Worldwide Satellite Magazine – June 2018

SatMagazine

Asia & Australasia

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InfoBeam

China National Space Administration names new head

China's State Council has appointed a new head of the China National Space Administration (CNSA), with the position having been left unfilled since early in January.

The announcement that Zhang Kejian would take on the role was made on May 24.

Zhang also becomes the head of the State Administration for Science, Technology and Industry for National Defence (SASTIND), which oversees Chinese space-related activities, for which he was previously deputy. Zhang was also installed as deputy of the Ministry of Industry and Information Technology (MIIT), to which SASTIND is subordinate.

The roles of administrator of CNSA and executive of SASTIND had been vacant since the promotion of Tang Dengjie to governor of the province of Fujian in early January 2018. Tang, who lacks aerospace experience, was himself appointed only in June 2017.

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Hard WORK proves to be profitable with new SATCOM solutions

WORK Microwave's V-band Block Upconverter.

Gearing up for CommunicAsia, WORK Microwave will present an end-to-end solution for wideband applications, and will demonstrate how it is helping operators adapt to future requirements with ease and affordability.

In the SATCOM environment, today's operators have a critical need for flexibility, scalability, and a future-proof solution.

At CommunicAsia, WORK Microwave, a satellite technologies provider with an end-to-end solution for wideband applications, will demonstrate how the company is helping operators adapt to future requirements with ease and affordability. WORK Microwave will be at Booth 1V2-07.

Some of WORK's new products include:

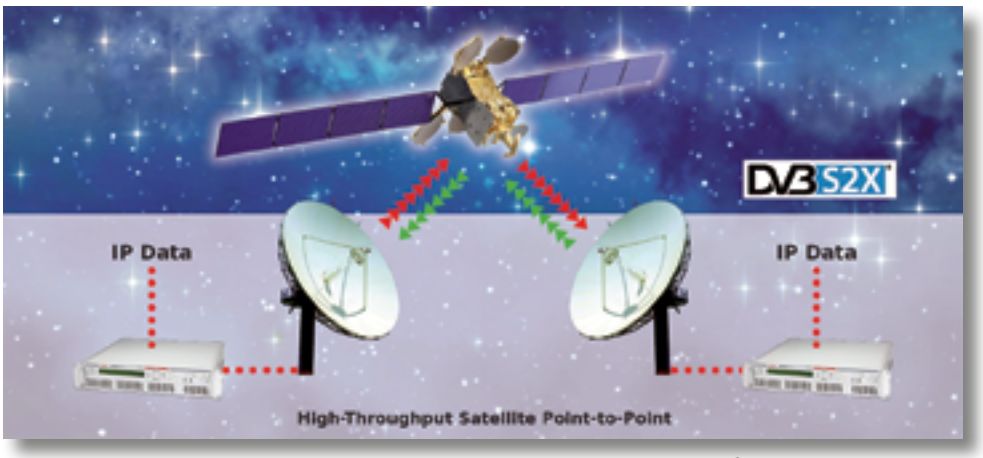
- *WORK Microwave's new 3-channel, V-band block upconverter will be on display at CommunicAsia. By offering support for higher frequencies, between 47.2 to 51.40 GHz, the upconverter optimizes the use of Ultra High Throughput Satellites (UHTS). Perfect for early laboratory testing, it has already been requested by global satellite operators to support secure, high-performance communications projects.*

  V-band support is available for WORK Microwave's entire range of frequency converters, including IF, block, and tracking. As one of the industry's first SatCom solutions providers to support the full V-band spectrum and a leader in frequency converters, WORK Microwave leads the industry in helping satellite operators expand their capacity to keep pace with the demanding communications requirements fueled by bandwidth-intensive broadcast and data services.

- *WORK Microwave's AX-80 Series of FPGA-based satellite modem, modulator, and demodulator platforms will be a highlight at CommunicAsia. The AX-80 product line is based on a powerful architecture that supports the new DVB-S2X standard for ultra-wideband transponders up to 500 Mbps.*

  DVB-S2X features include higher modulation schemes up to 256APSK and 3 Gbps per direction, a finer granularity of ModCods, and advanced filtering. Beyond DVB-S2X, the AX-80 platform can be extended to customized waveforms and user-defined data processing. Through an all-IP structure, the platform supports native network operation as well as data streaming over IP, providing satellite operators with the flexibility that is critical in today's fast-changing connected world.

work-microwave.com



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InfoBeam

ThinKom's Aero antennas are now interoperable with multi-constellations and multi-orbit satellites

ThinKom Solutions, Inc. has announced that their phased-array antennas are fully interoperable with the next generation of LEO and MEO) networks, as well as GEO satellites.

Agility tests have shown that the company's antenna design achieves switching speeds of less than 800 ms. This has been determined by LEO and MEO service providers to be more than sufficient for beam switching among the fast-moving satellites with virtually no interruption in connectivity.

Bill Milroy, the Chairman and CTO of ThinKom Solutions, said that the company's patented phased-array architecture provides rapid switching speeds without the limitations of electronic scanning antennas in terms of instantaneous bandwidth, low-look-angle performance, power consumption and aperture efficiency. The new LEO and MEO satellite networks currently under development have the potential to disrupt the SATCOM market with inexpensive bandwidth and offer unique benefits in terms of latency, coverage, throughput and redundancy. ThinKom's antenna technology has the versatility to support an integrated multi-constellation solution offering gap-free pole-to-pole coverage with automatic beam switching, rapid outage recovery and network optimization for different geographical regions.

ThinKom's antennas are field-proven with nearly 750 installed units currently flying over 3,000 flights per day. They have more than 2.5 million hours of accrued service time and are consistently achieving 98 percent availability rates. In addition, the extremely low-profile antenna radome virtually eliminates aerodynamic drag, dramatically reducing fuel usage when flying with the SATCOM antenna.

ThinKom will showcase its Ku- and Ka-band phased-array antenna technology at the 2018 Global Connected Aircraft Summit in San Diego, June 4-6. Milroy will speak in the Hardware and Technology panel on Tuesday afternoon, June 5.

An informative product video is available at:

www.thinkom.com/future-proofed-satcom-antenna-technology/

Story by Jill Durfee, Assoc. Editor


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Figuring out how Mars was made...

NASA's Mars Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission is on a 300-million-mile trip to Mars to study for the first time what lies deep beneath the surface of the Red Planet.

InSight launched at 7:05 a.m. EDT (4:05 am PDT) on May 5, 2018, from Vandenberg Air Force Base in California.

"*The United States continues to lead the way to Mars with this next exciting mission to study the Red Planet's core and geological processes*," said NASA Administrator Jim Bridenstine. "*I want to congratulate all the teams from NASA and our international partners who made this accomplishment possible. As we continue to gain momentum in our work to send astronauts back to the Moon and on to Mars, missions like InSight are going to prove invaluable.*"

First reports indicate the United Launch Alliance (ULA) Atlas V rocket that carried InSight into space was seen as far south as Carlsbad, California, and as far east as Oracle, Arizona.

Riding the Centaur second stage of the rocket, the spacecraft reached orbit 13 minutes and 16 seconds after launch. Seventy-nine minutes later, the Centaur ignited a second time, sending InSight on a trajectory towards the Red Planet.

InSight separated from the Centaur 14 minutes later — 93 minutes after launch — and contacted the spacecraft via NASA's Deep Space Network at 8:41 a.m. EDT (5:41 PDT).

"*The Kennedy Space Center and ULA teams gave us a great ride today and started InSight on our six-and-a-half-month journey to Mars*," said Tom Hoffman, InSight project manager at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California.

He added, "*We've received positive indication the InSight spacecraft is in good health and we are all excited to be going to Mars once again to do groundbreaking science.*"

With its successful launch, NASA's InSight team now is focusing on the six-month voyage. During the cruise phase of the mission, engineers will check out the spacecraft's subsystems and science instruments, making sure its solar arrays and antenna are oriented properly, tracking its trajectory and performing maneuvers to keep it on course.

InSight is scheduled to land on the Red Planet around 3:00 p.m. EST on

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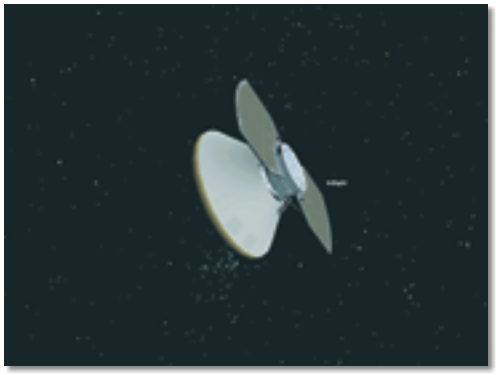

Artistic rendition of NASA's Insight spacecraft. Image is courtesy of NASA/JPL.

InSight is scheduled to land on the Red Planet around 3:00 p.m. EST on November 26, where it will conduct science operations until November 24, 2020, which equates to one year and 40 days on Mars, or nearly two Earth years.

"*Scientists have been dreaming about doing seismology on Mars for years. In my case, I had that dream 40 years ago as a graduate student, and now that shared dream has been lofted through the clouds and into reality*," said Bruce Banerdt, InSight principal investigator at JPL.

The InSight lander will probe and collect data on marsquakes, heat flow from the planet's interior and the way the planet wobbles, to help scientists understand what makes Mars tick and the processes that shaped the four rocky planets of our inner solar system.

"*InSight will not only teach us about Mars, it will enhance our understanding of formation of other rocky worlds like Earth and the Moon, and thousands of planets around other stars*," said Thomas Zurbuchen, associate administrator for NASA's Science Mission Directorate at the agency headquarters in Washington. "*InSight connects science and technology with a diverse team of JPL-led international and commercial partners*."

Previous missions to Mars investigated the surface history of the Red Planet by examining features like canyons, volcanoes, rocks and soil, but no one has attempted to investigate the planet's earliest evolution, which can only be found by looking far below the surface.

"*InSight will help us unlock the mysteries of Mars in a new way, by not just studying the surface of the planet, but by looking deep inside to help us learn about the earliest building blocks of the planet*," said JPL Director Michael Watkins.

JPL manages InSight for NASA's Science Mission Directorate. InSight is part of NASA's Discovery Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama.

The InSight spacecraft, including cruise stage and lander, was built and tested by Lockheed Martin Space in Denver. NASA's Launch Services Program at the agency's Kennedy Space Center in Florida is responsible for launch service acquisition, integration, analysis, and launch management. United Launch Alliance of Centennial, Colorado, is NASA's launch service provider.
A number of European partners, including France's Centre National d'Études Spatiales (CNES) and the German Aerospace Center (DLR), are supporting the InSight mission. CNES provided the

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Seismic Experiment for Interior Structure (SEIS) instrument, with significant contributions from the Max Planck Institute for Solar System Research (MPS) in Göttingen, Germany. DLR provided the Heat Flow and Physical Properties Package (HP3) instrument.

Precise calculations are required for InSight to arrive at exactly the right spot in Mars' atmosphere at exactly the right time, resulting in a landing on November 26.

Every step of the way, a team of navigators estimates the position and velocity of the spacecraft. Then they design maneuvers to deliver it to an entry point at Mars. That navigation team is based at NASA's Jet Propulsion Laboratory in Pasadena, California, which leads the InSight mission.

"*This first maneuver is the largest we'll conduct,*" said Fernando Abilleira of JPL, InSight's Deputy Mission Design and Navigation Manager. "*The thrusters will fire for about 40 seconds to impart a velocity change of 3.8 meters per second [8.5 mph] to the spacecraft. That will put us in the right ballpark as we aim for Mars.*"

Especially at the beginning of that cruise, navigators rely on NASA's Deep Space Network (DSN) to track the spacecraft.

The DSN is a system of antennas located at three sites around the Earth. As the planet rotates, each of these sites comes into range of NASA's spacecraft, pinging them with radio signals to track their positions. The antennas also send and receive data this way. The DSN can give very accurate measurements about spacecraft position and velocity. But predicting where InSight will be after it fires its thrusters requires lots of modeling, Abilleira said.

As the cruise to Mars progresses, navigators have more information about the forces acting on a spacecraft. That lets them further refine their models. Combined with DSN tracking measurements, these models allow them to precisely drive the spacecraft to the desired entry point.

The launch's 40-second burn relies on four of eight thrusters on the spacecraft. A separate group of four is autonomously fired on a daily basis to keep the spacecraft's solar panels trained on the Sun and its antennas pointed at Earth. While necessary to maintain orientation, these small, daily firings also introduce errors that navigators have to account for and counterbalance.

When the spacecraft is just a few hours from Mars, the planet's gravitational pull, or gravity well, will begin to reel the spacecraft in. At that point, InSight's team will prepare for the next milestone after cruise: entering Mars' atmosphere, descending to the surface and sticking InSight's landing.

For more information, visit:
www.nasa.gov/insight

InfoBeam

Globecomm signs on for Tipco Maritime Fleet comms

Globecomm has installed a complete hybrid satellite-LTE communications solution for Thailand-based shipowner Tipco Maritime Company.

In undertaking a review of its communications systems, Tipco identified a need to make better use of its onboard equipment, improve visibility of operations and achieve closer integration with office-based systems. Globecomm specified a solution that would enable Tipco to employ new techniques including remote management and virtualization of onboard PCs and deploy CCTV systems on its latest new building. Critical to acceptance was better management of the costs of ship-shore connections and improved performance of Tipco's onboard networks.

Globecomm provided Tipco with Nimbus, a powerful yet cost-effective network management tool that can be used to control multiple connections via satellite and LTE networks, while providing additional value-added functionality for both enterprise and crew applications. Using the automatic Wide Area Network (WAN) switching capability of Nimbus, Tipco implemented a 4G router alongside its Inmarsat Fleet Broadband terminals. Nimbus selects the satellite connection while at sea but switches over to the 4G connection when the vessels come within reach of shore, lowering the total cost of data consumption.

Tipco will manage all its shipboard Nimbus installations using the cloud-based Cirrus portal, which provides an effective overview of all its communications usage in real time. Details such as data consumption on different WANs, e-mail message logs from shore to ship and ship to shore, as well as user account management on the Crew LAN, allow it to monitor and report on business and crew usage.

Designed and built with cyber security in mind, Nimbus includes security features that are becoming widely adopted in the shipping industry. These include two fully-managed and highly-customizable firewalls covering Nimbus and Cirrus, providing a robust intrusion prevention system with deep packet inspection.

Shore to ship connections are encrypted to the latest standards and end-to-end connectivity is via a private IP space with no exposure to the public internet. Because crew and business traffic are carried across segregated networks, an infection, should it happen, cannot spread from one to the other.

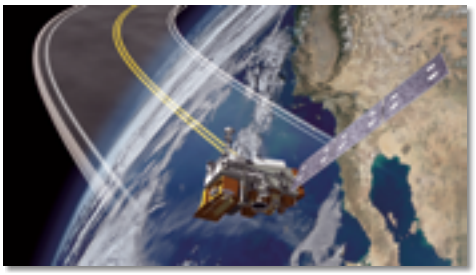
www.globecomm.com

InfoBeam

NOAA-20 satellite is pronounced fully operational by NOAA

Weather forecasters now officially have a new tool in their arsenal, as the first satellite in NOAA's new Joint Polar Satellite System has passed rigorous testing and is now operational.

Launched last November as JPSS-1, and renamed NOAA-20 once it reached orbit, the satellite features the latest and best technology NOAA has ever flown in a polar orbit to capture more precise observations of the world's atmosphere, land and waters. Data from the satellite's advanced instruments will help improve the accuracy of 3-to-7 day forecasts. NOAA-20 provides NOAA's National Weather Service with global data for numerical weather prediction models used to develop timely and accurate U.S. weather forecasts. In addition, high-resolution imagery from the satellite's Visible Infrared Imaging Radiometer Suite, known as VIIRS, will enable the satellite to detect fog, sea-ice formation and breaking in the Arctic, volcanic eruptions and wildfires in their very early stages.



NOAA-20 satellite

This advanced modeling and imagery information, shared with international and governmental partners, will help businesses, the emergency preparedness and response communities and individuals make the best decisions possible in the face of weather-related hazards.

NOAA-20 joins Suomi NPP — the NOAA-NASA demonstration satellite launched in 2011 — giving the U.S. the benefit of two sophisticated spacecraft in nearly the same orbit. Each circles the Earth in a polar orbit 14 times a day, collecting global observations that form the basis for U.S. weather predictions. JPSS-2, the second in the series, is scheduled to be launched in 2021, followed by JPSS-3 in 2026 and JPSS-4 in 2031. JPSS satellites are designed to operate for seven years, with the potential for several more years.

The JPSS mission will deliver its critical data and information for at least the next two decades to support a Weather-Ready Nation.

www.nesdis.noaa.gov/JPSS-1

InfoBeam

TCarta's satellite bathymetry data is proven to be faster and less expensive for Total SA

Efficiency really proved to be a major factor when TCarta, a global provider of marine geospatial products, delivered satellite derived bathymetry (SDB) to Total SA (Total), one of the world's largest oil and gas producers in just a few weeks instead of months and one tenth the cost. Total will use the water depth data for preparing seismic survey works off the coast of Myanmar (formerly Burma).

TCarta generated the SDB dataset by digitally extracting accurate water depth measurements from multispectral imagery acquired by the European Space Agency's Sentinel-2 satellite. The resulting bathymetric data had a point spacing of 10 meters with measurements to a depth of 15 meters. The deliverable covered a 30-square-kilometer area around Preparis Island in the Bay of Bengal. Total contracted with TCarta for the Preparis Island project following a benchmark study that also generated high-quality bathymetric data from Sentinel-2 imagery.

SDB products created by TCarta are appreciated among energy exploration and production companies, as well as environmental organizations and infrastructure development firms, due to their cost effectiveness and rapid turnaround. In addition, the remote collection of imagery by satellite poses no risk to personnel or the environment. And the bathymetric data can be captured in all parts of the world, even where security restrictions limit operation of aircraft or ships.

Another TCarta product used extensively in offshore hydrocarbon exploration and production is the Global GIS Bathymetry Package. This GIS-ready dataset provides a level of marine information that is superior to public-domain data for areas throughout the world. The 90- and 30-meter products each contain a Digital Bathymetry Model with spot-depth values, contour lines, and high-resolution shorelines derived from multiple data sources. These include nautical charts, single- and multi-beam survey data, LiDAR, SDB, altimetry data and seismic survey derived depths.

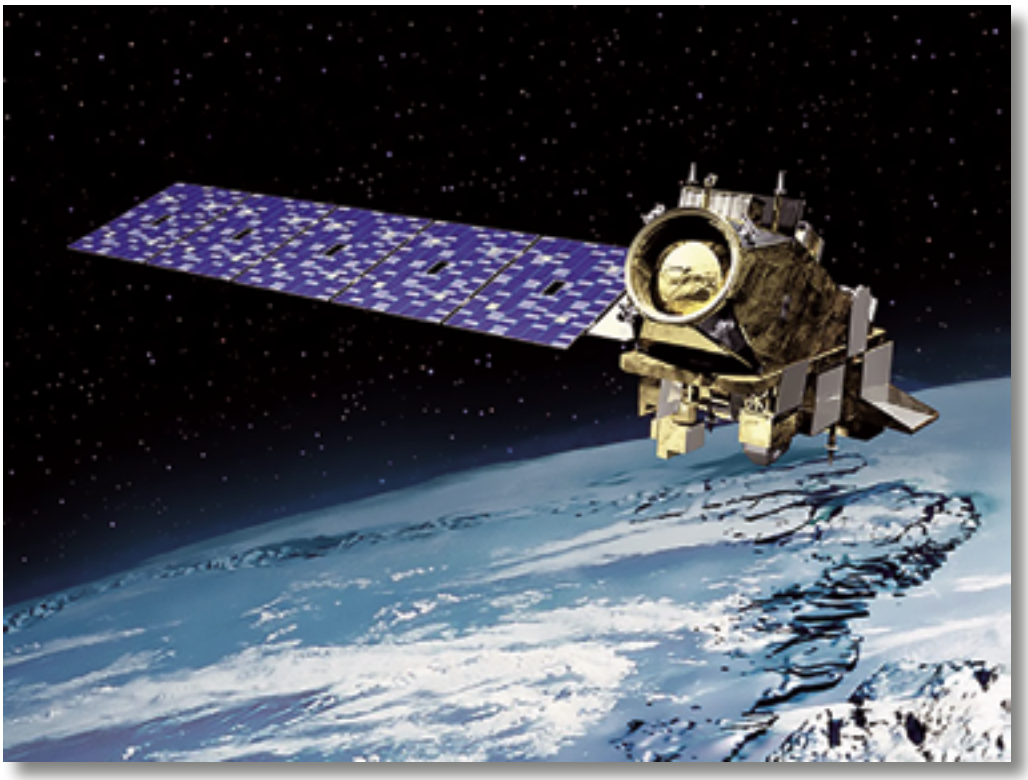
In 2017, the UK firm launched its Bathymetrics online portal making it convenient for purchases enabling customers to search for the availability of off-the-shelf TCarta products.

www.tcarta.com/

Story by Silvano Payne, Executive Writer

InfoBeam

Orbital ATK to bring two new weather satellites into play for NOAA



An artistic rendition of the JPSS-2 satellite.

Image is courtesy of Orbital ATK.

Orbital ATK (NYSE: OA) has reported that NASA has exercised options for two additional Joint Polar Satellite System (JPSS) spacecraft to be built by the company.

Orbital ATK is currently producing the JPSS-2 spacecraft, which is scheduled to be launched in 2021.

All three satellites are to be operated by the National Oceanic and Atmospheric Administration (NOAA) to provide critical weather forecasting data and to advance environmental and oceanographic science.

The total contract amount for all three spacecraft is valued at approximately US$460 million.

The JPSS satellites will provide operational continuity of space-based weather observations, extending the successful 50 year NOAA/NASA partnership into the 2020 and 2030 decades.

Orbital ATK is responsible for the design and fabrication of the spacecraft, integration of government-furnished instruments, testing of the satellites and in-orbit check outs.

The JPSS-2 satellite is on schedule for delivery in 2021, while JPSS-3 and JPSS-4 are on contract for delivery in 2023 and 2026, respectively, with launch dates determined by NOAA/NASA.

Each JPSS satellite will have a design life of at least seven years once launched into orbit.

Representatives from NASA, NOAA and Orbital ATK completed a successful spacecraft Critical Design Review (CDR) for the three JPSS spacecraft in October 2017, which demonstrated that the program met all system and schedule requirements.

JPSS-2 is currently scheduled to begin spacecraft integration and testing in summer 2018 at Orbital ATK's Gilbert, Arizona, satellite manufacturing facility.

JPSS-2 will be the company's first operational weather spacecraft and will be built on the company's LEOStar-3 platform, a flight-proven flexible satellite platform that can accommodate a variety of missions, including the successfully-launched NASA's Fermi and Neil Gehrels Swift Observatory gamma-ray astrophysics satellites and the Landsat 8 Earth science satellite.

The Landsat 9 and ICESat-2 spacecraft currently in production with the company are also built on this platform.

JPSS-3 and JPSS-4 will be manufactured and tested by Orbital ATK's Space Systems Group at their facilities in Gilbert, Arizona.

Steve Krein, the VP of Science and Environmental Satellite Programs at Orbital ATK, said that the company is making excellent progress on JPSS-2 and the program team is ready to start work on the additional two JPSS satellites.

Steve added that the company has an extensive history of delivering successful science and environmental satellites for customers and Orbital ATK is honored to continue building on this legacy with the JPSS satellites.

www.orbitalatk.com/

Story by Sean Payne, Industry Writer

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SpaceX's new Falcon 9 launches Bangladesh's first satellite

On Friday, May 11, Bangladeshi's first satellite — Bangabandhu Satellite-1 — was successfully launched aboard a Falcon 9 Block 5 rocket and the event included the 25th successful return to Earth of a SpaceX rocket booster.

The liftoff occurred from Launch Complex 39A (LC-39A) at NASA's Kennedy Space Center, Florida at 4:14 p.m. EDT and the Bangabandhu Satellite-1 was deployed into a geostationary transfer orbit (GTO) approximately 33 minutes after launch. The Falcon 9 Block 5 is a new 23-story tall giant rocket and spaceship combo, the BFR, for the first time taking into space the first high-orbit communications satellite ever for the country of Bangladesh. The Block 5 sports numerous upgrades designed to make the rocket easier to reuse.

The Bangabandhu Satellite-1 mission served as the first flight of Falcon 9 Block 5, the final substantial upgrade to SpaceX's Falcon 9 launch vehicle. Falcon 9 Block 5 is designed to be capable of 10 or more flights with very limited refurbishment as SpaceX continues to aim for reusability and reliability. Following stage separation, SpaceX successfully landed Falcon 9's first stage on the "Of Course I Still Love You" droneship in the Atlantic Ocean.

The Block-5 is the first rocket from SpaceX to comply with NASA's standard for its Commercial Crew Program to carry agency astronauts to the International Space Station. But NASA still requires seven successful flights before the new rocket receives final certification for a manned mission. SpaceX chief executive Elon Musk says the improved boosters can be reused more than 10 times each and require little or no work between launches.

Bangabandhu-1 traveled to a path 22,000 miles above Earth, where the satellite will provide telecommunications coverage for Bangladesh and as well as surrounding countries such as Nepal, Myanmar, and Bhutan territorial waters in the Bay of Bengal, as well as India, Nepal, Bhutan, Sri Lanka, the Philippines, and Indonesia. The satellite will also provide C- band capacity for the entire region.

Bangabandhu Satellite-1 is Bangladesh's first geostationary communications satellite. Development of the satellite program, known as the "Bangabandhu Satellite Launching Project," was managed by the Bangladesh Telecommunication Regulatory Commission (BTRC) with technical support from Space Partnership International (SPI).

