilians but their military potential renders their disseminations problematic. The domestic investments supporting this approach could dampen the multiplying economic dimension of exports when the military dimension is enhanced, as it has sometimes been the case in the U.S.

The Japanese space diplomacy is seeking to create favorable conditions for the space industry in a very comprehensive manner in both the Asia Pacific and beyond. APRSAF's last annual meeting confirmed the importance of the maximum utilization of space assets for social problem solutions through the cooperation between technology providers (space agencies and aid supporters) and users. The event has been a fruitful opportunity to report on achievements and discuss further cooperation. The conference has been conducted through technology-oriented and solution-oriented working groups. The working groups support APRSAF's initiatives for the space utilization and technological capacity building purposes. This year's new activities have been entered into the APRSAF's agenda for the exploitation of GNSS assets, rule-making process for the space situational awareness and actions for facilitating capacity building of small satellites .

The concluding plenary session hosted country reports from 13 states' representatives with new cooperation in the area being delivered by

representatives from the USA and the U.K. The adopted recommendations highlighted the importance of pursuing space cooperation through the APRSAF approach as an informal forum, open to governmental and non-governmental entities, as well as international organizations. They agreed to renew the appointment for both the next annual meeting in Bali, Indonesia and the meeting following one year after in the Philippines. One of the new recommendations is the synergetic use of space assets (Earth Observation, Positioning-Navigation-Timing and satellite communications) for which a feasibility study will be deployed during the current year.

Policy Recommendation For The European Space Stakeholders

The new space policy elects the U.S. as a strategic primary partner for the main security oriented space programs and related purposes. The other Japanese space policy objects, such as expanding space utilization and enhancing space industry and science and technology, do not deny a potential role for the EU. For instance, in order to enhance EU—Japan industrial cooperation, European know-how should be tapped in order to fill Japan's gaps in the accomplishment of these objects.

The advanced European know-how of satellite data processing and related development of applications will be commercially exported to Japan for civilian and security purposes. Copernicus' free data will not be beneficial in one way to Japanese players but ad hoc business partnerships will be encouraged and supported.

European and Japanese space launching technologies are both under a renovation phase for technological improvements. They are also both struggling with international price competition from China Great Wall Industry Corp. (CGWIC) and Space Exploration Technologies Corp. (SpaceX). Thus, the European and Japanese shared vision for the optimization of technological performances could be a key-priority for cost reduction targets and a means of industrial cooperation.

The complementary operational capability of QZSS and U.S. GPS could negatively affect the coming Galileo's market. Thus, the EU will consider substantial actions for downstream applications embedding strong strategic business relationships between European and Japanese companies.

The eventually emerging issues for Japan's technology export controls offer the potential for the European space industry that has a more diversified set of technological standards to pursue the development of ITAR-free space solutions under joint European and Japanese consortiums.

The emerging synergetic space utilization of space services proposed by the last recommendations of APRSAF will be filled by European technological expertise that will deliver integrated applications under the European Space Agency's Integrated Applications Promotion by combining different type of space assets for satisfying specific users' needs. The developed and tested solutions satisfy almost 110 diversified thematic needs (health, transport, energy, safety and development) [12] with huge market potential in Japan.

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The views expressed in this article are the author's own and do not necessarily represent the views of the EU-Japan Centre for industrial Cooperation.

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Overcoming SATCOM Disruption, From RF Interference To Rain Fade

By Yen-Wu Chen, Vice President, Asian Operations, Kratos ISI

Those attending CommunicAsia will undoubtedly hear that the Asian satellite communications market continues to grow and its near-term future looks bright.

According to a Northern Sky Research (NSR) ***Global Satellite Capacity Supply and Demand*** report, Asia-Pacific (APAC) will experience growth from numerous sources over the next ten years, with total revenue forecast to exceed $4.5 billion by 2023. Market growth has been driven by telecommunications applications; however, Direct-To-Home (DTH) satellite broadcasting is rapidly becoming a key growth-driver, as well. Satellite demand is no longer limited to established markets such as Singapore, Hong Kong and Indonesia; newly developing markets such as Cambodia, Vietnam and Myanmar are now expressing demand for satellite communications.