The satellite, which is comprised of 26 Ku- and 14 C-band transponders, was manufactured by Thales Alenia Space on the Spacebus 4000B2 platform and will be operated by the Bangladesh Communication Satellite Company Limited (BCSCL).

Located at 119.1 degrees East, Bangabandhu Satellite-1 will provide Direct-To-Home (DTH) services, video distribution and VSAT communications across the aforementioned regions. Bangabandhu Satellite-1's mission is expected to last at least 15 years.

www.spacex.com

www.bcscl.com.bd/

InfoBeam

Hull to Hull using EGNSS

Hull to Hull (H2H), an EU-funded research project established to develop technical solutions for safer navigation in close proximity of other stationary or moving vessels and objects, is in its Concept Definition phase and will move on to the Technology Adaption and Integration Work Package (WP03) this summer, all to be coordinated by Kongsberg Maritime.

H2H was established in November of 2017 to develop solutions using the European Global Navigation Satellite System (EGNSS), EGNOS and Galileo, that can enhance safety in busy waters and during close maneuvering, helping mariners to make the correct navigation decisions and creating the fundamental conditions for autonomous vessel navigation. H2H aims to create a system that will allow proximity zones to be set for their own vessels as well as neighboring objects, with high precision and high integrity.

H2H focuses on solutions for measuring the location and orientation of a vessel and creating a 3D digital twin representing the vessel's hull, which is linked to a coordinate system, e.g. WGS84. This data can then be used as an input to an autonomy controller. H2H will also support manual navigation, providing reliable input for the captain or navigator to make better informed decisions. This could potentially be achieved by e.g., displaying the digital twin on the ECDIS or other display systems.

The project is coordinated by Kongsberg Seatex, a subsidiary of Kongsberg Maritime, developing solutions for maritime sensing and connectivity. Expert project partners include SINTEF Ocean and SINTEF Digital for broad research-based expertise; KU Leuven, a leading European university and expert on inland waterways navigation; and Mampaey Offshore Industries, a Dutch company specialized in towing, berthing and mooring systems.

H2H is divided into nine work packages, of which four are led by Kongsberg Seatex. The pilot system will be developed in WP03, where the main objective is to define precise sensors and communication systems, and develop an integrated solution based on the best available technology. The solution will be implemented using protocols and 3D models described in the concept. The project will also research specific needs related to auto-mooring and inland waterways, perform lab testing of various sensors and technologies and develop test scenarios for demonstrations scheduled for 2019 and 2020 in Norway's Trondheimsfjorden, in Rotterdam harbor and inland waterways in Belgium.

The Hull to Hull project has received funding from the European GNSS Agency under the European Union's Horizon 2020 research and innovation program grant agreement No 775998.

www.sintef.no/projectweb/hull-to-hull/

Story by Silvano Payne, Executive Writer

InfoBeam

A new launch window and manifest additions for Rocket Lab mission

Rocket Lab's Mahia Peninsula launch site in New Zealand. Photo is courtesy of Rocket Lab.

Rocket Lab has confirmed the new launch window for their upcoming 'It's Business Time' mission — the 14-day launch window will open from June 23 to July 6 (NZST), with launch opportunities between 12:30 and 16:30 NZST daily (00:30 – 04:30 UTC).

'It's Business Time' — the mission's name — will launch from Rocket Lab Launch Complex 1 in New Zealand, the world's only private orbital launch facility. The site is licensed to launch every 72 hours and, according to the company, offers the widest range of orbital inclinations of any launch site on the globe.

The launch window, originally slated for April 20 to May 3, 2018, was moved after unusual behavior was identified in a motor controller during a wet dress rehearsal. The team used the additional time to review data, identify the cause of the issue and put corrective measures in place.

As the corrective measures were implemented, additional customers were added to the launch manifest, including IRVINE01, an educational payload from the Irvine CubeSat STEM Program (ICSP), and NABEO, a drag sail technology demonstrator designed and built by High Performance Space Structure Systems GmbH. Ecliptic Enterprises Corporation assisted with the pairing of NABEO with Electron as a candidate hosted technology demonstrator.

These new payloads join existing 'It's Business Time' customers, including two Lemur-2 satellites from Spire Global and a GeoOptics Inc. satellite, built by Tyvak Nano-Satellite Systems. The payloads will be launched to a 500km x 250km elliptical orbit at 85 degrees, before being circularized using Rocket Lab's Curie engine powered kick stage.

The NABEO drag sail is a system created to passively de-orbit inactive smallsats. The small sail is an ultra-thin membrane that can be coiled up tightly within a spacecraft and then deployed once the satellite reaches the end of its orbital lifespan. The reflective panels unfold to 2.5 square meters to increase the spacecraft's surface area, causing it to experience greater drag and pull the satellite back into the Earth's atmosphere, enabling much faster de-orbiting and reducing the amount of space junk in LEO.

The Irvine CubeSat STEM Program is a joint educational endeavor to teach, train and inspire the next generation of STEM professionals. It is comprised of students from six different American high schools (Beckman, Irvine, Northwood, Portola, University, and Woodbridge) in the city of Irvine, California, and powered by private sector donation through Irvine Public Schools Foundation. The students' main objective is to assemble, test and launch a smallsat into LEO.

Approximately 150 students are involved in the program at any one time. Aboard IRVINE01 is a low-resolution camera that will take pictures of Venus, stars and other celestial objects. Data from these images can be used to calculate distances to stars and determine pointing accuracy and stability of the satellite. Tyvak Nano-Satellite Systems is the payload integrator for IRVINE01 and worked closely with Rocket Lab USA to identify this opportunity for a rapid flight certification process.

Peter Beck, Founder and CEO, Rocket Lab.

Rocket Lab founder and CEO Peter Beck said that the addition of new payloads to the mission manifest highlights Rocket Lab's ability to respond rapidly to customer demand in an ever-evolving small satellite market and he noted that smallsats are playing an increasingly important role in providing crucial services that benefit millions of people on Earth. Frequent access to orbit is the key to unlocking the potential for these satellites, and Rocket Lab is the only small launch provider currently enabling this access.

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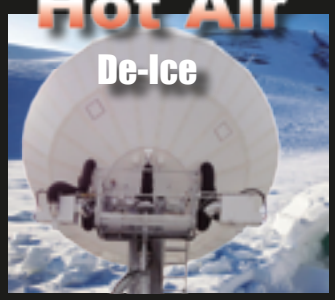

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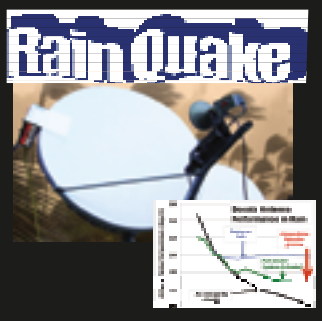

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InfoBeam

Thales Alenia Space signs agreement with Polish Technology Center

Artistic rendition of the Spacebus NEO platform. Image is courtesy of Thales Alenia Space.

Thales Alenia Space (JV Thales 67 percent and Leonardo 33 percent), together with Thales Alenia Space in Poland, have signed a partnership agreement with SCNTPL (Slaskie Centrum Naukowo – Technologiczne Przemyslu, Lotniczego Sp. z o.o.), the Silesian Science and Technology Center of Aviation Industry Ltd. that is based in Czechowice-Dziedzice, Poland, and specializes in composite materials.

Jean-Loïc Galle, CEO of Thales Alenia Space, and Bartlomiej Plonka, SCNTPL, sign the new agreement.

This partnership is the culmination of joint work between the partners reaching back several years, bolstered by the creation of Thales Alenia Space in Poland in 2015.

The agreement signed today also confirms a new joint initiative by SCNTPL and Thales Alenia Space, focused on both Research & Development and the production of satellite structures, and anchored in transfers of composite technologies.

Based on this agreement, Thales Alenia Space has placed an initial order with SCNTPL, to provide structural panels for its Spacebus NEO platform.

According to Jean Loïc Galle, CEO of Thales Alenia Space, with this agreement, Thales Alenia Space shows its sustained commitment to becoming a major partner in the Polish space industry by calling on the large pool of skills in the country and proposing even broader partnership initiatives, focused not only on government requirements, but also the commercial market.

Bartlomiej Plonka, President of the Management Board of SCNTPL, added that this agreement confirms SCNTPL's role in building sophisticated satellite structures to meet the needs of both the domestic and international markets.

He added that this agreement reflects the company's efforts over the last few years to develop materials processes and facilities with the support of both national and European institutions. SCNTPL is proud to have been selected as a partner by Thales Alenia Space and to work as a team to enhance the competitiveness of satellite solutions. This agreement also fosters the involvement of Poland on key ESA programs in the domain of spacecraft structures.

www.thalesaleniaspace.com/

www.scntpl.pl/

Story by Jill Durfee, Assoc. Editor

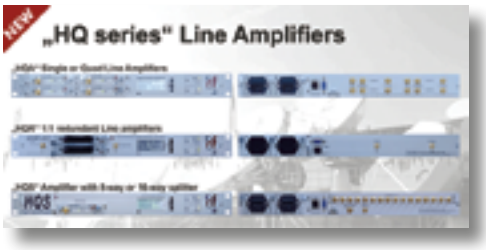
InfoBeam

RF-Design to spotlight their 4Gen amplifier family at CommunicAsia 2

RF-Design will be launching their fourth amplifier generation, "HQA series", including a new single, quad and 1:1 redundant RF amplifiers at CommunicAsia 2018 at Hall B/Level 1, Booth #1L3-14, German Pavilion.

Coming from Lorsch, Germany, RF-Design is recognized for RF-distribution, RF-over-Fiber and RF amplifier technology. Part of their main product range are the 1RU/19-inch rack-mount amplifiers that are well known in the Satellite Communication and Broadcast industry worldwide.

Thousands of RF-Design's amplifiers are in operation at satellite groundstations, teleports and broadcasting facilities worldwide and in use by companies such as Intelsat, SES, Viasat, Hughes, BTBritish Telecom, Thaicom, Media Broadcast, Axesat and many others.



The new HQ series come as single, quad or 1:1 redundant amplifiers and units with integrated 8-way, 16-way, 24-way or 32-way splitters are available, all in a compact 1RU/19-inch rack-mount chassis.

The units of the HQ series support variable gain-control, slope equalization, RF power monitoring, threshold alarming, switchable LNB-supply, a 10MHz external reference signal port and 1:1 redundant dual power supply.

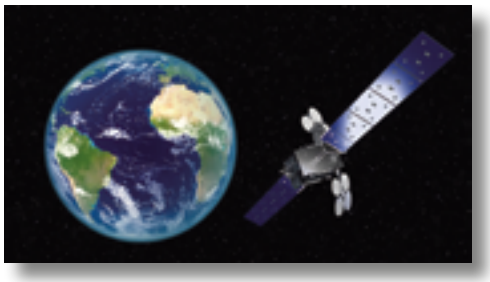
Local configuration can be realized via a front-panel LC-Display while remote access, configuration and monitoring can be done via a rear-side Ethernet-Interface (WebGUI, SNMP).

RF performances, such as at return-loss, frequency response and isolation in combination with beneficial features ensure these amplifiers are a fit for any RF distribution infrastructure where accurate RF power as well as excellent signal quality and stability is relevant.

www.rf-design-online.de/

InfoBeam

Al Yah-3 satellite completes on orbit testing



Yahsat has announced that their third satellite Al Yah 3, located at 20 degrees W, has successfully completed its on orbit testing and is ready to support the launch of commercial services.

The satellite will expand Yahsat's Ka-band coverage to 19 additional markets across Africa covering 60 percent of the population and marks Yahsat's first entry into Brazil, where 95 percent of the population will have access to the satellite's broadband services.

The successful mission is the culmination of a project which has seen the Al Yah 3 satellite, designed and built with Emirati engineers, leading at every stage of the process, in partnership with Orbital ATK.

The engineers were crucial in ensuring the successful end-to-end delivery of the satellite into orbit.

Al Yah 3, an all Ka-band satellite, and the first hybrid electric propulsion GEOStar-3™ satellite completed by Orbital ATK, was launched on an Ariane 5 rocket by Arianespace, on January 26, 2018.

Masood M. Sharif Mahmood, Chief Executive Officer at Yahsat, said that access to the internet is a key facilitator of social and economic progress. Today, broadband connectivity is playing an important role in creating new opportunities and in accelerating innovation. The company is excited by the opportunity Al Yah 3 brings in the firm's ability to deliver reliable and affordable satellite broadband services to parts of the world that need it the most, building upon the company's previous achievements as pioneers of such services across Africa, the Middle East and south-west Asia.

Mahmood added that it has been an incredible journey for Yahsat and a proud moment for both the company and for the UAE. The company's engineers have been heavily involved in managing all aspects of the project, including design, development and launch with the focus now on the commercial launch of Yahsat services using Al Yah 3 over the coming weeks.

www.yahsat.com

The launch of the Al Yah-3 satellite aboard an Ariane 5 launch vehicle on January 26, 2018. Photo is courtesy of Arianespace.

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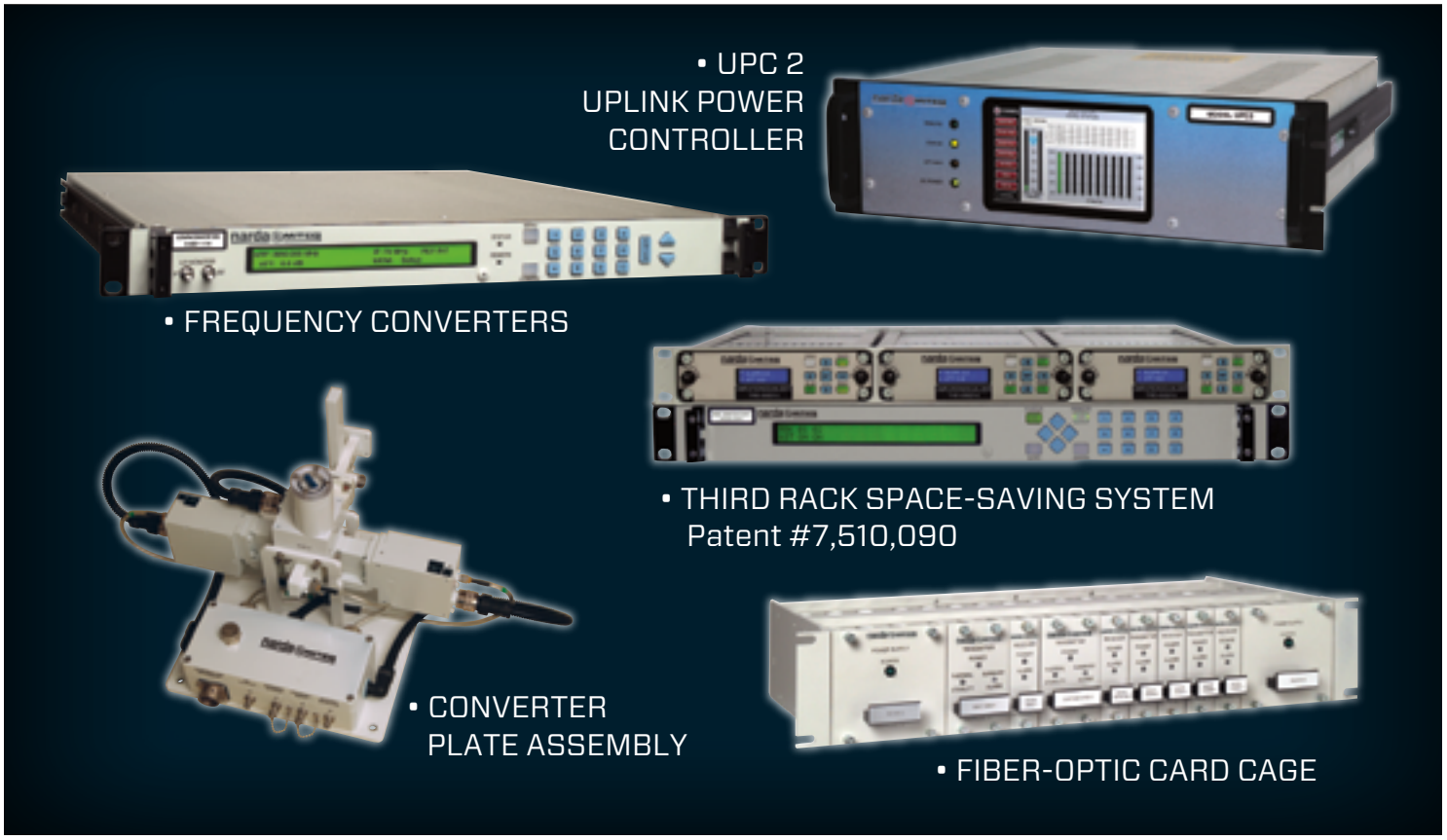

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InfoBeam

PD Aerospace unmanned spacecraft project receives capital infusion from ANA Holdings

ANA HOLDINGS (ANA HD) will be investing an additional 200 million yen to PD Aerospace, a space-venture company — ANA HD will receive PD Aerospace shares through a third-party allotment.

In October of 2016, ANA HD, the largest airline group in Japan, and H.I.S., one of Japan's largest travel agencies, established a capital alliance with PD Aerospace to develop commercial space flight using a new type of spacecraft. ANA HD invested 20.4 million yen in PD Aerospace at that time.

Last July, PD Aerospace succeeded in an experimental propulsion system[1], a world first, which can alternate between a jet engine and rocket engine function[2].

This time, in addition to ANA HD and H.I.S, Huis Ten Bosch, Mizuho Growth Fund No.2 Limited Partnership (Mizuho Capital Co., Ltd.), and Optima Ventures have also invested in PD Aerospace. PD Aerospace is still looking for new investors in order to close this funding round.

With the additional investment funds, PD Aerospace will transfer the Research and Development Center to a new location within the city of Hekinan, Aichi Prefecture, and accomplish its ambitious goal to fly an unmanned spacecraft equipped with the propulsion system up to an altitude of 100 km in the year 2019.

This new location includes a hangar for the spacecraft and is eight times bigger than the current one.

In order to accelerate and support the development of manned spacecraft, ANA HD has dedicated one of the company's own, skilled, aircraft mechanics, who has been relocated to PD Aerospace and is working together with their team.

As one of the efforts to realize "ANA Group Society 5.0"[3] in line with the ANA Group's Mid-Term Corporate Strategy for FY2018-2022, ANA HD aims to create new markets and demands such as space travel and high-speed transport which will significantly shorten travel time of commercial flights.

Amid the accelerating development of space projects by the private sector, ANA Group will set out to utilize the knowledge of operations cultivated in the air transportation business, to prepare for the space era and its many space projects and businesses including space travel and transportation.

Yoshiaki Tsuda, VP, ANA Digital Design Lab, said that the company is increasing their support to help expedite the project's timeline of testing and launching an unmanned spacecraft to an altitude of 100 km.

www.ana.co.jp

pdas.co.jp/en/

[1] *The engine is comprised of a simple tube structure which incorporates jet engine and rocket engine functions in one by using the characteristics of a pulse detonation engine to enable hypersonic flight. This mechanism makes it possible to fly through the normal atmosphere as well as space in one aircraft.*

[2] *The space plane uses systems similar to those on a conventional aircraft. It takes off and lands using its jet engine and converts to rocket engine mode when in space.*

[3] *For more Information about "Society 5.0" and "ANA Group Society 5.0" laid out in its Mid-Term Corporate Strategy for FY2018-2022, please access*:

http://www8.cao.go.jp/cstp/english/society5_0/index.html

https://www.ana.co.jp/group/en/pr/201802/20180201-2.html

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RADEUS LABS, INC.

Executive Spotlight

Jim Simpson, Chief Executive Officer, ABS

Jim Simpson, recently named CEO of ABS, possesses more than 37 years of experience in the space and defense business, 15 years in SATCOM with expertise in sales, marketing, strategy, business development and program management.

Prior to joining ABS, Jim was Senior Vice President at Aerojet Rocketdyne, Inc. where he was responsible for corporate strategy and business development. Previously Jim spent 35 years at Boeing in various leadership positions including President of Commercial Satellite Systems and Vice President of Strategy and Business Development for Network and Space Systems.

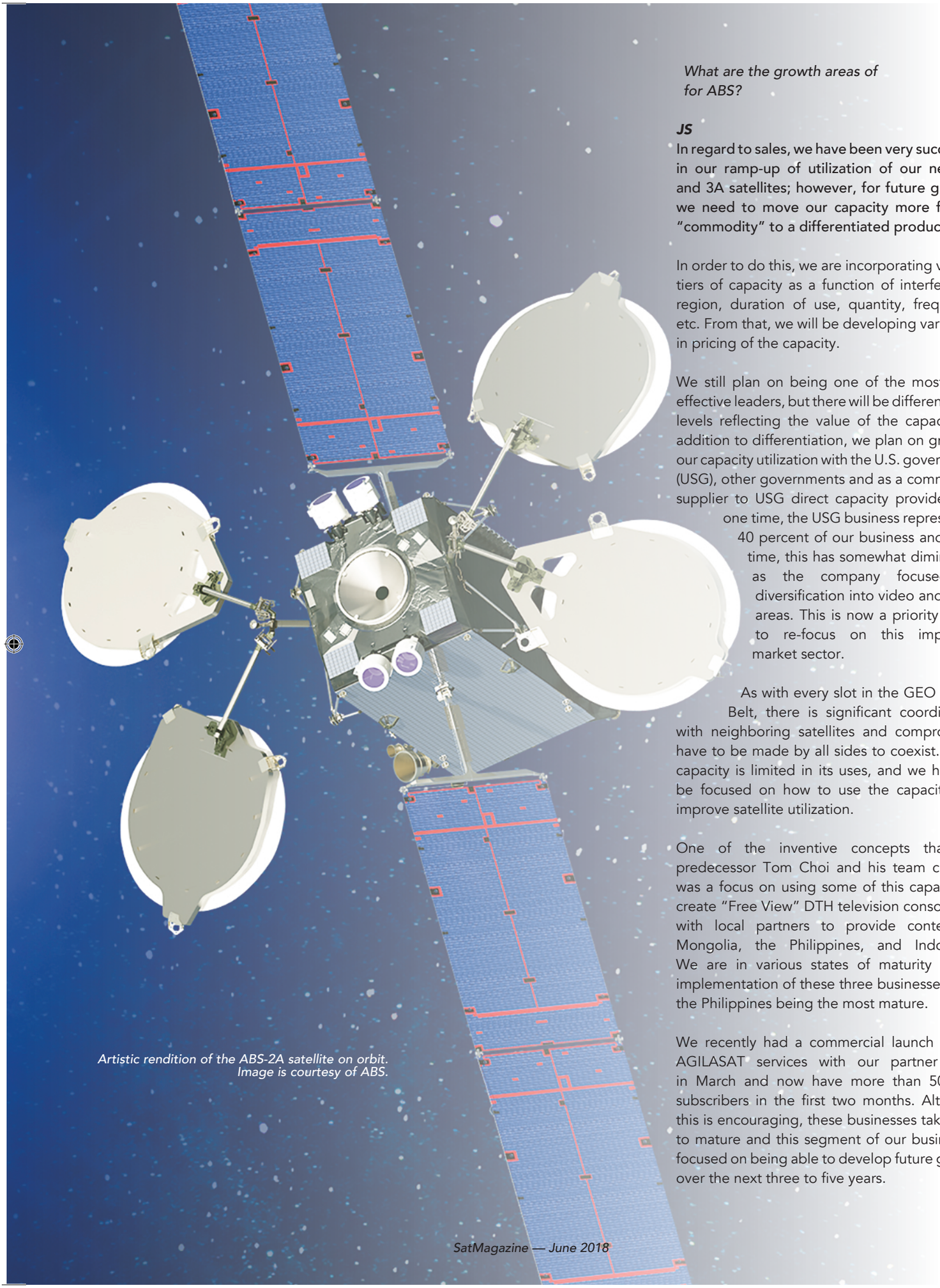
Jim holds B.S. and M.S. degrees from the University of California, Los Angeles, an M.B.A. from the University of Southern California and a graduate certificate in Program Management from California Institute of Technology.

Jim, where is ABS positioned at this time in the company's development?

Jim Simpson (JS)

ABS is one of the fastest growing global operators in the world. We have a fully revamped ABS management team with significant experience from industry operators with impressive track records of success. We have also promoted from within critical senior executives.

The objective of the new team is to create an executable plan based on current and projected market conditions. Specifically, the plan institutes our new sales approach to capacity, restructures and executes the DTH platform business, develops new revenue streams through expansion of existing satellite services and other new service offerings, and improves the operational efficiency of the business.



Artistic rendition of the ABS-2A satellite on orbit. Image is courtesy of ABS.

What are the growth areas of for ABS?

JS

In regard to sales, we have been very successful in our ramp-up of utilization of our new 2A and 3A satellites; however, for future growth, we need to move our capacity more from a "commodity" to a differentiated product.

In order to do this, we are incorporating various tiers of capacity as a function of interference, region, duration of use, quantity, frequency, etc. From that, we will be developing variations in pricing of the capacity.

We still plan on being one of the most cost-effective leaders, but there will be different price levels reflecting the value of the capacity. In addition to differentiation, we plan on growing our capacity utilization with the U.S. government (USG), other governments and as a commercial supplier to USG direct capacity providers. At one time, the USG business represented 40 percent of our business and, over time, this has somewhat diminished as the company focused on diversification into video and other areas. This is now a priority for us to re-focus on this important market sector.

As with every slot in the GEO Clarke Belt, there is significant coordination with neighboring satellites and compromises have to be made by all sides to coexist. Some capacity is limited in its uses, and we have to be focused on how to use the capacity and improve satellite utilization.

One of the inventive concepts that my predecessor Tom Choi and his team created was a focus on using some of this capacity to create "Free View" DTH television consortiums with local partners to provide content to Mongolia, the Philippines, and Indonesia. We are in various states of maturity in the implementation of these three businesses, with the Philippines being the most mature.

We recently had a commercial launch of the AGILASAT services with our partner Solar in March and now have more than 500,000 subscribers in the first two months. Although this is encouraging, these businesses take time to mature and this segment of our business is focused on being able to develop future growth over the next three to five years.

For our third party satellite services, we have a two-fold approach, in which we:

- *Provide capacity to and partner with managed satellite service providers who are highly focused in this market for government, geological, maritime and other applications.*

- *Manage the operations or provide support for third party satellite operators through our extensive family of teleports throughout the world. We have 16 teleports, more than most other satellite operators, and our objective is to evolve these more and more from a "cost center" to an ancillary business for us.*

What do you believe are the main opportunities or markets for the company?

JS

An additional key area for ABS is the creation of partnerships with other service providers, satellite manufacturers and others to expand the business by utilization of our 15 slots that do not presently have satellites assigned to them.

Unfortunately, we do not have infinite resources, and through partnerships, we are able to facilitate accelerated maturation of the slots, thereby enabling revenue more rapidly than a completely organic internal approach.

We are also looking to take advantage of some of the key new cubesat/micro/mini GEO and small satellite digital payload technologies (virtually, a soft satellite that can be configured/re-configured on orbit for various market needs). Such should substantially reduce the time to market and the economics through a "buy by the yard" (customized packages) approach, in which the smaller satellites can be largely filled by committed customers prior to launch, and with shorter build times.

This results in much less time to become creative and changes the economics — if the slots become more popular, the company can build up through additional smallsats or a larger one, if warranted. Alternatively, we halt the development of additional capacity if the slot revenues do not materialize. This approach reduces risk and minimizes capital outlays.

Jim, What do you see as drivers and trends that would impact the industry in the next decade?

JS

Our focus is on the evolving environment and how does ABS play a role with the advent of 5G, OTT, and High Throughput Satellites (HTS), since we do not currently have HTS.

A broad range of applications benefit from incorporating satellite technology as a delivery mechanism, including: broadcast-like services; broadband access everywhere; higher user mobility; massive IoT; lifeline communications; ultra-reliable communications; and broadband access in dense areas.

Our ABS satellites offer global reach, extremely high efficiency in distributing large volume of content and data, and synchronized delivery to provide these services. We see 5G as a positive for ABS. However, some of our regions do not have the terrestrial infrastructure available and there will be issues expanding terrestrial footprints that are difficult to overcome easily.

The correlation for our fleet is that we cover much of the developing world, where fiber infrastructure may never reach customers or, at least, not be available for the foreseeable future.

We also cover Asia where the terrain may not allow the fiber or other terrestrial infrastructure to be built out and, in some countries, there simply is not enough population that would allow investment to make revenue sense.

Satellite makes it easier and more cost effective to bring the large amounts of data wherever a cell site could be located. This is really the cell backhaul and cell extension services that satellite is in today but the large amount of data that 5G will enable on the ground will need satellite to augment terrestrial infrastructure.

In the future, ABS will expand more into HTS — currently data is less than 50 percent of our business. Video, which is the majority of our business, is less impacted by HTS, as the value of HTS is not in video.

In regard to the data region of our efforts, there are business factors that are maintaining the pricing that are similar to the price points we are currently providing. This is potentially a transient effect. For the interim, until we do incorporate HTS, the impact is to a large extent mitigated. Moreover, the verdict on the success of the HTS is not available as of this writing, as the introduction of the HTS capacity by some operators did cannibalize some of their traditional wide beam revenues.

ABS is excited about the future of the company, which is preparing and executing plans to be a leader and important contributor in the satellite communications business for a long time to come.

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Award Winning Teleport

The Forrester Report

Can C-band provide a lottery win for satellite?

By Chris Forrester, Senior Contributor

Imagine this: You are a major global satellite operator with massive borrowings of some US$15 billion. You control huge swathes of valuable C-band capacity that, for years, you have defended against the demands from telcos that would like to gain access to that frequency.

Then, along comes Intel. The company states — in effect — 'let's re-think C-band, at least over the USA.' That re-think could result in a blissful future for Intelsat as well as for its USA fellow-supplier of C-band, SES and their fleet of Americom and SES satellites, and a true windfall of life-changing dimensions.

C-band: 3.7 GHz-4.2 GHz, the pot of gold at the end of the rainbow?

The prospective numbers are truly fascinating and it is no surprise that at the start of May savvy investors also saw the massive dollar signs on the horizon for Intelsat (and SES) and lifted Intelsat's share price by a massive 42 percent in a single day, so great was their optimism.

Is it any wonder that speculators — and Intelsat's management — are enthusiastic? Last year Intelsat's total revenue was US$2.14 billion. There will be — as yet unstated — costs associated with a C-band repurposing; however, even allowing for those costs, there will still be ample profits.

The double news-flow started with Intelsat's Q1 results unveiled on May 1. ***Steve Spengler***, Intelsat's President and CEO, told analysts on his conference call that he preferred not to speculate on C-band because it was going to be a complicated process.

"Let me just say this, we do believe it's possible to clear more than 100 megahertz over time. But it really is going to be a matter of timing, cost and complexity. It's not a small undertaking. And as we assess that potential, our priority is always to maintain quality of services, continuity of services for our customers. And so, what we have focused on so far is what we believe we can do in a very short timeframe and that's the 100 megahertz. We've stated

that 100 megahertz could be made available within 18 months to 36 months after an order from the FCC."

Spengler also added *"there is significant interest from the FCC, the U.S. Congress and the Trump administration [in the proposal]" — "we believe that a Notice of Proposed Rulemaking (NPRM) could be issued by the FCC in the summer of 2018 with the potential for a final order in early to mid-2019."*

Watch Steve Spengler address the U.S. Senate Committee on Commerce, Science & Transportation, on the question of C-band:

www.intelsat.com/about-us/c-band-spectrum/

Intelsat is quite clear to caveat any optimistic tone with a typical *"no assurances"* language today but with strong hints of a more positive future.

A few hours later, still on May 1st, the FCC jumped into the argument with both feet, saying that it wants to consult on the prospects for 5G's roll-out in the U.S. and how C-band might help make those prospects happen. Moreover, the FCC wants the results of their consultations to be in their hands by June 15th — a sense of urgency that is not normal for any agency.

Intelsat and SES between them manage around 90 to 95 percent of the C-band capacity over the U.S.

Analysts at Deutsche Bank, in a detailed examination, suggest that an auction of C-band capacity could generate around US$11 billion in total and probably some 4 billion euros for SES. There are admitted "substantial" costs involved in repurposing this capacity.

The C-band proposal provides for certainty, control and expediency of re-farming of the spectrum which would help expedite 5G; the process going forward will be a "complicated" series of events that the FCC controls; Intelsat believes it can clear more than 100 MHz over time — it'll be a function of timing, cost and complexity — the priority right now is quality and continuity of existing services, the company said.

Intelsat, as noted, has focused on 100 MHz because that is readily achievable within 18 months of an FCC order; however, as analysts at investment bank Jefferies advised, the spectrum re-farming requires modifications in the network, such as additional equipment, relocation of some facilities, even some change in the configuration of existing / future satellites.

Neither Intelsat, nor SES, control the C-band timing and won't manage its capital structure to C-band developments; the question as to whether Intelsat tries to inject a sale of satellite capacity for

5G cellular backhaul into the "market-based mechanism" is an interesting one and something that management are obviously mulling, and to date there's no comment on how SES and Intelsat have worked out the split of a windfall.

Also, and not to be ignored, are the two 'minor' suppliers of satellite capacity over the USA: Eutelsat (via its Eutelsat Americas/SatMex craft) and Canada's Telesat (and its powerful Anik craft). Telesat's President and CEO, ***Dan Goldberg***, said bluntly that unless his company is welcomed into the C-band 'club', he'll be objecting to the scheme. "*As it stands, unless we can be persuaded that these proceeds are in fact going to be distributed in an equitable way, we are going to oppose this and will oppose it vigorously*," Goldberg said during a May 3 conference call.

SES stated the company would welcome Telesat into the C-band consortium.

The FCC's aim for the U.S. is to measure the "most fertile" source of C-band (3.7 GHz to 4.2 GHz) spectrum. According to a filing from Verizon last November, the 3.7 to 4.2 GHz spectrum "*is the most favorable mid-band spectrum range to introduce 5G services in the U.S.*" FCC Commissioner *Mike O'Reilly* is seeking 200 to 300 MHz of spectrum.

Other terrestrial operators have said that the spectrum on offer as the "sweet spot", but there are dissenting voices.

First up are the satellite operators themselves. SES's newly-appointed CEO ***Steve Collar***, who, while not pessimistic is, at least, realistic in the amount of work ahead. SES supports the Intelsat thrust, but cautions that anything over and above 100 MHz of spectrum would be expensive to manage and implement.

T-Mobile (in a filing made on November 15 last year) said, "*Not only does this approach give the satellite industry a multi-billion dollar reward for using spectrum inefficiently, it creates tremendous uncertainty regarding the availability of this spectrum for mobile broadband services and will likely result in inefficient reallocation of spectrum.*"

These, and other telco dissenters, also argue that the FCC should take back inefficiently managed C-band spectrum and auction off the bandwidth to the highest bidders, as it would with any other new frequency allocations.

However, Deutsche Bank said that their view is that Intelsat and SES will win FCC approval to mount a private market solution to solve the problem.

An analyst at investment bank Jefferies stated (immediately following Intelsat's Q1 results), "*Stuff the results: Let's talk C-band again!*" Indeed, ***Giles Thorne*** at Jefferies said that Intelsat's comments, while highly useful, and that "*there is significant interest from the FCC, the U.S. Congress and the Trump administration [in the C-band proposal].*" He, nevertheless, reminded investors that while Intelsat has focused on 100 MHz of its capacity "*because that is readily achievable within 18 months of an FCC order; re-farming requires modifications in the network such as additional equipment, relocation of some facilities, even some change in the configuration of existing / future satellites; Intelsat doesn't control the C-band timing and won't manage its capital structure to C-band developments; the question as to whether Intelsat tries to inject a sale of satellite capacity for 5G cellular backhaul into the 'market-based mechanism' is an interesting one and something that management are mulling; no comment on how SES and Intelsat have worked out the split of a windfall.*"

That windfall is the prize. Adding a (net) few billions of income to Intelsat, SES and a commensurate amount to Eutelsat and Telesat would completely revitalize the financial prospects for satellite operators over the U.S.

What America does today, the rest of the world might do tomorrow and 5G could end up being the best thing that has ever happened to satellite.

Intelsat's C-band objectives

"The C-band Joint Use Proposal was made in response to an FCC Notice of Inquiry about potential other uses for this mid-band spectrum. There is significant interest from the FCC, the U.S. Congress and the Trump administration to make additional spectrum available for terrestrial use in deploying future 5G networks in the U.S. Intelsat continues to meet with relevant parties, including our customers, mobile operators and regulators, to advocate for our commercial framework that would allow us to protect the reliability of the services we deliver and result in an efficient and timely process should the FCC implement the proposal. We believe that a Notice of Proposed Rule Making ("NPRM") could be issued by the FCC in the summer of 2018, with the potential for a final order in early to mid-2019. However, we can provide no assurance as to the likelihood of the FCC's acceptance of the various facets of our proposal, or as to the actual timing of issuance of an NPRM or a final ruling, all of which are in the control of the FCC."

Senior Contributor Chris Forrester is a well-known broadcast journalist and industry consultant. He reports on all aspects of broadcasting with special emphasis on content, the business of television and emerging applications. He founded Rapid TV News and has edited Interspace and its successor, Inside Satellite TV, since 1996. He also files for Advanced-Television.com. In November of 1998, Chris was appointed an Associate (professor) of the prestigious Adham Center for Television Journalism, part of the American University in Cairo (AUC), in recognition of his extensive coverage of the Arab media market.

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Satellites and the Deep Blue Sea

An SSPI Perspective

They transport 90 percent of the world's trade: everything from oil to smartphones, toaster ovens to automobiles — yet, there are only about four million of them, out of the world's seven billion and the chances are, you have never even met one.

They are mariners: the men (mostly) and women who crew the vessels that move commodities and products from one port to another on every continent of the world.

Theirs is a unique calling with severe challenges. Their reward is a paycheck and a chance to see the world as few of us see it.

Dangerous Isolation

A mariner's life can be quite lonely — they spend long periods at sea, from a few months to a year aboard a vessel.

Their time in port is short because that costs money. They leave behind family and friends to sail with a rotating cast of strangers.

Their life is also filled with danger. In port, they rig cargo for loading and unloading, with cranes and cables flying back and forth. At sea, they chip and paint, service machinery, mend lines, rebuild pumps and weld broken metal back together. With long hours and bad weather, fatigue sets in and the risks of accident and injury grow.

The rigors of life at sea present the shipping industry with a challenge. Economic growth is making opportunities ashore ever more attractive, and recent studies predict the industry will face a hiring shortfall of more than 360,000 mariners by 2050. The challenges of the mariner's life are rapidly becoming a problem for ship owners — and the solution for both is directly overhead.

Satellites Serving Ships at Sea

The modern ship is always in touch and navigates by GPS, just as you do.

Satellites carry email, voice calls, weather forecasts and navigation charts. A growing range of "digital ship" applications keep engines running at peak performance and protect cargo from loss.

Add in broadband for the crew — from social media to Netflix — and ships can start consuming more bandwidth than a roomful of teenagers. That can produce real sticker shock for ship owners, because connecting ships at sea is always going to be more expensive than connecting homes on your street.

A company called **ITC Global** (**www.itcglobal.com/**) has an answer. It offers a service called Crew LIVE that gives each ship two kinds of connections.

One is for the vessel, to handle its own needs. The other is for the crew. Crew members receive their own pay-as-you-go accounts for email, social media and entertainment.

The mariners get to decide how much online access they want — and ship owners get the predictable costs they need.

Applications for Physical and Emotional Health

As a subsidiary of Panasonic, ITC Global delivers Crew LIVE over the Panasonic broadband mobility network and provides the hardware, software and management services to ships.

"We're nearing 25,000 registered crew members on the network and we're seeing them each use an average of 1 gigabyte of data per month," said ITC Global CEO *Ian Dawkins*.

That is more than 1.8 terabytes per month combined — yet ship owners don't have a problem, because their costs are controlled and they know their spending goes to greater safety, efficiency and productivity for the vessel. That has opened up a world of applications that benefit both ship owners and crew.

A company called FutureCare (***futurecare.com/***) provides remote medical care for more than 25,000 crew members aboard ships around the world. When illness or injury strikes a member of the crew, FutureCare physicians use video conferencing to make a diagnosis, create a treatment plan and follow up.

Managing health aboard ship reduces the chances of an emergency stop at the nearest port, which can throw off the ship's itinerary and cost potentially millions of dollars. The peace of mind it provides officers and crew aboard ship can be priceless.

Just as valuable is the emotional well-being that comes from being able to stay connected with friends or take part in a child's birthday over FaceTime or Skype. Mariners seeking to advance their careers can also have access to training without having to put in extra time ashore without pay.

Through heat and cold, long days and raging storms, the world's mariners still go down to the sea in ships. They make sure the shelves in your store are stocked, the service station can fill your car with gas, and factories have the materials they need.

With a little help from satellites far overhead, that job has become safer, a little easier and far more rewarding.

References

"Wearable Technology: Is it Tailor-Made for Shipping and Maritime" by Leah Kinthaert, KNect365 Maritime Talent and Training, February 20, 2017.

"Life as a Merchant Marine" by John Dunaway, Filson.com, March 30, 2016.

"Benefits of Liner Shipping: Global Economic Engine," World Shipping Council, July 15, 2017.

"The Future of Maritime Care," by Greg Trauthwein, MarineLink, April 20, 2017.

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Produced for SatNews by Space & Satellite Professionals International (SSPI)

See more stories and videos of satellite making a better world at ***www.bettersatelliteworld.com***.

How Satellites Make a Better World Campaign

SSPI develops, distributes and promotes powerful stories that depict space and satellite technologies as the world's invisible but indispensable infrastructure, contributing to the economy, society and sustainability of planet Earth.

SSPI also hosts a ***Better Satellite World Awards Dinner*** *in London each December to honor organizations for developing and using space and satellite technologies to make a better world.*

The campaign targets students and young professionals seeking a career that makes a difference in the world. It educates the regulators and policymakers on whose judgment the industry depends.

The program engages potential customers who might not otherwise consider satellite as an option. Additionally, sponsors are provided with unique content that promotes their technology and services in an exciting new light.

Is the Campaign Working?

Thanks to SSPI's media and association partners, sponsors and members, the BSW campaign has generated US$3.5 million in gross impressions and in-kind advertising value that has been worth US$410,000 in its first two years.

SSPI makes the BSW stories and videos freely available for you to share through social media, your employee newsletter and in presentations to customers, investors, conferences and the press.

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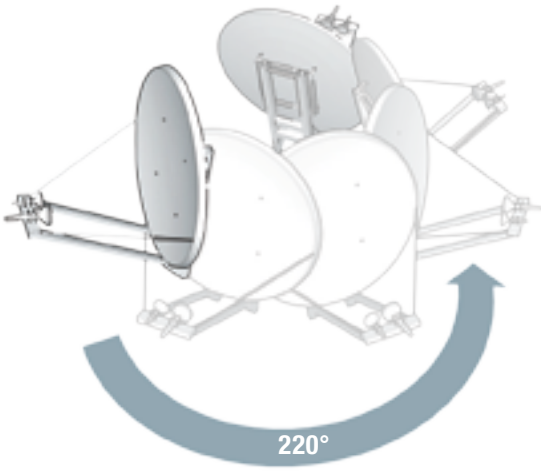

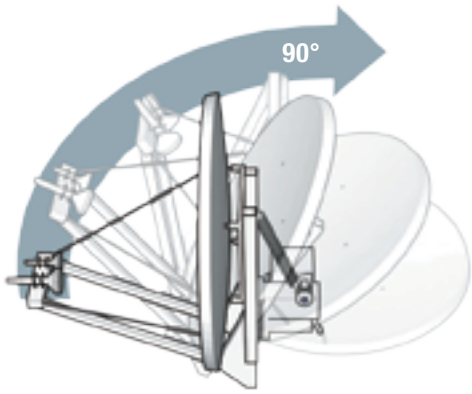

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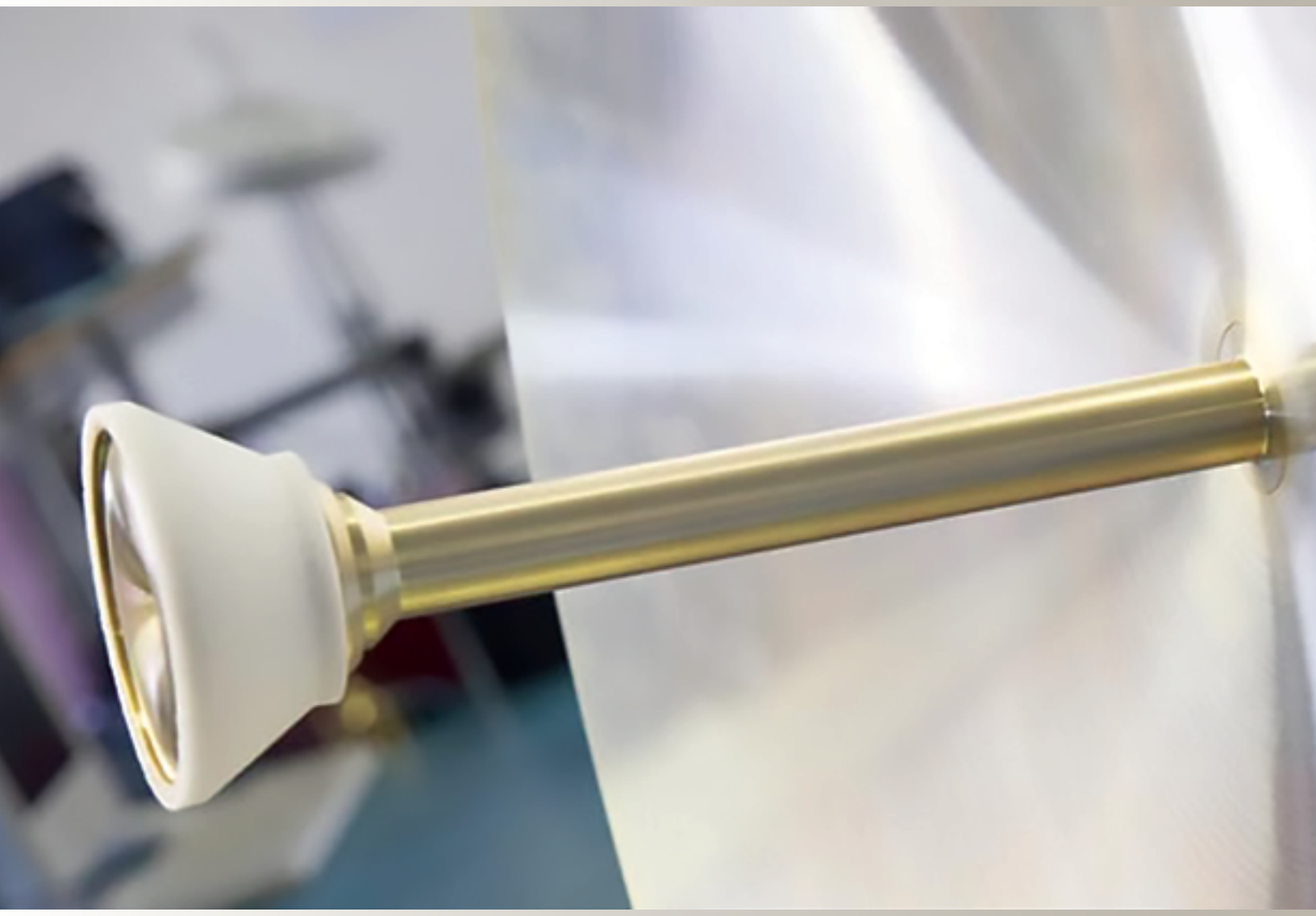
Another Australian "On-The-Move" First

An EM Solutions Insight

By Dr. Rowan Gilmore, Chief Executive Officer, EM Solutions

Great moves are afoot in Australia — the Defence market for the first time in many years is optimistic and expansive, undergoing a massive rebuild of industry capability; the establishment of an Australian Space Agency has recently been announced; and the economy has continued its growth for a record-breaking period edging close to nearly three decades. These augur well for more Firsts.



A dry continent with huge expanses between urban centers is a great environment for radio communications and people on the move. This dependence on radio communications has already spawned a number of Firsts in Australia by local satellite ground terminal provider EM Solutions.

Celebrating 20 years of continuous operations this year, the company began by designing and manufacturing microwave components such as filters, low phase noise oscillators, and power amplifiers. However, EM Solutions recognized earlier than most the promise of Ka-band satellite communications to provide high throughput links.

The company began to specialize in robust and powerful block up converters (BUCs) and low noise block down converters (LNBs), which EM Solutions has continued to innovate with the introduction of GaN devices and broadband power combining techniques for high power amplification.

Today, the firm's BUCs and LNBs are leaders at the premium end of the market for their size and the power levels over the Ka-band bandwidths in which they operate.

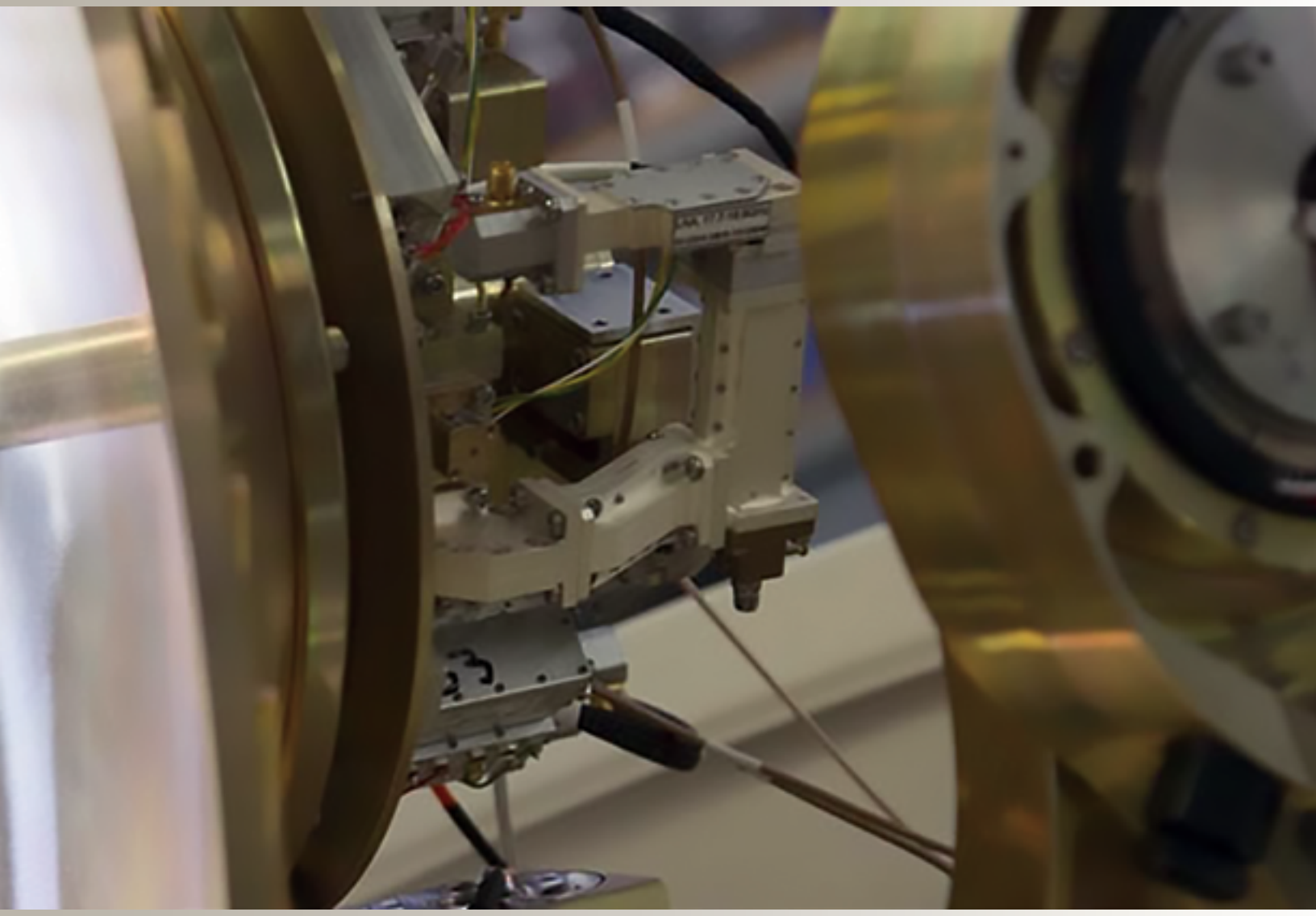
Seeking to differentiate itself in an increasingly crowded market, the company continued to move up the value chain and soon developed a unique on-the-move satellite ground terminal that was characterized by its ability to stabilize itself and point to the satellite even under the most violent motion conditions. That terminal used a clever 'monopulse' technique to generate a pointing vector from the satellite signal itself.