Despite the potential, there are some operational issues that, while not unique to the region, have their own geographical complexity. One is man-made RF interference (RFI)—the other is a product of nature—rain fade—but both have the same effect… disruption of satellite communications.

Fade Away, Rain Fade

Rain fade is a temporary attenuation of an RF signal and typically affects transmissions above 10 GHz, but can cause issues at lower frequencies ,as well. Rain fade is caused by the scattering or absorption of electromagnetic waves by many randomly scattered electrically charged cloud drops or rain drops. Due to their higher operating frequency, and the fact that their signal wavelengths are usually shorter than that of a C-band, Ku- and Ka-band satellites are more susceptible to rain fade than are C-band satellites.

Rain Fade Mitigation Techniques

The simplest way to compensate for the rain fade effect is Uplink Power Control (UPC), the increase of power at the hub. In this example, the transmitter signal is monitored and uplink power is adjusted to overcome rain fade interference with the signal. The advantages of this technique are that it's a proven technology, is applicable to all satellite service types and good for cases where transponder gain is constant. The disadvantages include limitations for SATCOM power control limits and the need for additional equipment, such as beacon receivers for measuring sky noise and the attenuation caused by rain and water vapor to satellite signals. Additionally, constant transmission of high power may result in interference among users during clear sky conditions.

Site diversity is the ability to connect two or more Earth stations so that signals from an antenna experiencing rain fade interruption can transfer its RF signals to an antenna in a location not affected by rain fade at the time. The advantages of site diversity are that it maintains signal quality, reduces the chances of outages, is a ground-only solution (nothing has to be done to the satellite), and the use of smaller, less expensive antennas is enabled.

Traditional RF transport limitations reduce geographical diversity. RF signals captured at an antenna can only be transmitted over short distances (typically <0.5km over cable and <10-50km over fiber optic) before the signal degrades. Depending on the network and the distance between the two sites, there can be high signal loss and the process requires complex monitoring and switching processes. Distance limitations restrain ground system design by requiring processing equipment to be co-located with antennas.

The challenge has been to develop technology that would enable long distance transmission of RF signals. SpectralNet is such a technology as RF signals are digitized for transport over IP networks, while preserving frequency and timing characteristics, and then uniquely restoring the RF signals at their destination. This approach offers wide geographic diversity as RF transport over IP networks is virtually boundless and enables ground station design to maximize the promise of IP transport. (*Please see the sidebar.*)

Another approach is Adaptive Code Modulation (ACM) where the modulation/coding is modified to operate in a lower power environment. ACM can help maintain service during some rain events but cannot overcome all, especially intense events. Additionally, ACM will impact achievable data rates during the rain fade event and is good only for services that do not need a minimum data rate services requirement (*e.g.*, many packet-based data services). Additionally, there can be a lack of interoperability among vendors and higher cost modems are usually required.

Frequency diversity draws on a lower frequency band payload during the occurrence of fading at higher frequencies via a ground control station. The affected Earth stations are authorized by the control station to switch to the lower frequency resources when the climatic condition reaches a certain threshold while a processor onboard the satellite ensures the interconnection among the stations operating over two different bands. This method is suitable for satellites operating in two frequency bands, typically Ka- and C- or Ku-band, and usually achieves low levels of outage probability, especially during severe rain fade. However, this comes at a high cost due to the need for an available lower frequency band to support the transition during the rain events.