Unlike existing systems that measured only the amplitude (signal strength) of the incoming signal and was dependent for this upon delayed feedback from the modem, the EM Solutions pointing and tracking system directly measured both relative amplitude and phase of a so-called TE21 mode in its special antenna feed, which gave a very precise indication of not only the distance the feed needed to be turned to return to boresight, but also the direction in which to travel.

Because it did not rely on a one-dimensional amplitude-only feedback signal from the modem that was also affected by scintillation and fading, the resulting terminal proved much better at acquiring and tracking the satellite than others. As a result, the new EM Solutions on-the-move (OTM) **Taipan** terminal (shown in *Figure 1 on the next page*) has begun to displace an installed base of competitor land mobile terminals that fail to acquire or retain the satellite under even the simplest of maneuvers, such as sharp figure-of-eight turns, or after intermittent signal blockage. Its use of a three axis gimbal system is also beneficial in areas with a high satellite look angle, since that avoids the keyhole effect and the slow response of the azimuth axis on its own to maintain accurate pointing.

The Taipan has recently been improved to operate in commercial and military Ka-bands, offering unprecedented availability and redundancy in mission critical application. This required the development of a new BUC and LNB architecture that could support dual-band operation, but also a more complex feed system — one that passed not only the broader bandwidth signal itself, but also generated the more complex TE21 signal required for tracking both bands as well.

The same tracking technology advances used in the Taipan have been ported to its larger sibling, the **Cobra** tri-band maritime terminal (*Figure 2* on the next page). Even better, the Cobra also features simultaneous X-band capability, so that the terminal can provide both military X- and Ka-band communications simultaneously.



Not only has this new innovation further increased redundancy, since a second transmit and receive chain have been added to manage X-band communications in addition to Ka-band, it has increased system capacity since it allows simultaneous usage in both bands, and provides protection against weather related impacts that can occur at the higher frequency Ka-band.

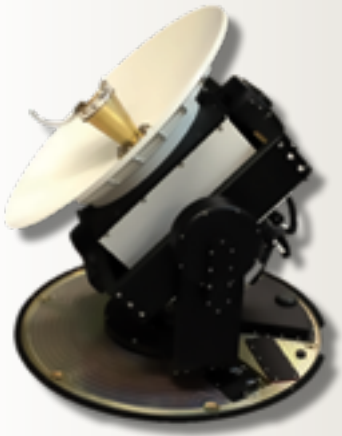


Figure 1. EM Solutions Taipan terminal.

Figure 2. EM Solutions Cobra terminal.

With the massive shipbuilding program being undertaken by the Australian Navy, demand for the Cobra terminal is strong, and moves are underway to increase its antenna to 2 meters in size, to better suit the larger classes of ships in the pipeline.

EM Solution's 0.65 meter amphibious **Salamander** terminal is the most recent SATCOM First to come out of the Australian region. For the first time, in a single, small and lightweight high performance terminal, true broadband communications can be provided with increased availability in both maritime and land environments.

Currently available at Ku-band for deployment by an army in Asia, the Salamander form factor is suitable for use on either land mobile or below-the-horizon maritime operations.

Again deploying proprietary monopulse pointing technology, the Salamander has been proven by customers to track both off-road and on small boats in choppy seas, where it has displaced other OTM systems whose claims have not lived up to their promise. Ka-band and X-band variants are currently under development and will be available in late 2018.

However, one of most exciting innovations EM Solutions has pursued in the past year is the firm's flat panel antenna. The company's existing parabolic shaped antennas sweep a large hemispherical volume when they steer to the satellite, making them unsuitable when height or profile is of concern. Even though flat panels lose gain and performance as the look angle to the satellite angle moves off-normal, sometimes this is an acceptable compromise to achieve low profile.

After two years of research, the EM Solutions team, working with **University of Queensland** researchers, has developed a completely novel antenna that is low cost, low profile, broadband, and can steer on-the-move. The antenna is based on creating a reconfigurable antenna impedance surface that forms and steers a beam in the same way that an optical holograph is produced.

The antenna itself is low cost as it is made only of passive materials, meeting the antenna pattern specifications required for satellite operator certification by careful control of sidelobes. It is reconfigurable — *i.e.*, the beam can be steered continuously, relatively simply and quickly by changing the impedance surface, using mechanical motion only in the plane of the flat panel (so the antenna remains flat).

The antenna is not intrinsically bandwidth limited — i.e., its operating characteristics are not limited by the antenna itself but instead by the external terminal characteristics.

Finally, the antenna incorporates monopulse sensors within the antenna, which can be used for beam steering in a control loop similar to EM Solutions' other terminals. These features differentiate the EM Solutions antenna from phased array solutions (which are costly and digital and thus non-continuous in their beam steering) or meta-material proposals (which are inherently resonant thus narrowband, potentially limiting the operating frequency/band and inhibiting high data rates).

During the coming year, EM Solutions is packaging this new antenna into a low profile Ka-band on-the-move terminal, suitable for land mobile or UAV applications. As EM Solutions manufactures its own BUCs, LNBs, and RF subsystems, the company has complete control over the RF and electronic features of the terminal, which will also be completely flat and thin.

The company's BUCs are already being used by major systems integrators around the world to work in an airborne atmosphere and offer multi-band communications.

A dry and rugged sunburnt country like Australia is a great proving ground for radio innovations. Adopted by the **Australian Border Force** and the **Royal Australian Navy**, EM Solutions' satellite terminals are increasingly being used for high reliability and mission critical applications around the world. Look south for more Firsts...

www.emsolutions.com.au/

Dr. Rowan Gilmore is CEO of EM Solutions, a Brisbane-based technology developer and producer of innovative microwave radio and on-the-move satellite radio products used in broadband communications networks. EM Solutions is the 2016 winner of the Brisbane Lord Mayor's Business Awards for Innovation, and its products are in use by customers as diverse as the New York Stock Exchange and the Royal Australian Navy.

He was previously CEO of the Australian Institute for Commercialization, where he helped numerous start-up companies and worked to accelerate technology transfer between research institutions and industry.

He has 35 years of experience in the ICT industry and spent more than a decade in the U.S. and later in Europe as Vice President of Network Services for the airline IT company SITA, now France Telecom's Orange subsidiary, and in Sydney with Telstra International.

Rowan graduated from the University of Queensland (UQ) and later earned his doctorate in electrical engineering at Washington University in St Louis, Missouri. He currently holds adjunct professorships in both the School of Business and the School of Information Technology and Electrical Engineering at UQ.

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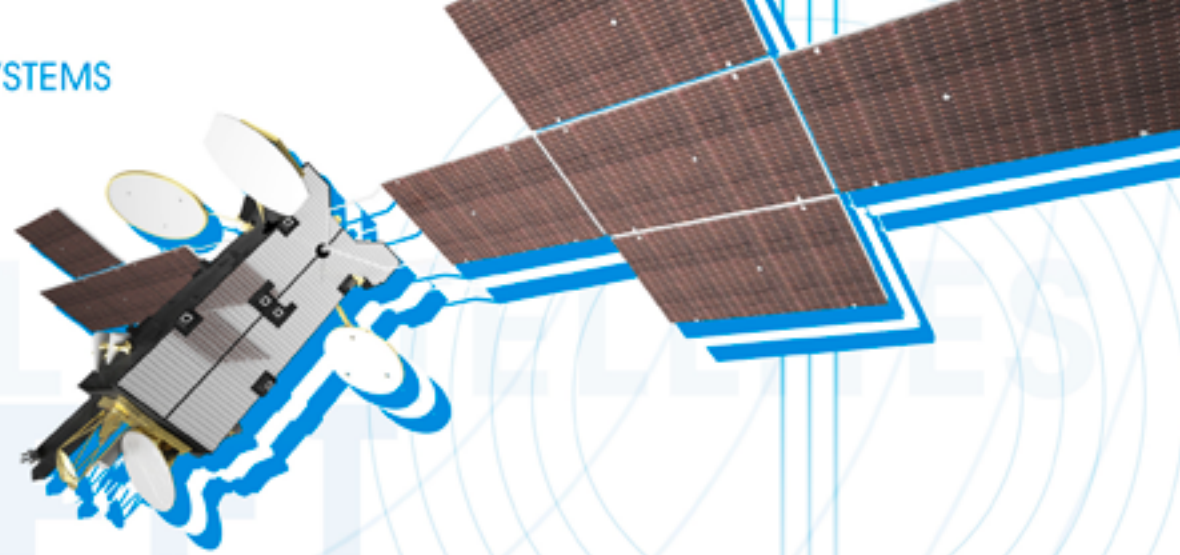

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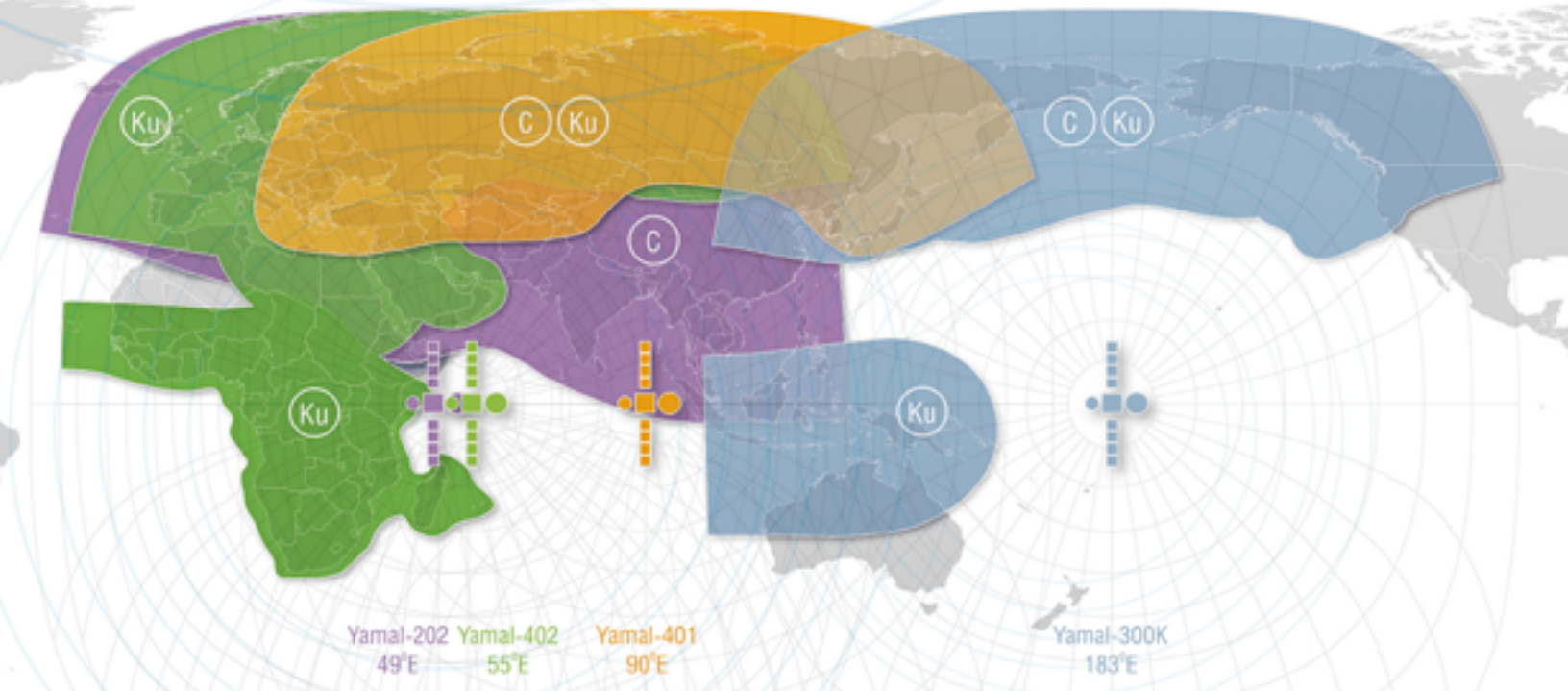

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Multi-Path Satellite Simulator

Simultaneously test two terminals with minimum satellite interaction

By Geoff Burling, Chief Executive Officer, AtlanTecRF

There has never been a better time to be talking about simulation of satellite transponders.

These high-flyers are incredibly expensive pieces of kit, not just to build, but also to launch and operate. While there is a strong and concerted effort to drive down the cost of low orbit vehicles and to provide alternative fixed geo-position platforms such as High Altitude Platforms (HAPs), still the majority of high data rate traffic is cornered by the multi-billion dollar geostationary 'birds' and using those for testing ground stations, of any size, cannot make any level of economic sense.

The current alternative of convenient-to-use, comparatively low-cost Satellite Simulators, pioneered by UK based AtlanTecRF, have therefore swiftly come into their own in just about every SATCOM application, from commercial satellite news gathering (SNG), through to in-flight internet connectivity to military secure communications. Having delivered many test systems to delighted operators of SNG vans and airliner antenna systems, AtlanTecRF has now turned its attention to the needs of the manufacturers of equipment where the program requires delivery of, likely portable, ground/mobile terminals as part of a civilian or defence related communications network.

Why is it necessary to go beyond the extensive range of Satellite Simulator products which AtlanTecRF has offered to date? The answer lies in the plural 'terminals' as the deliverable system. While it is clearly possible to carry out a simulated satellite test on an individual terminal, how much better to be able to prove the whole of the contract hardware with the minimum of real satellite interaction? The new MSS series of Multi-Path Satellite Simulators from AtlanTecRF provides such a possibility.

Figure 1 below shows the MSS Multi-Path Satellite Simulator set up. The system talks to two sets of ground equipment simultaneously, enabling the user to run extensive and prolonged tests without the need to go 'live' on a satellite. The entire network can therefore be set up to a deliverable state, and contract performance achieved in an extremely cost-effective manner.

Satellite Simulators in the AtlanTecRF MSS Series consist of three parts, a base control unit and two weatherproof transponders each of which can be orientated to connect with a system under test (SUT) antenna. There is also the option to incorporate all of the digital control within one transponder housing to achieve a two-part test system.

The base control unit is a convenient portable bench instrument with the capability of both local and remote, Ethernet control. This unit is connected to two mast-mounted transponders via a power and data cable. The two transponders are inter-connected, each capable of communicating with a fixed or mobile terminal in either X-, Ku-, DBS, Ka- or Q-bands (see ***Figure 2*** on the next page — the system shown is a Ka-band unit) and with the ability to vary the path attenuation, thereby reducing the real-world atmospheric effects.

Taking the uplink or Transmit (Tx) carrier from one ground-based system the MSS re-transmits on the receive (Rx) carrier frequency for the downlink. But, instead of sending the signal back to the same ground station from which it received it, the MSS makes contact with a second ground terminal, thereby completing the satellite link from point A to point B, but without any satellite being involved.

The AtlanTecRF MSS Series of Multi-Path Satellite Simulators accommodate the appropriate polarizations of the various carrier configurations with horizontal and vertical being the most favored in the Ku band and right and left-handed circular being the norm in Ka-band.

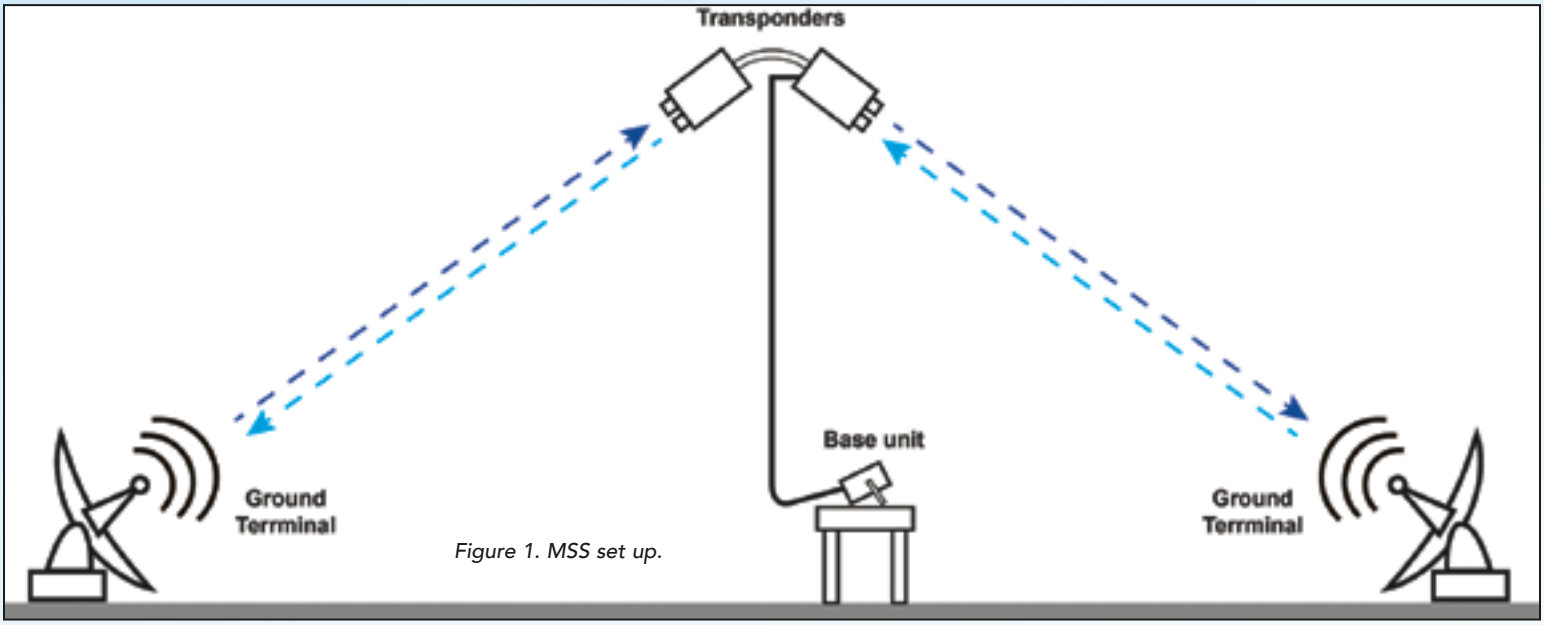


Figure 1. MSS set up.

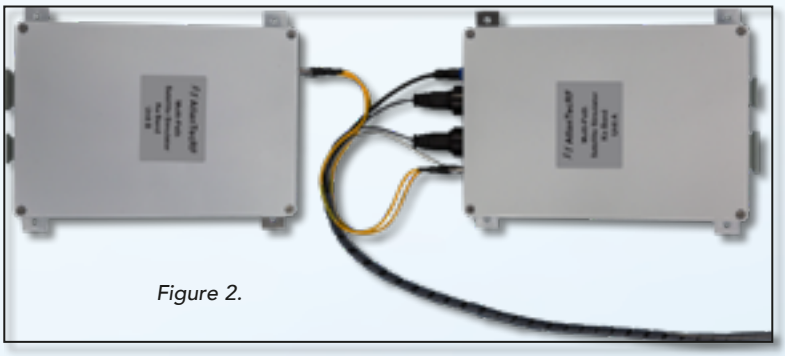


Figure 2.

Figure 3.

Internally, the Satellite Simulator takes on the architecture of a high-performance microwave frequency converter, which includes variable input attenuation to cater for the naturally varying Effective Isotropic Radiated Power (EIRP) levels experienced in a typical 44,000 mile round-trip satellite link through the earth's atmosphere. The other variable parameter is the local oscillator (LO) frequency, which is adjustable to ensure coverage of every likely satellite transponder turn-around to be experienced in the real world.

Control of the attenuation and frequency are achieved through AtlanTecRF's proprietary digital control technology (LTT ConnecT$^{TM)}$, which via Ethernet provides the user engineer with the choice of a GUI PC interface or remote programmed control for automated test schedules.

With such a Satellite Simulating Test System, the program provider can test multiple Tx and Rx paths over the full envelope of frequency regimes and gather data to verify the deliverable performance criteria in an incredibly effective and cost-effective way.

In addition to the pure issues of economics and speed there may also be other critical considerations in employing this off-air testing using the AtlanTecRF MSS range. If the projected use of the multi-location communications system is to carry either commercially or military confidential information, there is much to be gained by carrying out link path testing in a secure environment rather than in public on an open satellite transmission.

Why give your competitor or enemy the heads up on your encryption techniques before you need to send real and vital data?

Also by testing privately right across the available Ka-, Ku- and X-band spectrum there is no divulgence of the actual frequencies to be used and the operator, once again, stays ahead of the game.

The MSS Satellite Simulator Systems from AtlanTecRF are typically supplied as a two module set to enable pointing to each of a two-terminal communications link with waveguide horn antennas (see ***Figure 3***) of nominal 15dB gain each, whether of linear or circular polarization. The internal input attenuator is controllable in 0.5dB steps up to 60dB while the frequency range of the LO enables the whole of the standard operating bands to be explored.

The base conversion is selectable through options from -20dB to +10dB. Local oscillator frequency stability is determined by either a very high grade, low phase noise internal OCXO or from an input from the general system 10MHz reference.

Other optional features include phase shift and time delay, thereby further emulating the true and likely conditions to be encountered in the practical application.

As always with AtlanTecRF SATCOM RF Testing products ease of use is at the forefront of the design philosophy. No complex menu chains but rather a quick reacting set up and responsive controls.

Through extensive user experience, the value of the single path Satellite Simulator has already been established and documented and now its logical extension, the Multi-Path Simulator is set to achieve similar technical and economic milestones for a range of satellite communication manufacturers and operators in the ever demanding and competitive space sector.

AtlanTecRF specializes in providing SATCOM RF test equipment to the Military, Government and Commercial organizations. Its comprehensive range of equipment includes Loop Test Translators, Frequency Converters, Signal Generators, Noise Injection Translators, Noise Generators, Line Amplifiers and Satellite Simulators. Equipment covers bands L-, S-, C-, X-, Ku-, DBS, Ka- and Q-.

Atlantecrf.com/satellite_equipment.htm

Geoff Burling is AtlanTecRF's CEO. His role, to drive growth across all aspects of the business by bringing to market a range of new and high quality RF and microwave components, interconnects and equipment. Geoff sets the company's long-term business strategy and takes the lead in building customer relationships and developing employees. A passionate engineer, who uses his in depth knowledge and market expertise to ensure AtlanTecRF delivers the highest quality products, technical expertise and customer service demanded by today's engineers.

Editor's note: This article first appeared in ***Microwave Journal*** *and is re-published with that publication's and the author's permissions. The original article may be accessed at:* ***www.microwavejournal.com/articles/29711-multi-path-simulator-simultaneously-tests-two-satcom-links***

Perception Versus Reality...

Satellite-based cellular backhaul

By Doreet Oren, Product Marketing and Corporate Communications, Gilat Satellite Networks

Mobile network operators (MNOs) are rethinking their cellular backhaul strategies to meet a new set of performance and cost requirements. As mobile networks evolve, MNOs need to adapt their backhaul solutions to handle increased data usage and expand service availability.

Traditionally, the use of satellite communications for cellular backhaul was considered a last resort, due to bandwidth limitations and high costs. For these reasons, the satellite option was only used where terrestrial solutions such as fiber, next generation copper or microwave were either too expensive or unfeasible (*i.e.*, hard-to-reach areas such as islands, mountains and remote places).

Today, with technology advancements in both satellite capacity and ground segment equipment, traditional perceptions about satellite backhaul are quickly becoming obsolete. Satellite capacity is rising fast and bandwidth costs ($/Mbps/month) are declining fast. This means that thousands of cell sites can now be served economically by satellite, enabling MNOs to support a new set of use cases such as metro-edge coverage extension, urban network densification, roads and highway coverage, emergency response and network backup.

Debunking Three Common Misconceptions

While the business case for satellite backhaul has never been stronger, adoption is still hampered in some cases by MNOs' outdated view of satellite technology. Therefore, the major barrier to widespread deployment is simply a matter of perception. Often, decision makers are unaware of the recent improvements in satellite technology, which leads to apprehension about its suitability for cellular backhaul.

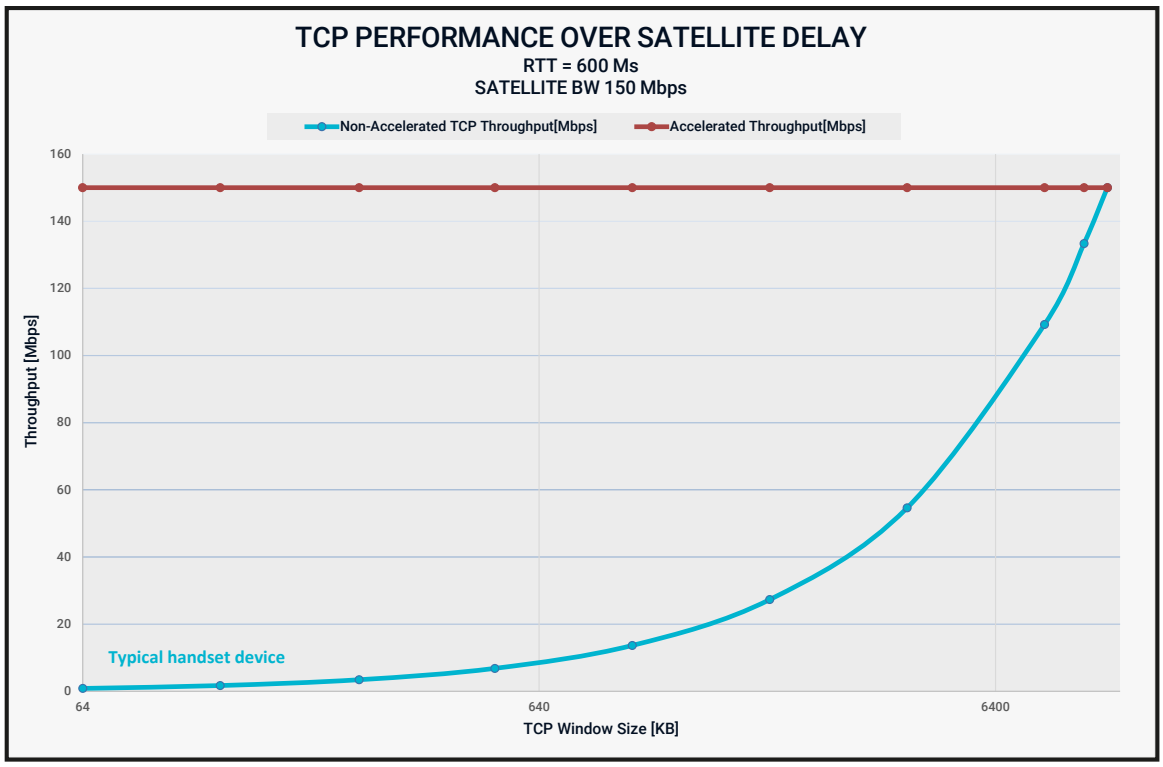
Let's take a closer look at three common misperceptions of satellite backhaul — performance (*i.e.*, latency), cost, and complexity — and let the facts speak for themselves.

Myth #1
Satellite Backhaul Cannot Support LTE Performance

Due to the inherent delay in satellite communication, some MNOs fear that this delay will result in poor backhaul performance and a less than satisfactory user experience. The facts show that satellite technology is now able to overcome this delay, and this has been proven in real-world satellite backhaul deployments. Patented acceleration technology mitigates latency effects

To overcome the inherent satellite delay, Gilat has developed an innovative application acceleration technology that mitigates latency. This patented technology enables true LTE speed by accelerating the high bandwidth application traffic inside the LTE GTP tunnel. This acceleration technique has been implemented in Gilat's VSAT system and is being used in LTE deployments to achieve carrier-grade performance.

The example shown here, based on a round-trip satellite delay of 600 ms and satellite bandwidth of 150 Mbps, illustrates how acceleration impacts the actual throughput to the handset over satellite. Without acceleration, we can see that the smaller the handset's TCP window size, the lower the throughput.



On the other hand, with Gilat's patented acceleration, users enjoy full utilization of the 150 Mbps bandwidth for any handset window size. Since most handsets today have TCP window sizes less than 500 KB, this means non-accelerated satellite performance would be lower than 10Mbps.

An integrated solution, in which the acceleration functionality is embedded into the VSAT rather than using an external card or box, can both reduce costs and give MNOs a single point of contact for all hardware and software issues. Ideally, the integrated solution should use a central network management system to maintain QoS and guarantee maximum traffic efficiency by eliminating sync delay between cards, which is critical for avoiding packet loss during fade conditions.

Terrestrial-grade LTE satellite backhaul is proven in the field

Softbank (Japan) and EE, a BT division (UK), are two excellent examples of Tier-1 MNOs that have achieved true LTE performance over satellite. Both of these MNOs use Gilat's Capricorn VSAT modem technology for cellular backhaul. Featuring a multi-core processor, protocol optimization and application acceleration techniques, Capricorn delivers market-leading LTE performance. In an Ookla SpeedTest, Gilat's LTE satellite backhaul solution reached throughput performance of nearly 150 Mbps of TCP traffic to the handset, or 200 Mbps of UDP traffic (connectivity).

Myth #2:
Satellite Capacity Is Expensive

In the past, satellite bandwidth costs often made satellite-based communications prohibitively expensive for MNOs offering broadband services. With the ever-increasing supply of HTS bandwidth, together with advancements in satellite technology, this is no longer the case.

Satellite capacity pricing rivals terrestrial bandwidth solutions in many cases

According to industry analysis and forecasts (*see graph*), HTS global supply is expected to grow by a factor of 16 by 2025, as many new high throughput satellites, including GEO, LEO and MEO satellites, are launched. At the same time, we can see that the GEO HTS Global demand is significantly less than the supply. In the past few years bandwidth prices were in freefall and this drop is expected to continue in the future, with the abundance of satellite capacity propelling satellite solutions into the mainstream.

Based on these trends, it is expected that the cost for satellite backhaul networks will match those of terrestrial backhaul networks for many use cases. In fact, in a recent report, research firm NSR singled out cellular backhaul as the key vertical expected to drive growth in the satellite communications market.

Bandwidth optimization can significantly reduce costs

LTE and 3G data traffic is asymmetrical — users download much more than they upload. In addition, traffic is bursty with a high peak to average ratio (often reaching 10:1). In light of these attributes, using a dedicated link or two-way symmetrical pipe often doesn't make economic sense for mobile broadband services.

Global network management reduces complexity and facilitates scalability

Using a global network management system (NMS) can streamline the provisioning, configuration, control and monitoring of all satellite hub elements, as well as remote terminals, regardless of their physical location. This type of system also helps to simplify service fulfillment at each cellular site, as well as enabling comprehensive service assurance, based on performance monitoring and usage reports.

For better cost efficiency, MNOs can and should adjust bandwidth according to usage. Leveraging the inherent point to multi-point nature of satellite communication, bandwidth sharing access schemes, such as Multi-Frequency Time-Division Multiple Access (MF-TDMA), are an ideal solution for data-intensive 3G and LTE networks.

The advantages of using MF-TDMA include: optimal bandwidth utilization; ensuring sufficient capacity to meet peak usage; and enabling better QoS by sharing bandwidth among cell towers and prioritizing bandwidth in the same cell for voice and data traffic.

Myth #3: Satellite Connectivity Is Too Complex

A third common misconception is that satellite technology is too complex for cellular backhaul networks. As MNOs are already fully tasked with their rapidly evolving mobile networks, they are typically reluctant to take on unfamiliar complexity related to satellite.

With today's technologies and tools, it is possible to remove most of the complexity surrounding the deployment, management and operations of satellite backhaul solutions.

Moreover, a universal NMS lets MNOs start small and add sites over time to accommodate network expansion, as well as supporting smooth integration with the Operational and Business Support System (OSS/BSS).

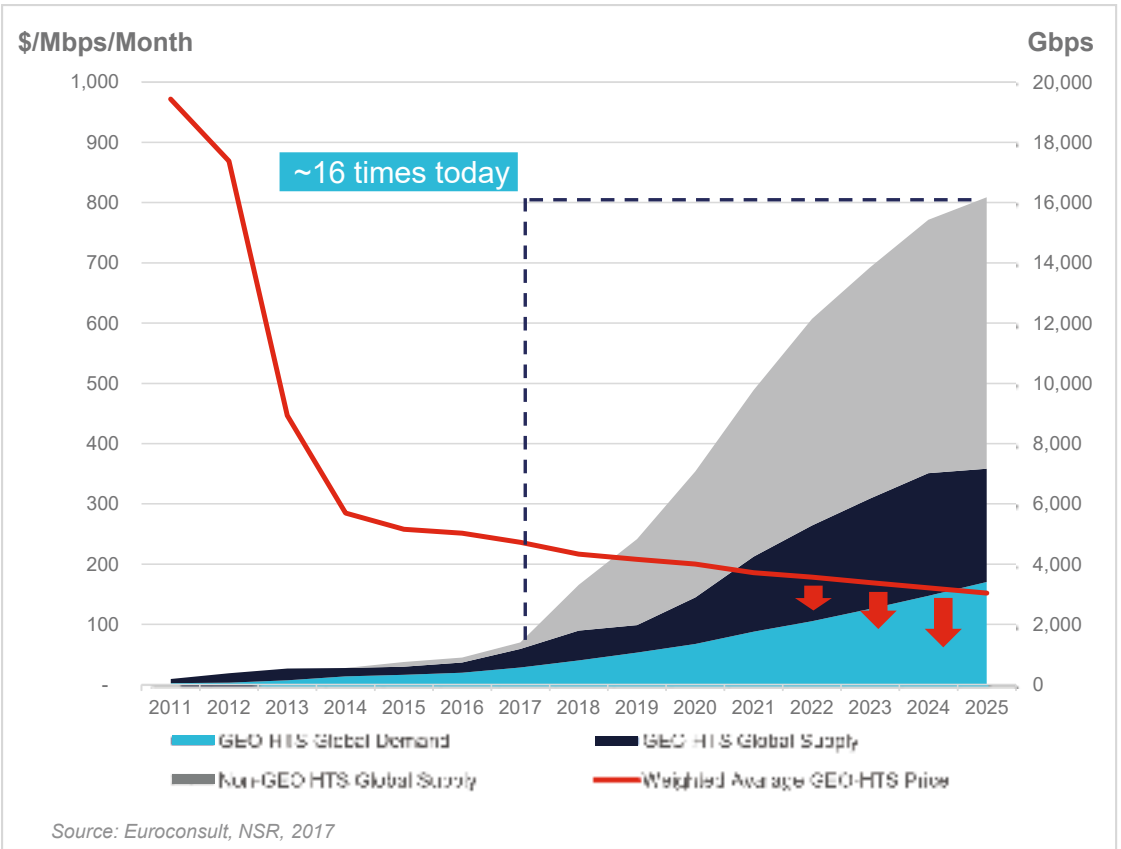
Layer 2 support facilitates satellite network integration

Satellite networks traditionally operate at Layer 3 (network layer), while MNO networks in some cases operate at Layer 2 (data link layer). This discrepancy can often lead to integration issues between the two types of networks.

However, there are carrier-grade satellite networks that can also operate at Layer 2. Using such a solution can simplify network operations by allowing the MNO to work with satellite backhaul in the same way it handles any other transport method. Layer 2 connectivity accommodates the use of existing MPLS/PPPoE protocols over satellite, while a transparent Layer 3 enables MNOs to maintain their existing IP network design and operational procedures.

GILAT ACCELERATION ENABLES 150 MBPS TO THE USER

GLOBAL HTS BANDWIDTH SUPPLY, DEMAND AND PRICE PER MBPS



Source: Euroconsult, NSR, 2017

"Black box" satellite backhaul using managed service option

By outsourcing the satellite backhaul operation to a satellite network provider, MNOs can free themselves from dealing with satellite-related issues altogether. Gilat is currently involved in several managed service projects, including Globe Telecom in the Philippines, T-Mobile and Sprint in the U.S., as well as others, where Gilat has taken full responsibility for the establishment and ongoing operations of the MNO's satellite backhaul network.

Using this model, each MNO specifies its requirements, service level agreement and key performance indicators, as well as the required site locations and schedule.

Once these requirements are defined, Gilat manages the complete satellite backhaul operation as a "black box" for the MNO, covering a wide range of activities — from satellite network design and capacity setup to onsite installation, 24x7 NOC and SLA management. The managed service model significantly reduces complexity for the MNO, allowing it to focus on its core competencies while leaving the intricacies of satellite backhaul for the satellite experts.

	MYTHS	FACTS
1	LTE performance cannot be met with satellite backhaul	Satellite technology now enables LTE speed, performance and terrestrial-grade user experience
2	Satellite connectivity is expensive	Today's satellite TCO rivals terrestrial solutions in many cases
3	Satellite backhaul is too complex	Comprehensive services simplify deployment, integration and operation

THE TRUTH ABOUT SATELLITE CELLULAR BACKHAUL

Satellite-Based Cellular Backhaul Is Going Mainstream

The facts show that today's satellite backhaul solutions are more than capable of supporting LTE performance as well as being economically viable. Rather than serving as a fallback option where terrestrial solutions are not feasible, satellite backhaul is rapidly transitioning into the preferred choice of leading MNOs worldwide across a diversity of use cases.

www.gilat.com

Doreet Oren (doreeto@gilat.com) is Director of Product Marketing and Corporate Communications for Gilat Satellite Networks. She has been in this role since 2012 and has been responsible for defining product positioning, messaging, go-to-market strategies, market research, and analyst relations.

Oren has more than 20 years of industry experience, and has held management positions in R&D, product management and product marketing, for international high-tech companies. In this capacity she contributed to next generation product definition and was responsible for delivering the company's vision to the media and analyst community.

Oren has published thought leadership articles in renowned international journals, and has spoken at numerous industry conferences worldwide. Oren received a BSc in Computer Science from George Washington University.

AsiaSat Insights

Gateway network rollout methods for a future VHTS system

This AsiaSat article presents some concepts on the VHTS gateway rollout scheme. The practical implementation of these concepts may be tied to specific satellite payload designs and the available space-ground segments control management system features.

With the advanced technology development in the multi-beam High Throughput Satellite (HTS) industry, the achievable capacity of a single HTS can be further enhanced to more than 500 Gbps and become a Very High Throughput Satellite (VHTS) system.

To realize such enhancement, the ground gateway system deployment must be carefully designed and implemented. In principle, the total amount of usable capacity of a VHTS is directly proportional to the total number of active gateways in the whole network.

When VHTS operators consider the actual business deployment, several challenges must be evaluated and addressed as below to ensure business sustainability and a timely profit:

- *User capacity demand over time and region*
- *Strategy of New network implementation versus Existing network migration and expansion*
- *Scalability for additional gateways*
- *Flexibility to increase system throughput*
- *Investment allocations*
- *Risk mitigations*
- *Service level opportunities (i.e. coverage area, data rate supported and gateway redundancy)*

Artistic impression of AsiaSat's satellite on orbit.

Figure 1 illustrates the scenario of deploying all active gateways from the beginning and deploying the gateways progressively to minimize the idle capacity. In this example, there is a huge amount of capacity wastage indicated by the shaded area over the years, if user demand ramp-ups are not properly considered. This is not a desirable situation in terms of investment, or in return and risks.

To address the aforementioned VHTS ground network deployment issues, this article presents some concepts on the VHTS gateway rollout scheme. The practical implementation of these concepts may be tied to specific satellite payload designs and the available space-ground segments control management system features.

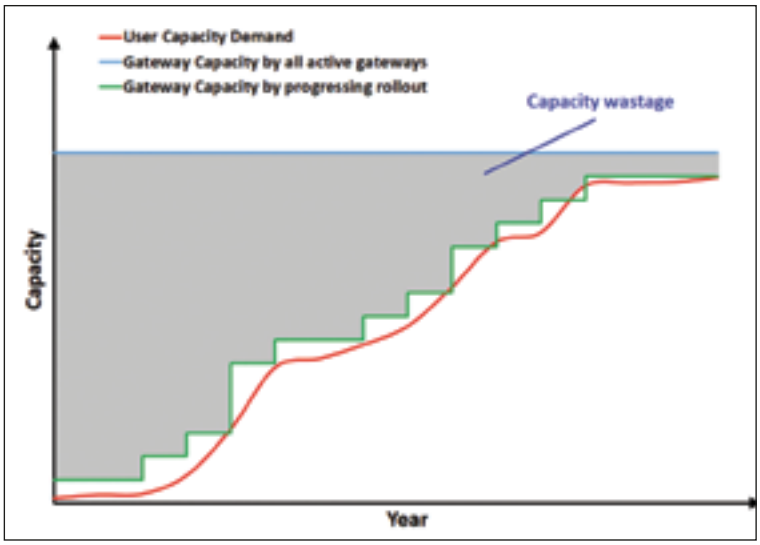


Figure 1. Illustration of capacity demand variation over a satellite mission life.

Gateway Network Rollout Methodologies

Frequency Domain Method

The frequency domain rollout can be demonstrated by the deployment of a 750 Gbps VHTS system. In this example, it is assumed the average spectral efficiency (SE) is 2 bps/Hz and at least 4 GHz gateway forward bandwidth as shown in *Figure 2*. The forward (FWD) to return (RTN) traffic ratio is assumed to be 2:1. Conventionally, the operator of this VHTS has to make available at least 64 gateways before the satellite launch, which would be a huge CAPEX investment.

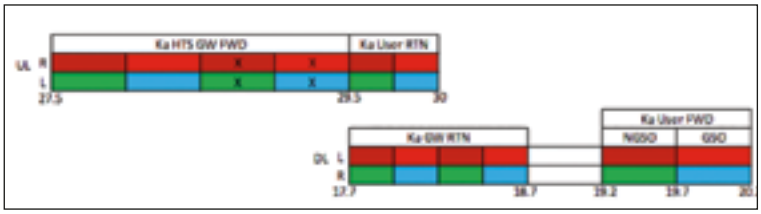


Figure 2. Frequency plan of a typical Ka HTS.

In order to minimize the initial investment of ground facility, progressive gateway rollout in frequency domain can be considered with properly designed satellite payload system. For instance, the 500 MHz user beam spectrum can be sub-divided into 4 by 125 MHz channels in each beam as shown in *Figure 3* in the next column.

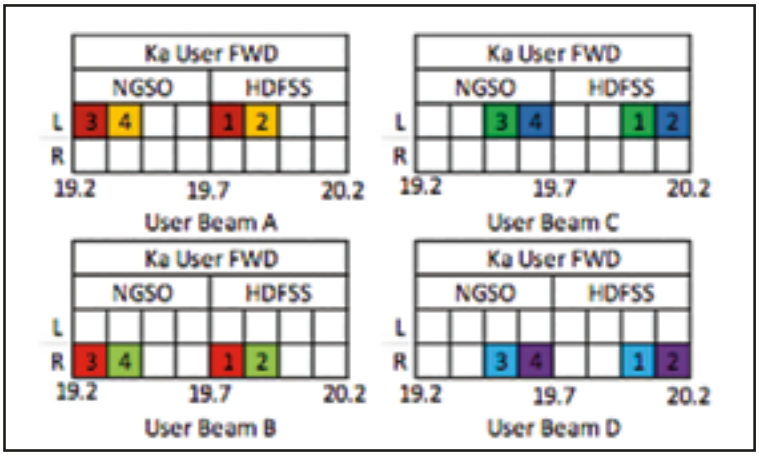


Figure 3. User beam frequency segmentation. The numbers in the cells indicate the gateway rollout phases.

These sub-channels can be rolled-out sequentially in four different phases. In the initial phase (phase 1), only 16 gateways stations are needed to provide full coverage, which is just one fourth of the total gateway facility CAPEX. In the followed three phases, the number of gateways will be gradually added. *Table 1* has illustrated this rollout plan for the 750 Gbps VHTS system.

Phase #	Added GW #	Added BW per user beam (MHz)	# of User beams per GW	Added capacity FWD + RTN (Gbps)
1	16	125	32	192
2	16	125	32	192
3	16	125	32	192
4	16	125	32	192
Total	64	500		768

Table 1. Frequency-domain gateway rollout plan for a 750Gbps VHTS system

The detailed frequency plans for each gateway rollout phase is illustrated in *Figure 4* on the next page. In phase 1, a total of 16 gateways are deployed to serve all 512 user beams. Each gateway serves eight sets of 4-color reused user beams. The capital letter in *Figure 4* indicates the frequency allocation of each set of 4-color reuse beams. Each user beam will have 125 MHz usable bandwidth which can provide one fourth of the total throughput capacity. The numbers in the user beam cells indicate the rollout phases. In the last phase, i.e. phase 4, each user beam will have a total of 500 MHz bandwidth fed by a total of 64 gateways.

This frequency domain rollout method can be realized by either an analog or a digital satellite payload system. In the analog payload implementation, filter banks or multiplexer banks can be used. In the digital payload implementation, an on-board digital channelizing processor can be used. *Figure 5*, also on the next page, illustrates the feasible satellite payload realizations.

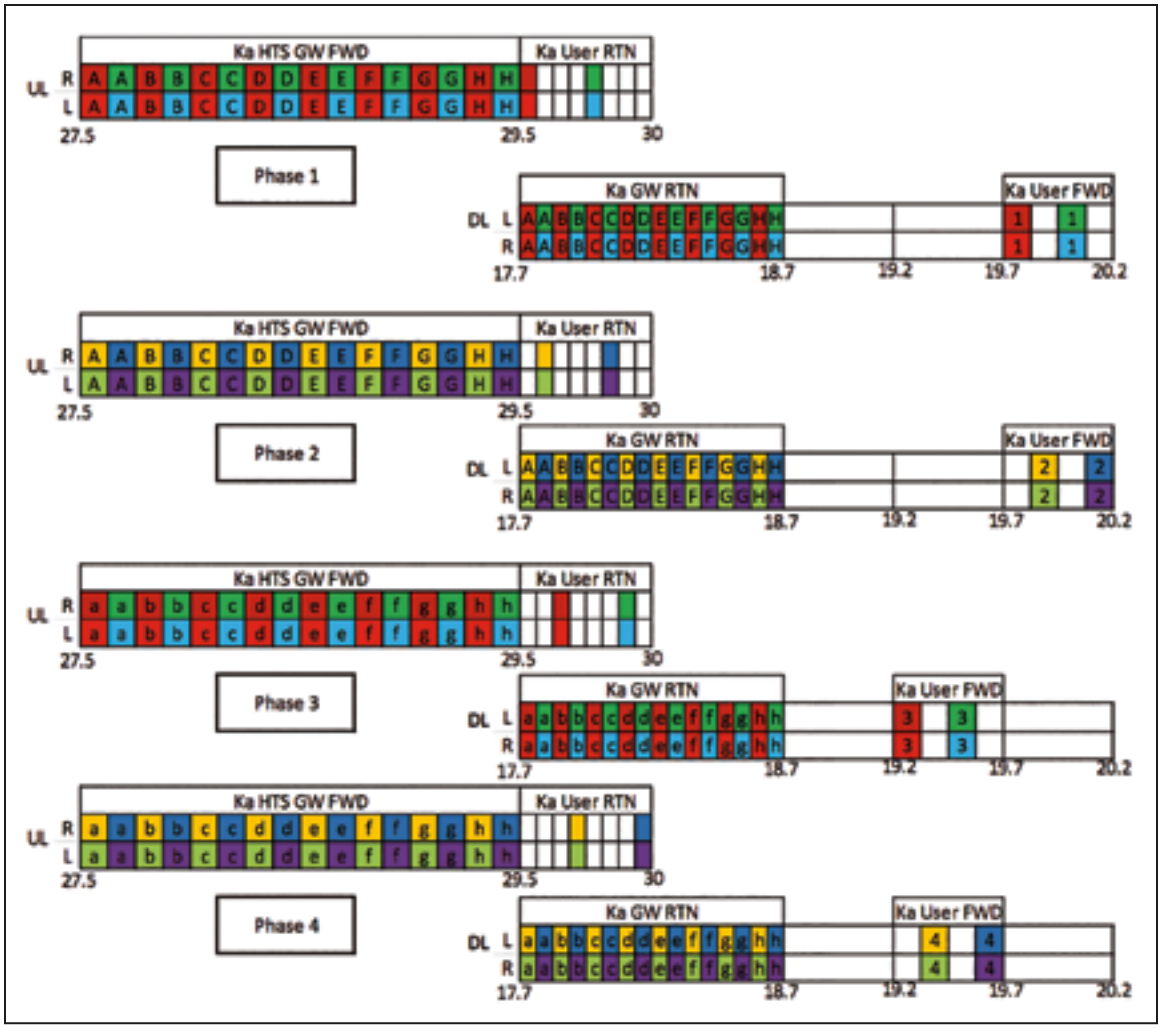


Figure 4. Frequency plans for the rollout of a 750 Gbps VHTS

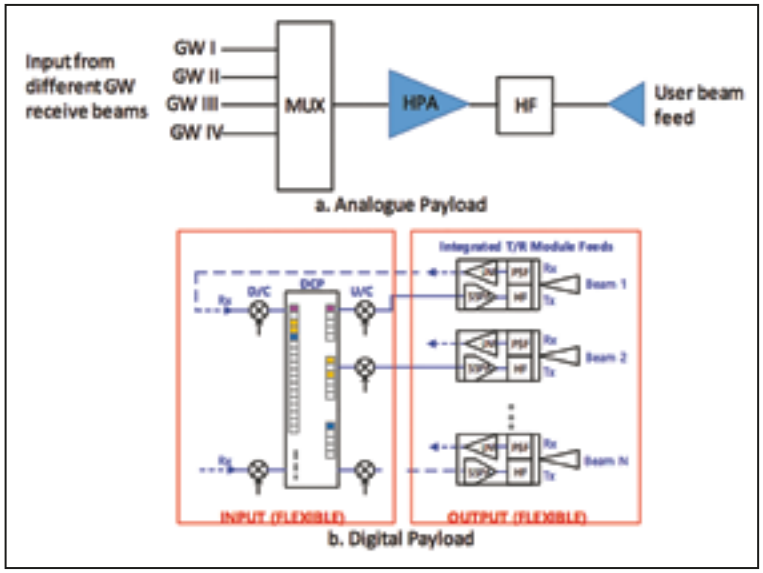


Figure 5. Example of analog and digital satellite payload design.