Accidental or Deliberate— Interference Remains A Problem

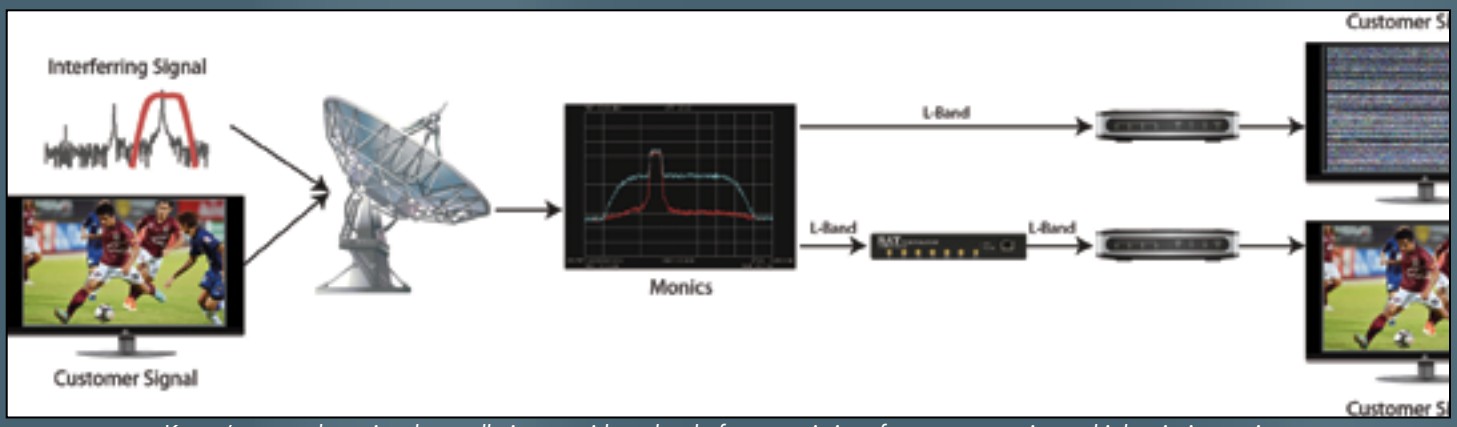
Unlike rain fade, RFI is a man-made issue. RFI can be accidental (which accounts for anywhere from 95 to 98 percent of all interference) or deliberate. In either case, both are the result of human error, equipment failure or intent.

Accidental interference includes cross pol leakage, equipment issues and adjacent satellite interference. Deliberate RF attacks on satellites include piracy and jamming. Piracy, or unauthorized access, occurs when carriers (with content) are transmitted towards a satellite without any prior contract with the satellite operator. Intentional jamming can be the result of one party's objection to the content (political, cultural, social, etc.) of the targeted carrier and/or extenuating circumstances (political situation, social unrest, etc.)

According to Martin Coleman, Executive Director, satellite Interference Reduction Group (sIRG), deliberate jamming is more a Middle Eastern and North African problem, while piracy is more of an issue for the Asian region. The Cable and Satellite Broadcasting Association of Asia (CASBAA), the trade association for the Asia Pacific payTV industry, has stated that pirated TV programming has a significant negative impact on Asian TV companies' profits. The Asian content industry is particularly affected by pirates who intercept TV channels and programs and stream them via "pirated devices," said Christopher Slaughter, CEO of CASBAA.

New Approaches

The first step toward mitigating the disruptive effects of satellite interference is the rapid detection and analysis of an interfering signal through effective carrier monitoring. Once the interfering signal is identified and characterized, its source can be located by a number of geolocation systems.