It has been shown that frequency segmentation provides a method of minimizing the initial investment of the gateway facility. However, due to the limited Ka gateway uplink frequency spectrum (2 GHz each on the two orthogonal polarizations as shown in ***Figure 2***), a significant number of Ka- band gateways have to be built eventually to support the high throughput target. To further minimize the total number of gateways, we can also deploy the VHTS by progressively migrating the gateway links to the even higher frequency bands such as Q (40 GHz) and V (50 GHz) bands. Thus, another 3-phase rollout example of a 750 Gbps VHTS is introduced below.

As shown in ***Table 2*** (below): At phase 1, only Ka-band spectrum is used for gateway links, which enables a full coverage of 256 user beams with a throughput of 192 Gbps. At phase 2, V band is used for gateway uplinks, providing an additional capacity of 210 Gbps.

At phase 3, gateway downlinks are switched to Q-band, which frees up to 2 GHz in Ka-band that can be used by the user beams, and thus another 360 Gbps can be added by the 12 new Q / V-band gateways. The phase 3 user beam forward spectrum is illustrated in ***Figure 6*** below. In this demonstration, the targeted 750 Gbps throughput is achieved by only 35 gateways, which is 45 percent less than that in the first example, where only Ka-band is used for the gateway and user links.

Phase#	GW FWD		User FWD		Added GW #	# of User beams per GW	Added capacity, FWD + RTN (Gbps)
	Band	BW (MHz)	Band	BW (MHz)			
1	Ka	2000	Ka	250	16	16	192
2	V	5000	Ka	250	7	40	210
3	V	5000	Ka	500	12	20	360
				Total	35		762

Table 2. Q/V band gateway rollout implementation of a 750 Gbps VHTS

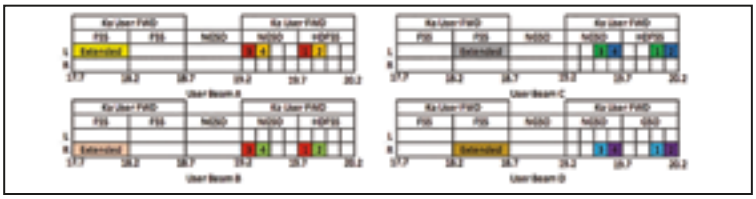


Figure 6. Frequency plan of Ka User FWD beam utilizing Ka gateway downlink spectrum.

This progressive rollout method can be further extended with user beams using V and Q-bands, with the gateway links moved to optical spectrum. A multi-band user beam antenna system can also be adopted in the VHTS. With proper optimization on the feeds and the reflectors, the spot beams of different bands can

be seamlessly overlaid on the same geographical area with similar or different beam widths [1]. By using this method, as shown in *Figure 7*, the VHTS operator can firstly rollout the Ku- user spot beam capacity and then 5 to 10 years later progressively move on to Ka- and Q-band user beams in accordance with the traffic needs and the maturity of the ground user terminals. Correspondingly, the operators and users can deploy their gateways and terminal facilities on a step-by-step and frequency band-by-band basis to save unnecessary CAPEX costs until the future demand arrives.

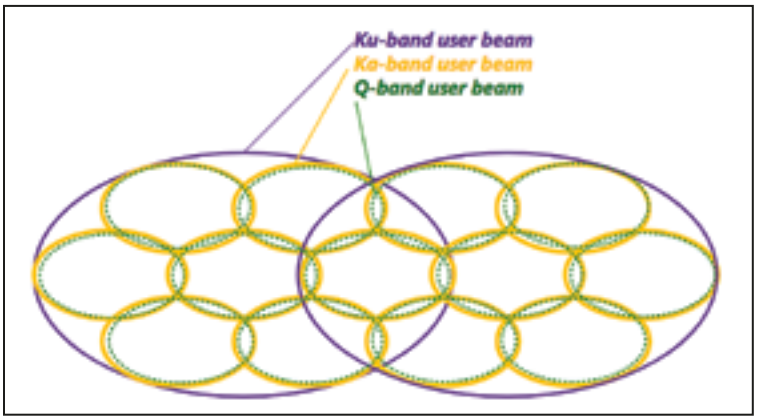


Figure 7. Example of VHTS progress rollout in a band-by-band basis

Spatial Domain Method

To adapt the flexibility and scalability for adding gateways in the network, the implementation of beamwidth control can be considered. For example, Beamforming is a well-known technology by integrating different elements in an antenna phased array in such a way that forming signals with constructive or destructive interference to control both the antenna gain and pattern. This technology is considered by the industry an essential element for next generation HTS and is commonly as displayed on the product roadmap. When it is applied to a HTS system, the beam size of each spot beam can be adjusted selectively. The typical spot beam antenna gain patterns with different beamwidths can be referred to *Figure 8*.

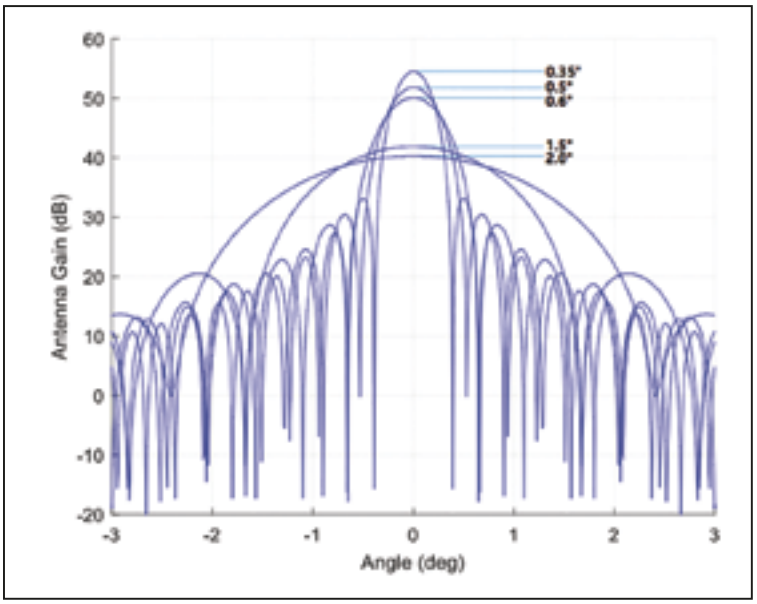


Figure 8. Antenna gain and pattern vs different antenna beamwidth

Smaller beamwidth can provide more focused beam and hence higher gain. Within the same desired coverage area, more number of beams can be implemented by reducing the beam size in the beam layout. As a result, the aggregate throughput can be increased accordingly. Using this concept can help the gateway rollout in multiple stages when the capacity demand ramps up. For example, at the beginning of life, the beamforming adjusts the beams to a relatively larger size when the demand is minimum. When the demand starts to grow, more active gateways can be set up to serve additional capacity. These additional gateways can be located and accommodated through a smaller beamwidth with the beamforming adjustment. As a result, the ground network capability can be enhanced dynamically until reaching the maximum level in the design.

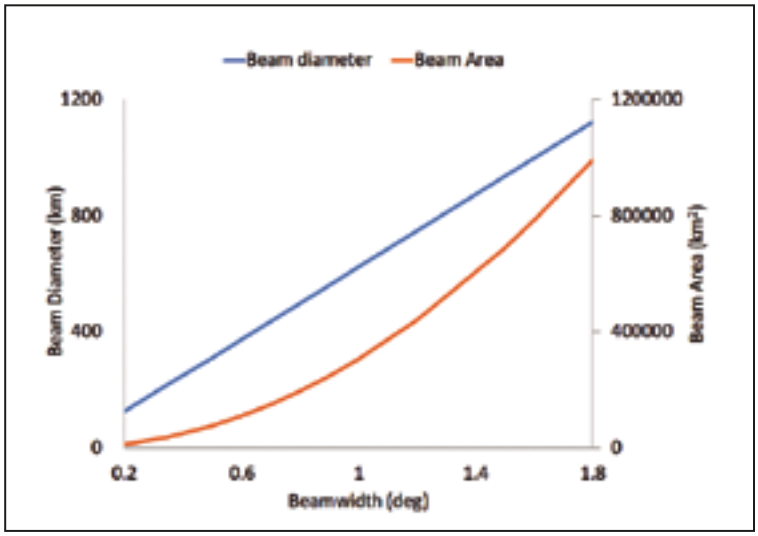


Figure 9. Spot Beam diameter and area vs beamwidth, referenced to the beams close to Nadir

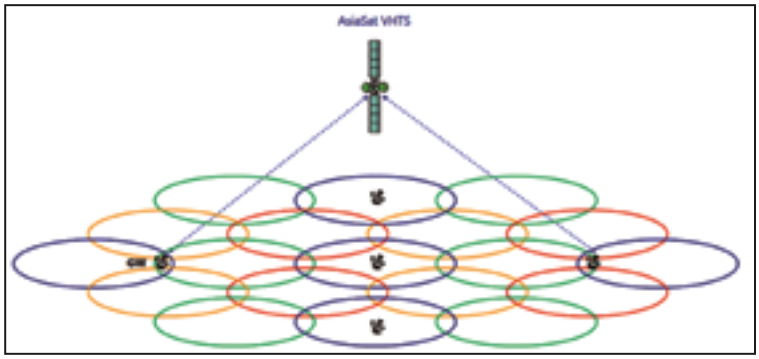


Figure 10. Beam layout with larger beamwidth; smaller number of beams and active gateways.

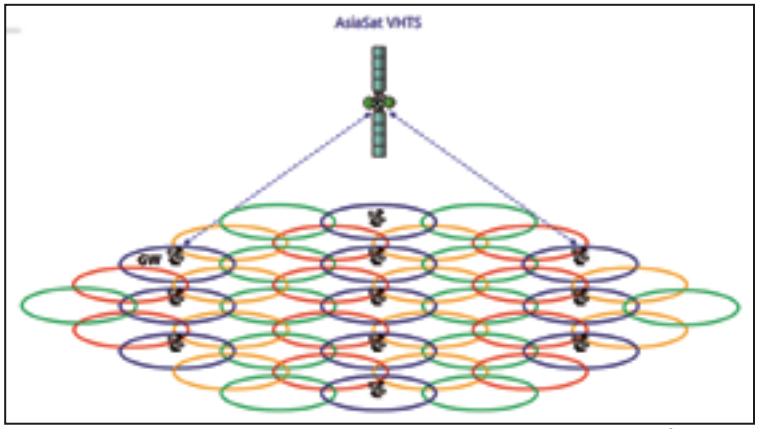


Figure 11. Beam layout with smaller beamwidth; larger number of beams with additional active gateways.

Time Domain Method

The HTS capacity rollout can also be efficiently realized by a time domain method thanks to the on-board digital channelizing processor (DCP). A DCP digitizes and channelizes the incoming signal and processes it in digital domain. The DCP multi-cast function is to be exploited in the rollout campaign.

The initial state of the HTS rollout is shown in *Figure 12 (a)*, where one single TDM (Time-Division Multiplexing) carrier is uplinked from the only gateway station. This carrier is then duplicated and multi-cast by the DCP to all user downlink spot beams in different RF frequencies and polarizations (i.e. multi-color reuses). The user terminals (UTs) in different beams will lock the carrier and extract only the designated data stream. The time domain data stream lengths can vary for different beams to meet the different levels of demands.

In the expansion phase, two schemes can be implemented. The first one is to expand the gateway spectrum. As is illustrated in *Figure 12 (b)*, four carriers are uplinked from the gateway and then multi-cast to all user beams. Consequently, more TDM data streams are added for the user beams and the total throughput of the system is quadrupled. To generalize the implementation of this scheme, the gateway spectrum may not be limited to conventional Ku- and Ka-bands, but higher frequency bands like Q- and V-bands and even optical links can be exploited. The merit of this scheme is that only one or few gateways are needed to feed the whole HTS system.

The second scheme is to expand the number of gateways. With sufficiently spatial isolations, the additional gateways can fully reuse the whole gateway spectrum, adding more TDM data stream capacity to increase the HTS system throughput. This scheme is illustrated in *Figure 12 (c)*, where eight carriers are uplinked by two gateways, where the capacity would be eight times of the initial state. With the increased number of gateways, the merit of this scheme is the relaxed requirement on each individual gateway (RF and baseband equipment) which can reduce the total cost of the system.

The time-domain rollout scheme must be supported and controlled by the ground network management system, so that the traffic between gateways and user beams can be maintained in the expansion phase.

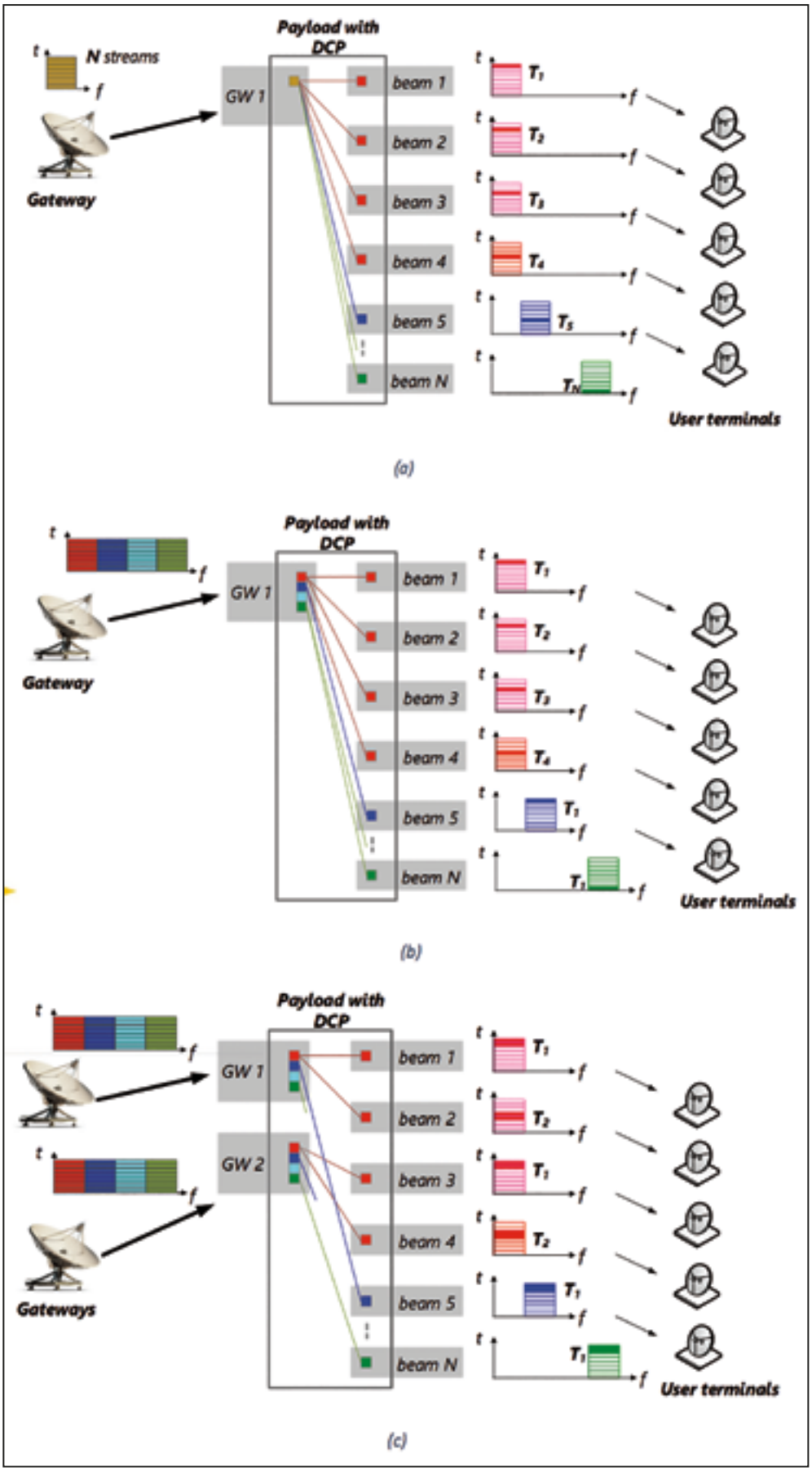


Figure 12 Time-domain HTS gateway rollout scheme, (a) the initial state, and capacity expansion by expanding (b) Gateway spectrum (frequency domain), and (c) number of gateways (spatial domain). The vertical and horizontal axes in the above figures are the time (t) and the frequency (f), respectively.

Beam-Hopping Method

The beam-hopping method, which is a frequency, time and spatial domains combined reuse method, can also be used in HTS deployment and gateway rollout. The beam hopping HTS communication payload can realize the required flexibility with full analog RF components, but the cost is a more complicated ground-satellite system.

The beam-hopping HTS gateway rollout scheme is illustrated in ***Figure 13***. In the initial state, the gateway uplinks one single carrier to the satellite payload. However, unlike the TDM HTS system, the carrier will not be received by all beams at the same time. Instead, it will be switched (or "hopped") in between user beams in a predefined sequence and duty cycles. By controlling the dwelling time lengths and intervals, the throughput demand from each beam can be correspondingly met. Full spectrum can be used in each user beam to increase the capacity.

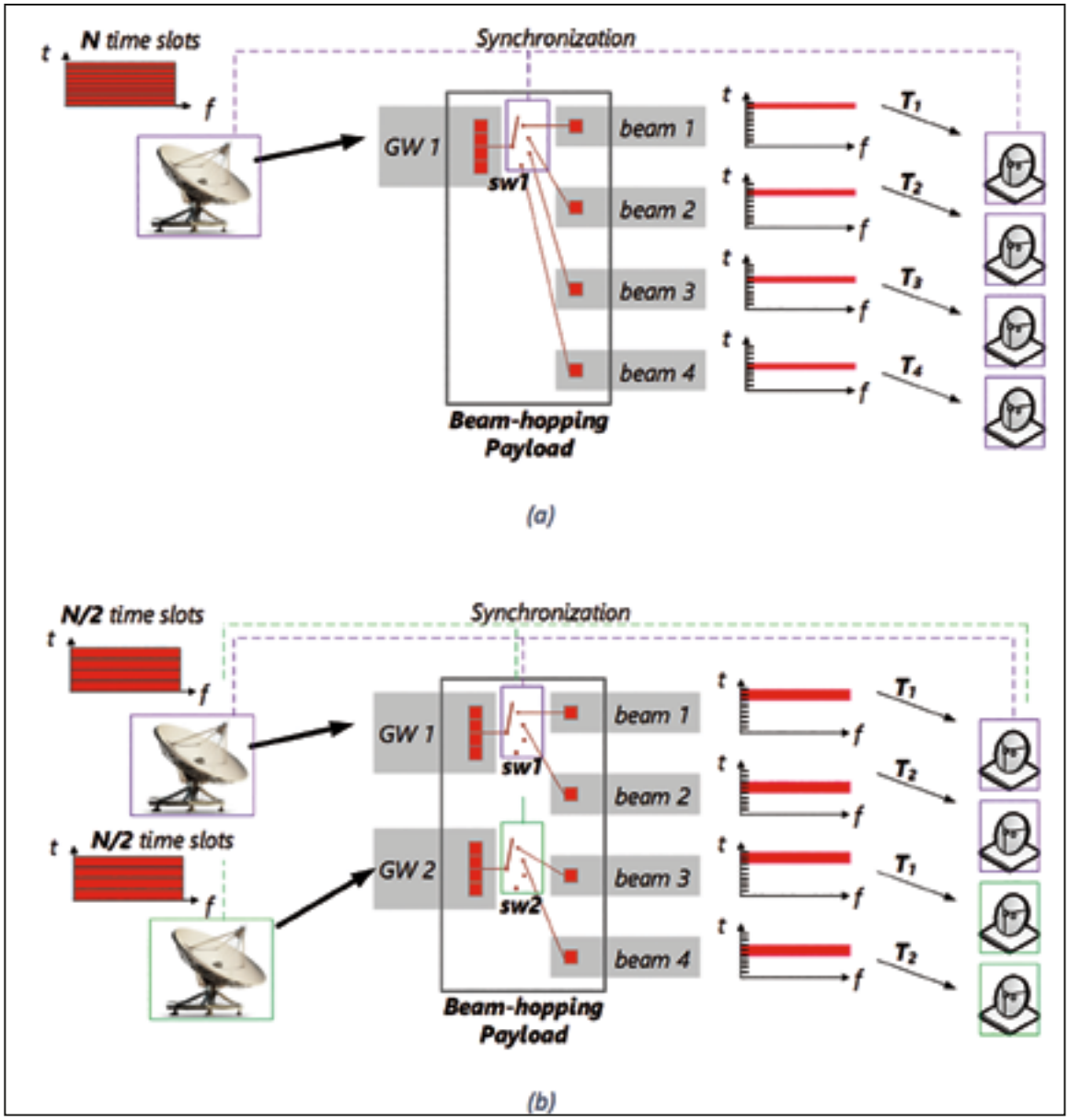


Figure 13 Beam-hopping HTS gateway rollout scheme, (a) the initial state, and (b) capacity expansion with more than one gateways.

To ensure the user downlinks keep pace with the gateway uplinks, the actuation of the on-board output switches (*e.g.*, sw1 in ***Figure 13 (a)***) must be synchronized with the gateway transmission as well as the user beam receiving time patterns. This implies that a new and complex payload-gateway-user terminal control and management system must be established with stringent timing and synchronization requirement. The existing DVB-S2X standard has an optional feature of super-frame structure that supports the implementation of HTS beam hopping [2], which can be adopted by the HTS equipment manufacturers as well as the HTS operators.

To expand the capacity of the beam-hopping HTS system, more than one gateway can be employed, as shown in ***Figure 13 (b)***, where each gateway serves a portion of all user beams. To reduce the inter-beam interference, the beam hopping sequences for each gateway can be optimized so that no adjacent beams are dwelled at the same time. The conventional frequency/polarization color reuse scheme can also be adopted for different user beams so that each gateway can dwell more than one user beam at the same time and reduce the time interval between two consecutive dwellings on the same beam.

Conclusion

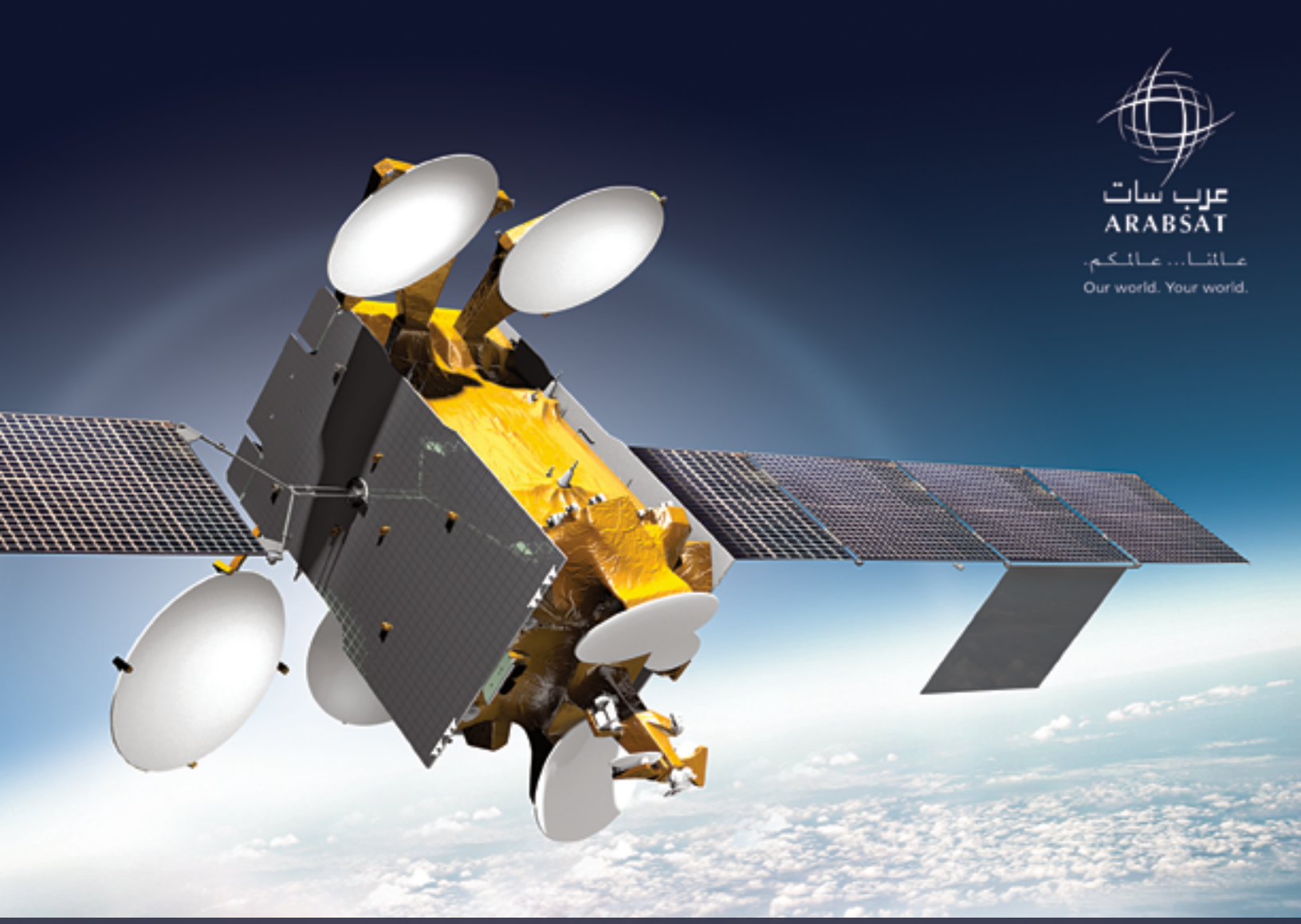
Gateway rollout planning is critical to enhance the efficiency of HTS/VHTS business economics as well as provide a high quality user experience. This article has discussed several ideas of gateway rollout in the aspects of frequency, time and spatial domain to adapt different scenarios. AsiaSat is excited by the great potential of HTS development in the market, and we are committed to delivering optimal solutions for the different needs of our customers. By working with our customers, partners and suppliers, we believe we can reach further by serving next generation HTS services to the Asia Pacific region.

www.asiasat.com

References

[1] AsiaSat, "Dual-band communication satellite system and method". Submitted to USPTO at 2016.

[2] ETSI, "Digital Video Broadcasting (DVB) second generation framing structure channel coding and modulation systems for Broadcasting Interactive Services News Gathering and other broadband satellite applications Part 2: S2-Extensions (DVB-S2X)", Annex E.1, p100, Draft ETSI EN 302 307-2, v1.1.1, Oct, 2014.



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Community WiFi

WiFi hotspots with satellite backhaul

By Vinay Patel, Senior Product Line Director, Hughes Network Systems

According to the latest Internet World stats (*www.internetworldstats.com/*), more than four billion people are now online, representing more than half of the world's population — yet, there remains a huge disparity in penetration between the well-served developed regions, which are approaching 100 percent, and the billions of people living in rural and even ex-urban areas with limited or no access to broadband internet.

The Problem: Cost and Affordability

There are two primary and well documented obstacles to building out infrastructure for expanding broadband Internet access.

First, capital costs of terrestrial fixed or wireless networks are directly proportional to distance and hence are a major barrier to operators seeking to justify expansion outside of urban and higher traffic density environments.

Second, the typical business model for deploying broadband to communities with a lower median income base ultimately equates to an unaffordable service as subscription revenue has to exceed the expansion investments.

According to the ITU, broadband internet is considered affordable when it costs the user less than 5 percent of their monthly income. By this measurement, roughly 3.5 billion people — more than half the global population — currently do not have access to affordable internet. Compounding this issue, many of the unconnected communities are located in rural and remote areas, which may not have any access to broadband internet, let alone affordable access.

Recognizing its social and economic importance, governments are evaluating various initiatives to bring affordable Internet access to all of their citizens, often through subsidized voucher programs, while progressive Internet Service Providers (ISPs) and technology providers are rising to the challenge by exploring innovative approaches to make it affordable.

Addressing Affordability with a Cost-Sharing Approach

In urban areas, internet connectivity is usually provided by a high-speed cable or fiber direct to each home or business.

However, a single user per terminal model is simply not justifiable in areas unserved or underserved by terrestrial access. Community WiFi is one emerging method proving to be successful in bridging this so-called digital divide and bringing Internet to places where it is either not available or unaffordable for the local people. But though deploying WiFi access points makes the last mile affordable, it still requires a broadband backbone to carry traffic to and from the internet connection point. Plus, the cost of using terrestrial backhaul such as fiber or cable is directly proportional to distance, making it increasingly unjustifiable the further the reach from urban centers.

Enter High-Throughput Satellite (HTS) backhaul –the only cost-justified method to connect WiFi access points to the internet in areas unserved by terrestrial broadband, and for which cost of satellite capacity is uniformly the same no matter the distance to the internet core.

In this approach, a shared, high capacity very-small-aperture terminal (VSAT) can be readily configured to the traffic requirements of a local community of WiFi users, whether on their handhelds or laptops, enabling operators to cost-effectively expand their networks to make Internet accessible and affordable to the unserved — and sometimes ignored — market segments, while also attaining profitability.

The service offerings for users are flexible and can be configured for the number and type of WiFi users, and can be for occasional use, pre-paid use or even on a monthly subscription-based plan. The key underlying principal is that this is a cost-share model; by splitting the cost between dozens of users, the cost-per-user price decreases substantially with corresponding budget-friendly plans for local markets.

In terms of implementation, this model is especially attractive to governments with the objective of providing Internet access to an entire country's population on a relatively short timeline and without massive cost implications. Given the wide coverage areas, satellites have the power to cover an entire country, overcoming the distance and terrain barriers faced when expanding terrestrial service.

The community of Altegrosky with community WiFi in eastern Russia.

This shared VSAT model is ideal for local service providers seeking to expand services to areas with smaller populations that also generally have lower per capita income.

Key Considerations

When an ISP or a government entity seeks to bring access to an unconnected population using the community WiFi model, they should start by considering the following aspects of the project:

Throughput: The terminal should have sufficient capacity to carry traffic of up to several 100s of Mbps, thereby adequately serving a pool of customers with download rates of typically at least 10Mbps, and within a typical 500 meter WiFi reach.

Power Use: ISPs should look for a system offering the most throughput using the least amount of power, since standby power generators are typically the norm in these areas.

Provider Value: Back-end support systems and billing mechanisms are essential to manage individual subscribers within the shared WiFi cloud; this may mean employing a local payment system such as an ATM, with cash and debit options to meet the needs of potential subscribers.

KB Iskra: A Successful Case

A working case in point of a successful community WiFi model is KB Iskra's implementation in rural areas of eastern Russia.

KB Iskra provides high-powered WiFi access points to create a mile-wide cloud covering an entire population of a remote town or village with high-speed Internet access. Typically, each VSAT supports 20 to 30 subscribers, each paying on average 50 percent less each month than individuals with home based service in urban areas, thanks to the cost-sharing model.

The company has installed more than 600 such shared VSATs, and now provides affordable service to almost 20,000 regular WiFi users who would have otherwise remained unconnected.

As innovative ISPs like KB Iskra partner with technology and service providers, new business models such as Community WiFi are emerging to bring affordable broadband Internet connectivity to people everywhere.

Together, we can power a connected future and close the digital divide to the benefit of all.

www.hughes.com

The author, Vinay Patel, is the Senior Product Line Director for Hughes Network Systems

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Big Bucks in BUCs

Mobility drives SATCOM terminal design

By Steve Richeson, Vice President, Sales & Marketing, Mission Microwave Technologies, LLC

If there is a single theme that has driven growth in the satellite industry over the past several years, it would be mobility.

Satellite terminals need to be mobile for airborne, maritime, vehicular and tactical applications — and even if the terminals are not mobile, they often need to be able to support satellites that are not "fixed" but moving in a low or medium orbit. Whether it is the antenna platform that is moving, or the satellites themselves, the net result reduces to the same requirement: rapid and automated pointing and tracking.

Top: Mission Microwave's Flatpack BUCs
Top: Ku- , Bottom: Ka-

Not only antennas are changing shape...

Mobile or rapidly moving antennas and man-portable platforms require Size, Weight and Power (SWaP) to be optimized. It is obviously easier to move and track a lightweight antenna system, and mobile applications have limited power and thermal budgets that demand efficient energy utilization. This is true regardless of the shape of the antenna; terminals using flat panels, parabolic antennas and conformably shaped antennas all need to be efficient in terms of their SWaP footprint.

When we look at a complete mobile or portable satellite terminal, we see it is made up of four major subsystems: the antenna/pointing mechanism, the baseband equipment (modem/router) and the RF (Radio frequency) components — the BUC (Block Up Converter) and LNB (Low Noise Block downconverter). At Mission Microwave we make Solid State BUCs and SSPAs. This paper explains the rationale behind the market opportunity for BUCs and why the BUC remains a center of value in the evolving ground terminal market.

Antennas Get the Attention

The antenna is the most visible aspect of a satellite terminal — hence, it usually gets the most attention.

The past five years have seen amazing plans for smaller, lighter antennas for commercial and military mobile terminals. There are even new industry acronyms for Flat Panel Antennas (FPAs) and Electronically Steered Antennas (ESAs) in the jargon.

Some of these advances really are breakthroughs and others are just hype. Hype is good — it brings attention and analysis to the market and ultimately brings visibility to the companies that actually do offer value to the market. A number of advances have been noted in materials, devices and design that promise drastically to reduce the manufacturing cost of the antenna and pointing mechanism from tens of thousands of dollars to hundreds of dollars (in volume). These new antenna technologies are appealing and they make the satellite terminal look materially different. The antenna can be extremely low profile, which has obvious benefits when mounted on top of an airplane or a tactical vehicle; or the antenna can be easier to install on a home or office as they point themselves (without actually moving) and there is very little wind loading from a flat surface.

Some of the architectures use an array of many small active elements — they do not even need a BUC. Obviously, we view those with a good deal of self-serving skepticism. In any case — as any satellite engineer will tell you — "*there is no substitute for aperture.*"

Flat antennas tend to be a good deal less efficient than traditional parabolic antennas — and therefore require physically larger sizes to get the directivity they need. They don't need much gain per se in a LEO environment but — when you're planning on having thousands of satellites in orbit — directivity (beam width) starts to matter and there is no substitute for aperture. The end result is really big, yet attractively shaped, antennas to provide the same service as smaller, traditional antennas.

Small affordable antennas have a niche in many mobile applications where even a small amount of connectivity is a vast improvement over essentially zero connectivity today. These small, sometimes referred to as "disadvantaged" terminals, rely on using more satellite bandwidth and sophisticated modems and RF processing to make up the difference for their small apertures.

There is a lot of action in the antenna side of the business, and overall there is a tremendous amount of investment being made to reduce the price point for the antenna component of a satellite terminal, which is being driven by the volume of mobile applications and the introduction of new technologies and architectures.

Modems Do the Math

The baseband or data processing equipment is typically referred to as the "modem" or "Satellite Router." These boxes have become smaller, less expensive and bring much faster performance than their predecessors. The signal processing math in these things is amazing — they manage (2-way!) megabits or gigabits per second and cost less than a television set. Highly integrated chip designs incorporating the latest DVB-S2X waveforms are re-defining the performance expectations of satellite links to the point that they are competitive and often even better than terrestrial alternatives. The signal processing capability of the modems can help make up for the smaller effective aperture in a flat panel antenna system. Modem and baseband equipment cost have dropped rapidly while performance continues to increase. The baseband equipment

follows a predictable "silicon" cost curve — increasing performance/ decreasing cost.

RF Parts Quietly Evolve

The RF equipment in the satellite terminals has two major and very different components — both involve amplifying and frequency converting signals.

The LNB is a Low Noise Block Downconverter combined with a Low Noise Amplifier. In the early days of satellite communications these were hard to come by and very expensive. Amplifying signals without adding (much) noise is tough and used to require cryogenic technology. Thanks to advances in semiconductor technology driven by the very large consumer markets for receive only terminals — such as Direct to Home (DTH) TV — the cost and reliability of these devices has improved by orders of magnitude. They literally cost a few dollars, but some links will require LNBs that cost ten times that — still cheap.

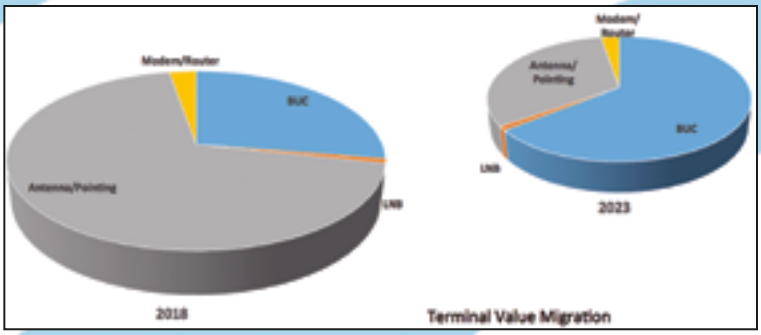
More Bang for the BUC

The other RF component is the BUC — Block Up Converter and Power Amplifier. In a mobile satellite terminal the BUC takes the signal from the modulator (the transmit side of the modem) and boosts it from under a milliwatt to several watts or several hundreds of watts. Changing the frequency of a signal and making it a million times more powerful without distorting it is hard to accomplish.

LNB's do this with receive signals at very low power levels, but receivers in mobile terminals are largely unregulated because they really can't hurt anything else if they are poorly implemented. There are understandably a lot of regulations on how to build a transmit terminal to avoid creating interference to the adjacent satellites or frequencies. Higher performing modems require better "linearity" to support higher order modulation signals schemes. Newer satellite bands, like the 30 GHz Ka-band, require higher frequencies and higher power levels to overcome rain fade. These BUCs are the high value component in the remote mobile terminal.

At Mission Microwave, the value thesis is that BUC retains an (increasingly) large value in SATCOM terminals even as the baseband and antenna portions undergo more rapid price reductions. To paraphrase Willie Sutton – "*That's where the money is.*" BUCs and RF Power amplifiers have evolved considerably over the last decade. Exotic compound semiconductors like Gallium Nitride (GaN) have become commonplace — yet still difficult to work with in volume. The size, weight and efficiency of solid state amplifiers have changed drastically.

This reduction in SWaP enables new designs. For example, Mission Microwave's Flatpack amplifiers produce 12 watts in Ka-band or 25 Watts in Ku-band in a 28 ounce and 1 inch thick package that can be built directly into a flat terminal. Even today a leading Ka-band BUC will weigh in at twice that and a typical one will be 4 times the weight and twice the volume. At Ku-band, the differences can be even greater. While BUCs do benefit from economies of scale they follow a very different cost and performance curve than traditional electronics. They are not silicon-based and they do not have the very high volumes associated with DTH LNBs. BUCs are typically based on solid-state electronics using compound semiconductors like Gallium Arsenide (GaAs) or Gallium Nitride (GaN). This stuff comes from a more limited and completely different supply chain



Terminal Value Migration

than Silicon semiconductors and the skill base to work in these technologies is extremely limited. BUCs will get cheaper — but not as quickly as the other elements in the terminals.

Here's why: There are constraints on available cost reductions due to the supply-side limitations (design skills and production capability) while new low cost / high performance baseband equipment is increasing demand and simultaneously requiring higher RF power and higher frequencies with "cleaner" output performance.

The growing mobility market requires the lowest SWaP that can be delivered. So we have a trifecta for finding value — limited supply capabilities, increasingly challenging and constrained performance requirements, and growing demand. Mission Microwave and its industry competitors have recognized this value opportunity and are working to bring the required performance improvements to enable new mobile terminals and support high-throughput waveforms while reducing cost. Even so, the BUC will remain the high value component in satellite communications terminals for several years as antenna and modem prices continue to decline at a much faster rate.

Value Distribution Changes Over Time

The next time you see a mobile or portable satellite terminal look at the BUC — that's where the money is — and it is a fundamental design choice that separates the good terminals from the poorer ones.

Mission Microwave focuses on BUCs and RF design; we support customers who have developed decades of value and experience in sophisticated satellite terminal design. As the next decade progresses and satellite network terminal architectures continue to evolve BUC manufacturers will meet the need for reliable low SWaP, highly mobile RF products. The value metrics for the market support continued investment and innovation and create opportunities for those who can bring these needed skills and expertise to the market.

www.missionmicrowave.com/

Author Steve Richeson joined the company in 2017 and is responsible for sales and marketing. He has 30 years of Satellite and Radio Frequency (RF) experience in engineering and sales leadership roles at Advantech Wireless, Exelis Inc., Harris Corporation, EchoStar, Scientific-Atlanta, GTE Spacenet International, SATCOM Technologies and Schlumberger. Steve is a Senior Member of the IEEE and a Registered Professional Engineer. He earned his engineering degree at Georgia Tech and an MBA at Georgia State University.

Executive Spotlight

Christopher Richins, Co-Founder and Chief Executive Officer, RBC Signals

Christopher Richins is the co-founder and CEO of RBC Signals, a multi-national company providing flexible global communication services to commercial satellite operators.

The company leverages the excess capacity of existing, strategically located global assets to provide real-time, high-bandwidth and low latency data delivery and data processing services. According to the company, RBC Signals is the only provider using a sharing economy business model delivering affordability, flexibility, and speed-to-service.

Richins began his career as an RF Communications Engineer at Sea Launch, where he supported multiple satellite launch campaigns from the ship-based equatorial launch site. After business school, he completed an internship with SpaceX before joining Bain & Company as a management consultant. Post Bain, Richins held management roles at Arkyd Astronautics (Planetary Resources), Space Angels Network, Expedia, and Applause.

Richins earned an MBA from the Darden Graduate School of Business at the University of Virginia as a Jefferson Fellow, a master's degree in Astronautics from the University of Southern California, and a bachelor's degree in Electrical Engineering from Brigham Young University.

Thanks for taking the time to "chat" with us, Mr. Richins. First, a good idea would be to inform our readers as to your background and how you became interested in this industry.

Christopher Richins (CR)
My story is a bit unusual as I started in business and later became an engineer in order to be a better business leader. I was just three semesters from graduating with a business degree when I heard about Sea Launch and

thought it was the coolest place to work ever! The idea of running a multi-national space company like Sea Launch captured my mind. I was willing to do anything to work there and literally called them on the phone and asked what they needed.

When they responded that they needed RF engineers, I changed my major that same day to electrical engineering and I've never looked back. Subsequently, I earned a BS in Electrical Engineering, an MS in Astronautics, and an MBA all in pursuit of my dream of leading a multinational space company.

You have a wealth of expertise and initiated your career with an internship at SpaceX and moved into RF comms with Sea Launch. Could you tell us about your experience at both companies and what those positions provided you for your following successes?

CR
My professional career actually started with an internship at Sea Launch. It took me three-and-a-half years after making that first call to Sea Launch to finally graduate with my engineering degree. I tried every year during that time to get an internship, and every year they turned me down. Undeterred, I kept pursuing my dream and did everything I could to prepare myself for the job I wanted with them. Finally, during the last summer before graduation, they welcomed me as an intern and I was ready! It was no surprise I was also invited to return to the company upon graduation. This process taught me patience and reinforced the value of hard work that I was raised with.

My time as a full-time engineer with Sea Launch set the stage for subsequent success. While there, I was fortunate to be mentored by some great people like Rod Saylor (Blue Origin) and John Garvey (Vector Space). The lessons they taught me in those formative years have benefited me throughout my life. I absolutely loved my time at Sea Launch, and my trips to the equatorial launch site are definitely highlights of my career. It was the team that made the job so special.

Later on, after graduation from the UVA Darden MBA program in 2009, the great recession provided me with a unique opportunity to gain some experience at another great company, SpaceX. My full-time consulting job offer with Bain & Company had been deferred for six months, so I reached out to Rob Peckham, who was the VP of Sales for SpaceX at the time. He had been the President of Sea Launch, and remembered me from our time together there.

I was fortunate he agreed to let me join the company for the summer in support of the sales team. It was a significant change to work on the business side rather than the engineering side of a launch company. It was also an exciting time to be at SpaceX. I built some great relationships and I appreciate the time I was able to spend there.

Why did you co-found RBC Signals and who partnered with you to create the company?

CR
I founded RBC Signals to provide a communications service that was required, however missing, in the commercial space industry. LEO satellites are difficult to communicate with because they are only in line of sight of a single communication terminal for a few minutes per day. For small commercial space companies this poses a significant challenge to overcome, especially if their mission requires low latency or high bandwidth communications. I recognized a market demand for an affordable, flexible, simple service providing global communications capability between Earth and space. I incubated the idea for three years before starting the company, as I waited for the market to mature to the point of supporting such a business. I invited my co-founders Olga Gershenzon and Stacy King to join the company, and while they are no longer active in RBC Signals, I'm grateful for their contributions and pleased they remain shareholders.

What gap in the space communications sector is RBC Signals looking to fill and what product offerings are making headway in these competitive market segments?

CR
Today there is a real lack of options for LEO satellite operators who need to move data between space and the ground. In particular, the cost and complexity of managing these services globally present a significant challenge to most satellite operators. RBC Signals makes it simple for these operators to access the infrastructure, expertise, and regulatory support they need to achieve mission (and commercial) success. We fill this gap with global communication infrastructure offered as a pay-as-you-go service with the ability to meet the individual requirements of each customer. Our services are flexible, cost effective and tailored to our customer's needs — something that's difficult for larger providers to deliver.

How does the RBC Signals business model differ from the firm's competitors?

CR
The primary difference between RBC Signals and our competitors is flexibility in the scope of services, benefits and customization that we provide. Rather than forcing a client to conform to a rigid technical or commercial framework, we are able to work collaboratively with the customer to provide solutions that fit their needs. Not everyone can afford "failure is not an option" service levels when they are flying test and demonstration missions. We provide cost effective service levels that match the budgets and technical requirements of our customers as they mature their operations. The service levels and areas of operation we offer can increase with our customer requirements.

Our ability to provide this level of flexibility at incredible speed, while keeping costs low is a key differentiator. We also enjoy partnering in our customer's success by making recommendations on how to best utilize the large number of antennas in our network. In doing so, we help to maximize the revenue generation of our clients' spacecraft, at prices that meet their commercial requirements. These are real selling points for commercial operators.

Who is your typical customer and what type of services do they offer with their LEO constellations?

CR
Our typical customer is a commercial operator with satellites in LEO. There is a wide range of different applications that our customers support. We are specifically well suited to serve operators whose applications generate large amounts of data and require low latency

services. Earth observation and satellite communications spacecraft are two key applications that fall into this category.

Your company's infosite states the firm's global ground station network provides access to more than 30 antennas, with expansion in the works. Additionally, your ground station network offers "infrastructure-as-a-service" — please explain the tagline and inform us as to the antenna access.

CR
The RBC Signals global ground station network now includes more than 44 antennas in more than 30 locations around the world. These represent a mix of antennas owned by RBC Signals and our partner stations. We offer "core" services, which provide guaranteed access anytime from a single antenna, just as if the customer owned it, as well as "network" services based on the unused capacity of our shared partner antennas.

The beauty of our offering is that satellite operators can take advantage of this global network of LEO tracking antennas, with one simple contract and technical interface. This means that satellite customers can "pay-as-they-go" for the services the use across the network, without having to bear the CAPEX burden and complexity that comes with building and operating a global ground station network of their own. Our customers use the network, and pay a simple subscription fee each month for the services they consume.

What are the most common challenges that your customers face in today's environment?

CR
A common challenge our early stage customers face is the lack of a systems engineering function in the organization. The importance of this role cannot be overstated as it provides a broader perspective to look across the entire mission. This holistic point of view is the basis for good decision making from both a technical and a business perspective, taking all systems into consideration at once. Without commercially-minded systems engineering, seemingly insignificant design choices in one area of the system design can have major negative consequences on operations and profitability over the course of a mission.

Another common challenge I'll address is bridging the extended time gap between starting a space company and having a fully deployed service in operation. Bringing a satellite constellation into service is a long process and companies must find creative ways to demonstrate progress and generate revenue ahead of having a final product in orbit.

I'm highly skeptical of companies that don't have a path to near term revenue, or that require investment of many millions before demonstrating customer value. Companies need to find a way to monetize the path of technical development required to bring their product to market!

In addition to your in-place global ground station network, will RBC Signals build its own ground stations in the future?

CR
Yes and, in fact, we have started — we now have two ground stations owned and operated by RBC Signals and will be expanding that with several antenna additions around the world in 2018.

What, in your opinion, are the major challenges facing the SATCOM and satellite industries today?

CR
In my opinion, regulation and commercialization are two of the major challenges facing the LEO satellite industry today. As access to space by commercial companies grows, the challenges of how to manage this growth in a sustainable way must be addressed through cooperation between industry and governments. There are inevitable growing pains as the speed of innovation collides with the inherently slower realities of bureaucracy. However, I'm pleased to see industry groups such as the Commercial Smallsat Spectrum Management Association (CSSMA) partnering with regulators around the world to find workable solutions, and there is more work to be done across the board.

On the topic of commercialization, we have only just scratched the surface of the potential for space-based technologies to materially improve life on Earth. The more the satellite industry is able to articulate, demonstrate, and facilitate the adoption of space-enabled services, the faster demand for these services will grow. I'm pleased to see more commercially-minded technologists bringing solutions to the table, rather than merely developing technologies looking for a problem to solve.

Looking back at your career, when you consider all of the projects and programs you have been involved with, which ones bring a true sense of satisfaction to you?

CR
The work I am doing now at RBC Signals brings me the greatest sense of satisfaction. As fun and exciting that the different roles in my career have been, I feel the RBC Signals' mission to "improve life on Earth by providing affordable access to real-time data from space" has the greatest potential to impact the world in a positive way.

I'm proud of what the RBC Signals team has accomplished thus far, and look forward to continuing to support the growth of the satellite industry and the realization of the benefits the industry can offer the world.

rbcsignals.com/

Orbcomm AIS = Tracking Assistance

Data assists fisheries' global footprint

By Asif Rehman, Product Marketing Manager, Orbcomm

According to the Food and Agriculture Organization of the United Nations (FAO), there are approximately 38 million fisherman or fish farmers in the world, and fishing and aquaculture provide direct and indirect employment to over 500 million people the world over. In fact, fishing is the most widespread means by which humans harvest natural resources.

Given the importance of fishing to the global economy, the better this sector is understood, the better we can ensure the resource is available for future generations.

This is an objective of a paper by Global Fishing Watch, in collaboration with their research partners, entitled "***Tracking the Global Footprint in Fisheries***," which was recently published in *Science* magazine.