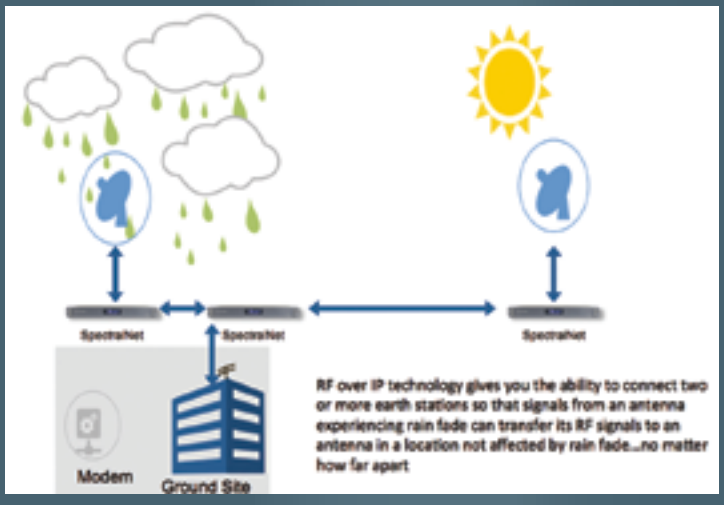
Kratos' approach to signal cancellation provides a level of automatic interference protection to high priority carriers, both unmodulated (CW) and modulated interferers and requires receive site equipment only.

Modern geolocation systems, such as satID, offer next generation features and capabilities that are designed to save operator effort and therefore cost. Features such as scenario templates, higher levels of automation, improved reporting capability and integrated operator notebooks enable less experienced operators to perform geolocation more accurately and faster resulting in a more robust capability. This improves operational efficiency and can also represent a significant financial savings to the organization.

Another method of identifying the source of an interfering signal is the deployment of Carrier Identification (CID) codes. Under the auspices of sIRG, many satellite operators are embedding a unique CID code to a signal transmission. The CID is embedded in a separate carrier onto the carrier(s) it is identifying.

Operators can use Digital Spectrum Analyzers (DSA) to extract the CID, quickly identify the source of the interfering signal and then contact the interferer to resolve the interference issue. Carrier monitoring and interference detection systems such as Monics, can extract the CID from the carrier with no new hardware required.

To facilitate the use of CID, a Satellite Operator Carrier ID database (CIDB) containing all CIDs is being developed by the Space Data Association.



The database will enable rapid identification of an interference source and allow rapid interference mitigation among cooperating operators. Most RFI mitigation approaches require the cooperation of the interfering party. SigX Protect, a patent-pending radio frequency (RF) signal protection technology can be configured to automatically cancel many forms of interference in real-time.

Where once rain fade and RF interference were thought to be inhibitors to satcom growth, new techniques for mitigating each have eased the path to continued growth as evidenced by NSR's forecast for Asian satcom growth.

Yen-Wu Chen is the Vice President of Asian Operations at Kratos ISI of Lanham, Maryland U.S.A. Mr. Chen has more than 20 years of experience in the development and service of the Asian market. He plays a key role in expanding the company's business and is responsible for Kratos ISI's Asian business. He can be reached at Yen.Chen@Kratos-ISI.com."

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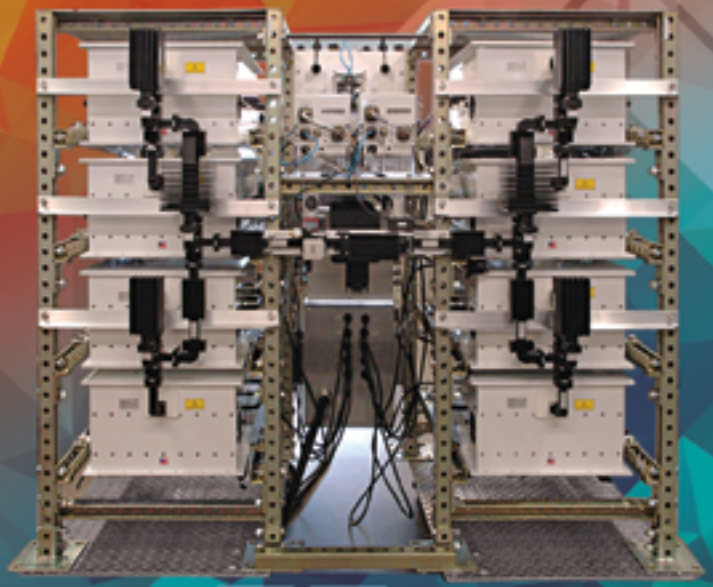

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