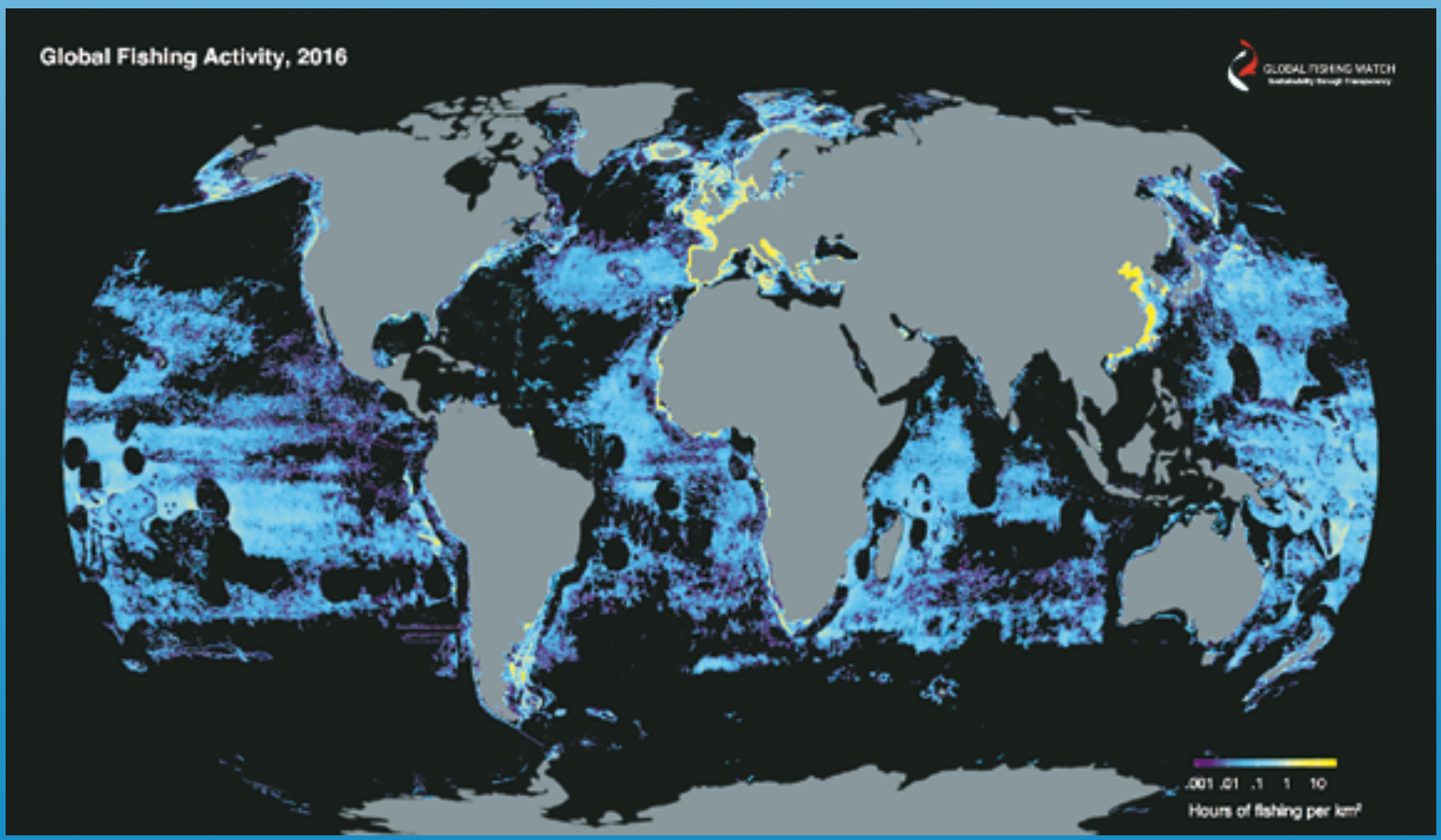
The paper analyzed billions AIS messages provided by Orbcomm to develop insights into the global fishing industry. Global Fishing Watch and their partners took advantage of new technology and creative use of data sources to identify more than 70,000 commercial fishing vessels.

Additionally, data was collected regarding the sizes of and engine powers of these vessels, what type of fishing they engaged in, and where and when they fished down to the hour and kilometer.

This new global view of fishing takes advantage of advances in satellite technology and big data processing and opens a new window to improved ocean and fishery management.

New research by Global Fishing Watch (***globalfishingwatch.org***), aided by Orbcomm AIS data, reveals when and where fishing occurs on a global scale for the first time, expanding opportunities for marine conservation and ocean management.

The research revealed that fishing extends to a least 55% of the ocean, which is four times more than the surface area taken up by surface agriculture. The results also suggest that fishing activity is more closely tied to cultural and political events, like holidays and fishing regulations, than naturally-occurring events, like El Niño or fish migrations.



Fishing activity by vessels broadcasting AIS. Fishing hotspots were seen in the Northeast Atlantic and the Mediterranean, Northwest Pacific, and in upwelling regions off South America and West Africa. Boundaries or 'holes' in effort show where different regulations apply, e.g., the exclusive economic zones of islands states. ***Source: "Tracking the global footprint of fisheries," Kroodsma el al, 2018.***

In China, there is a significant decline in fishing during the annual fishing moratorium and the Chinese New Year. In the northern hemisphere, fishing activity declines over the weekend and breaks for Christmas. Interestingly, significant regions of the ocean are not heavily fished, and these areas may offer opportunities for low-cost marine conservation, creating 'buffer zones' which conservationists say help marine species to regenerate.

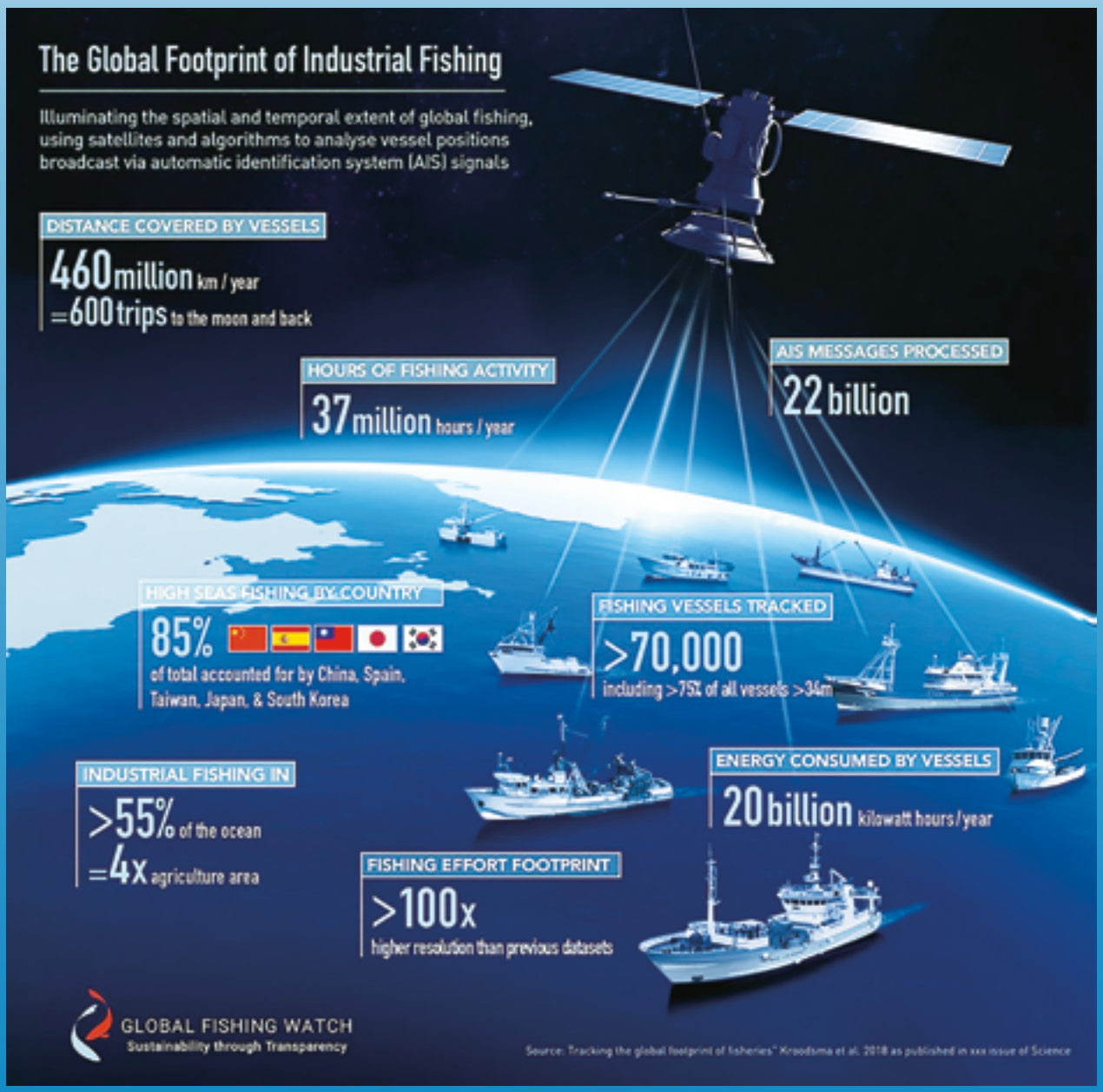
The data used to create this report and power the Global Fishing Watch fishing activity map is now available for download via the *Global Fishing Watch Research Accelerator Program* ***(globalfishingwatch.org/research/research-accelerator-program/).*** The researchers hope that this data provides the tools for scientists, advocates, governments, journalists and citizens to better understand and therefore better protect their oceans.

Orbcomm was selected by Global Fishing Watch (and its creators, the partnership between Google Oceans, Skytruth and Oceana) to be its launch partner for satellite AIS data services in part for the data quality and rich historical data archive, as well as for the flexibility in providing AIS data for use by the public to illuminate the problem of IUU Fishing to the world.

Collaborations between partners such as ORBCOMM and Global Fishing Watch show how technology and data can be used to achieve unexpected results, and how taking a new or unusual look at the data at hand can uncover remarkable findings.

Additional information is available at
http://www2.orbcomm.com/ais-data

Asif Rehman is a Product Marketing Manager at ORBCOMM responsible for driving marketing initiatives for the transportation, heavy equipment, and maritime markets. He is a passionate B2B product marketer and his experience stretches from large multi-nationals to start-ups to mid-sized businesses and across technology sectors



A Mobile Satellite Users Association Leadership Interview

with Dave Kagan, President and COO, Globalstar

By Catherine Melquist, President, MSUA

Catherine Melquist (CM)

I've seen a lot of recent news and activity featuring Globalstar….from press releases to conference speakers to Facebook posts. Globalstar feels like a hub of new energy, like you're going through some sort of Renaissance. Am I right about this and if so, what's going on?

Dave Kagan (DK)

We are going through a rejuvenation of our business mainly because of the explosive growth of IoT opportunities. What we're seeing is the demand for more and more "IoT-sized" data solutions where we have the perfect constellation and end-user devices to provide appropriately priced service plans and user devices.

The Globalstar team is running full throttle and we will launch at least four new products by the end of 2018. We have command of our cost structure, we're focused on our mission and, as you can see from our operating results, we are delivering on our promises.

CM

What is your role in all of this? And, how has your background in the satellite industry led you to this point?

DK

Jay Monroe is the CEO and I'm running the day-to-day sales, marketing and operations as the president and COO. I'm very fortunate to have held a broad spectrum of positions in my 21 years in the satellite industry.

Prior to joining the satellite industry, I worked for Norwegian Cruise Line for 10 years as the VP of Finance & Treasurer and we were one of Maritime Telecommunications Network's (MTN) first customers. I went on to become the CEO of MTN for 12 years, which as you know, was one of the most successful niche satellite service providers delivering FSS services to the world's leading cruise companies, U.S. government, as well as the demanding super-yacht owners.

I later went on to become the CEO of Globe Wireless (sold to Inmarsat) which provided me with the opportunity to gain an understanding of MSS business models.

My short tenures at both ITC Global (sold to Panasonic) and Speedcast also provided me with great experience in the energy market, which is now paying dividends for Globalstar. Altogether my past experiences have led me to assume my current position at Globalstar.

CM

Thinking broadly about trends in the mobile connectivity space (e.g. influx of new LEO systems, new terminal innovations, the rise in data analytics and cyber security firms, etc.), what changes do you feel will make the greatest impact on the future mobile connectivity business and what do these changes mean to Globalstar?

DK

I believe we're seeing a convergence of the FSS and MSS business models, as well as GEO and LEO solutions. All categories of satellite systems/solutions have their place in the market and we're able to provide absolute mobility very economically which none of the other major market players do because of their architectures, higher frequency spectrum bands or both.

At Globalstar, we always consider the end customer and their applications first and foremost. We will not simply design satellites to be the biggest, fastest or the cheapest, just because the technology exists. We consider what problems we are trying to solve for the ultimate customer, the cost and therefore the marketability of the user terminal, implications of the gateway equipment/operations and cost matrix in order to deliver an effective solution that drives return on investment for our shareholders. Based on the current activity in the market I'm not so sure that all the new LEO entrants agree with my holistic philosophy.

CM

What's in your immediate plan for developing the satellite mobility market?

DK

Clearly it is IoT opportunities and cost effective 2-way communication solutions. We believe that the company's 2-way messaging device, duplex satellite hot spot as well as our solar simplex data device will drive incredible growth for us into the future. We're very excited about the market opportunities going forward.

CM

As Globalstar continues to iterate its business, what technology or service innovations will or are helping you to do this?

DK

We're seeing the decreasing size and cost of end-user devices enabling us to address markets that were otherwise unreachable. Software and hardware technology developments will of course continue to drive innovation and we plan to continuously evolve our products to take advantage of such innovation. In addition to products mentioned previously we will be launching solar animal tracking devices, wearables, and two-way data/tracking devices in the coming months.

CM

Is there anything happening in an adjacent market (e.g. telecom, energy, etc.) that's of interest to the Globalstar business?

DK

I think this question really goes back to the explosive demand for more and more IoT driven data. The automotive industry is clearly investing billions of dollars in its autonomous car initiatives.

I recently attended the CES show in Las Vegas and I would guess in excess of 30 percent of that exhibition was focused on the "connected car". This is one of the reasons why we just announced our connected car initiative, Globalstar Automotive, as we believe that we can play a significant role in improving the accuracy of GPS signals, as well as in the safety and emergency services area.

We also believe we can play a meaningful role in the Over the Air (OTA) software updates to vehicles as well. As far our safety services aspirations on vehicles, one must realize that nearly 6,000 rescues have been initiated due to the use of our SPOT devices and handsets over the last 10 years accounting for thousands of lives saved.

We can easily adapt our technology to be used on vehicles to automatically send a distress (S.O.S.) signal upon an airbag deployment or roll-over. We are in extensive discussions right now with automobile manufacturers as well as Tier One suppliers to the automotive industry.

CM

How important is system interoperability to your users and if important, what forms (e.g., frequency, altitudes, commands) are your customers talking about?

DK

Our customers want their data delivered where and when they want it. They want it done affordably and reliably and they really don't care about what technology is used to deliver their service. I know this sounds blunt, but in the end I believe this to be true and that's the way we approach the design of our products and solutions.

CM

Thanks Dave, I think it is really interesting to hear how prevalent the Connected Car issue was at this year's CES conference and I imagine more satellite players will be attending next year's show.

www.msua.org

President of the Mobile Satellite Users Association, Catherine spearheads the group's mission to promote mobility market development and mobility innovation. With over 25 corporate and small business members representing all levels of the satellite value chain as well as end-users, MSUA collaborates with conference organizers around the world to facilitate panels and keynote speakers that decipher mobility market dynamics including: growth opportunities, strategic partnership, barriers to progress, application aspirations, adjacent market influences and more.

Catherine Melquist is a strategic marketer with more than two decades of experience developing marketing and public relations strategies for global companies in the satellite and space-based markets.

Innovation: An SSPA Revolution

A Rohde & Schwarz Focus

By Dr. Wolfram Titze, Director of Product Management and Business Unit Amplifier Systems, Rohde & Schwarz

Over many decades, satellite technology has provided a reliable and efficient platform for the communication of full motion video (FMV), audio and data. However, more recently, there have been discussions surrounding the impact of IP-based systems and how these new architectures could compete with and ultimately replace satellite communications.

One critical area of satellite technology are the amplifiers that are used within ground-based equipment to uplink signals to satellites. News of a new entrant to this market is really significant: such could place the amplifier market on a completely new and re-energized growth path.

Rohde & Schwarz has a proven track record stretching over more than six decades in the field of high power RF amplifier design. Its products were initially designed for terrestrial transmission applications but the portfolio has been successfully widened to include a diversity of applications including communications, scientific, EMC and design and product validation.

The reason for the company's entry into the satellite uplink amplifier market today is the opportunity the company has to apply significant advances in solid-state transistor technology, which could certainly impact the entire market.

Traditionally, high-power Ku-band satellite uplink amplifiers are tube-based devices. The tube-based product is proven technology which is relatively compact and lightweight and offers good operating efficiency.

However, there are some long-standing issues with tube-based amplifiers which can make their operation problematic. After first powering up the tube takes a period of time to warm up, thereby delaying system operation, plus the tubes are subject to failure and when this happens the entire system stops operating.

An alternative is the solid-state amplifier; however, they have only been available in low-power categories so far and, only recently, high power solid state amps have become available but remain relatively large and heavy.

Rohde & Schwarz' PKU100 SSPA.

Solid-State is State-of-the-Art

Now, using the latest transistor technology, Rohde & Schwarz has introduced the R&S PKU100 solid-state amplifier which combines the best of both worlds and offers users new and radically different functionality.

The amplifier achieves high efficiency, is compact and lightweight with high power output and is available with an optional adaptive linearization. An integrated block upconverter (BUC) from L-band is also available. Importantly, if transistors fail during operation, the amplifier continues to operate with reduced output power. With no high voltages used within the product, maintenance is easy and the product offers a significantly longer operating lifetime than the tube-based counterpart. Moreover, the R&S PKU100 can be equipped with redundant power supplies, both for AC and DC operation — this means that a power supply failure will not stop the operation of the amplifier.

Rohde & Schwarz has developed two power classes for these uplink amplifiers. A 400W and a 750W model will be available as outdoor and indoor units and for the two frequency bands — 12,75 GHz to 13,25 GHz and 13,75 GHz to 14,5 GHz.

The amplifier can be used in large scale fixed satellite installations serving customer applications such as broadcasters, telecom and internet service providers, financial institutions, government and non-government organizations. At the same time, the smaller amplifier can also be used for mobile, vehicle-mounted satellite applications.

What's So Important About Signal Linearization?

As mentioned above, the R&S PKU100 comes with an optional adaptive linearization.

Within satellite uplink amplifiers, signal linearization is critical as a significantly cleaner signal from the amplifier is obtained. Signal linearization has been a feature found in several tube-based amplifiers but, until now, it has not been possible within solid-state amplifiers. The linearization has two effects:

- *First, it improves the inband signal quality, which means better MER (Modulation Error Rate) respectively better EVM (Error Vector Magnitude), all making the signal easier to receive.*
- *Secondly, linearization yields much better out of band performance, i.e. significantly better shoulder attenuation which translates into lower adjacent channel power — this means less influence on neighboring channels on the satellite.*

A key aspect is the selection of the modulation scheme for transmission. Today, the de-facto standard is DVB-S and the trend toward ever higher data rates, required for the transmission of 4K/UHD video, for example, compels the use of higher order modulation formats in the future which are already defined in the DVB-S2 standard.

With built-in signal linearization, the R&S PKU100 provides much better amplifier performance and offers high potential for higher order modulation formats such as 64 APSK or even 256 APSK. The unit enables the user to extract the most from the available resource in a gallium nitride transistor.

As a consequence, satellite operators will need a significantly less powerful amplifier to transport more data across the same satellite. At a time when energy saving and increased efficiency are key drivers in the satellite communications market this is important news.

The adaptive linearizer option of the R&S PKU100 can be set to automatic continuous adaptation if desired and works for signals with a maximum bandwidth of 100 MHz. The PKU100 is easy to transport and comes in a compact enclosure: an issue which will drive a change in technology replacing tube-based amplifiers with an innovative design of solid state solution.

In many respects, the R&S PKU100 represents a quantum shift in satellite uplink amplifier technology — the world's first solid-state amplifier with automatic adaptive signal linearization offers the best of all worlds.

In the current economic environment where organizations are constantly striving to do more with less resources, the introduction of the R&S PKU100 will be a high-water mark in the international satellite market.

The product's first deliveries are scheduled for June.

www.rohde-schwarz.com/

The author, Dr. Wolfram Titze, is the Director of Product Management and Business Unit Amplifier Systems at Rohde & Schwarz.

Taming the 5G Beast

A Globecomm Focus

By Sathya Maruthi and John Geasa, Globecomm

There is a hungry beast lurking in the shadows of the mobile telecommunications market — network engineers are starting to realize that the good old ways of taming this beast are losing their power.

The beast goes by the name 5G and is extremely hungry for network capacity. The best hope of taming this beast relies on an innovative application of satellite technology in the communication mix.

Getting to Know the Beast

To understand the 5G capacity beast, it helps to understand the previous generation — the 4G mobile standard was originally envisioned by America's Defense Advanced Research Projects Agency at the beginning of this century, and it achieved serious commercial adoption beginning in 2011.

A major boom followed. The number of 4G mobile connections crossed the one billion mark in 2015 and is currently on track to account for one-third of all mobile connections by 2020, according to a study from GSMA (Global System for Mobile Communications). That helped the mobile industry make a US$3.1 trillion contribution to the world economy in that year.

With smartphones becoming the default device in people's pockets and purses, demand for capacity has also grown at a rate almost beyond imagining. In 2017 alone, global mobile data traffic grew 63 percent to reach 7.2 exabytes per month, compared with 4.4 exabytes per month one year earlier. (One exabyte is equivalent to one billion gigabytes.)

Although 4G connections represented only 26 percent of mobile connections in 2016, they accounted for 69 percent of mobile data traffic, according to the Cisco Visual Networking Index, because a 4G connection generates six times more traffic than earlier generations.

The next generation of mobility promises a drastic multiplication of growth in capacity demand. The upcoming rollout of 5G will provide individual 5G devices on the network with between 1 and 10 Gbps of speed with practically unlimited capacity. That translates into a requirement for backhaul that is 100 times greater than today, particularly as the rise of Internet of Things (IoT) applications adds to total demand.

Taming the Beast

Compared with previous generations, 5G service will depend on a much greater density of cell sites to support the high-bandwidth, low-latency service required by the 5G specification.

To manage the costs and complexity of deployment and operation, 5G networks will centralize network management in data centers and use new technologies including Cloud Radio Access Networks and carrier aggregation to interconnect baseband units with remote radio units at the edge. That interconnection is known as "fronthaul."

Not only will the backhaul capacity requirements significantly expand, the fronthaul between the center and edge will comprise a much larger component of network traffic than in previous generations.

Optical fiber is the clear default solution for moving all this data quickly and inexpensively in urban and suburban networks. While the fiber architecture may struggle to keep up at times, the essentially unlimited bandwidth it can offer will always be equal to the task.

The good news for operators is that their heavy investment in 4G in the early 2000s will lower the capital costs for rolling out this new capacity. Most of the world is using the same 3GPP (3rd Generation Partnership Project) standards for 5G. Therefore, while handling the Capacity Beast will be a challenge to technology, it will be less of a challenge to the bottom line.

The economics of fiber, however, are good fit for serving only about half the US population. Using data from the 2010 Census, the U.S. Census Bureau reports that 80 percent of the population lives in urban areas — but the definition of "urban" is not what most of us would expect.

For most of us, "urban" means one of the top 48 urbanized areas in the country. Seventy-five percent of the Census Bureau's "urban" areas, however, are actually small towns with

populations of under 20,000. They are often geographically large, with a population density that falls off rapidly once you leave the center of town, and often set in rural counties.

A unified, fiber-based solution to the fronthaul needs of 5G will simply not be possible, nor can the drastic growth in backhaul capacity demand be met the same way. As they work on early 5G implementations, network engineers are already learning that serious challenges await them. The Capacity Beast is waiting to pounce, not in high-density, high-demand markets but in places where fiber deployment has been minimal to date.

Hybrid Solutions to Capacity Constraints

Taming the Beast requires a hybrid approach to connectivity that combines fiber with satellite and terrestrial microwave. Though less familiar to network engineers than the fiber default, these technologies can enable cost-effective deployment and profitable operation. Properly implemented, they can address key challenges that arise when the market requires non-fiber solutions.

The most familiar of these is backhaul. For backhaul services in rural and underserved regions, satellite technology has proven to provide reliable and dependable links between base stations, or eNodeBs (as they are known in CDMA), and the mobile network's core for well over a decade. With consistent jitter and latency specifications as well as constantly improving optimization technologies and spectral efficiency, this tried and tested technology enables network operators to have ubiquitous and affordable backhaul coverage across any part of a country.

Less well known is the X2 interface, which was introduced as part of the 4G/LTE standard to interconnect the base stations or eNodeBs and support both Control and User Planes. As 4G networks expand beyond urban and suburban regions, engineers are already increasingly using X2 for dedicated links between eNobeBs — but many are unaware that satellite can be used as the transmission platform. In that configuration, they offer mesh network capabilities as well as lower-cost, point-to-point links. Transport links that are available and meet network specifications will further enhance the robustness and reliability of the network in rural areas.

Finally, there is the opportunity for data offload and optimization. The reality of 5G is that, like previous generations, it will coexist with LTE, 3G and 2G mobile and the infrastructure that supports them. At first glance, this would appear to be a big roadblock to delivering higher-generation service to lower-density markets. Data offload and optimization technology, however, offers a cost-effective solution to increasing the effective capacity of lower-generation networks.

Taking the most drastic example — a 2G network — data offload and optimization can reclaim 35-50 percent of the capacity currently filled with voice traffic and signaling links. Traffic-aware routing technology can route the 4G/LTE and 5G traffic used for signaling and VoLTE over the freed-up capacity and, at the same time, optimize it.

Optimization can make a huge difference for VoLTE traffic, as more than 60 percent of it is composed of packet headers. Least-cost routing can automatically route the LTE S1 data traffic over the lowest-cost route and provide TCP acceleration where needed to compensate for higher jitter and latency that can arise from the use of satellite, DSL or MPLS transmission.

From a business perspective, data offload and optimization require no changes to the existing network topology. It is transparent to the network, with all optimization being undone at the core network end of the links. It can also be used in either a one-way or two-way backhaul-enhancing solution, which means that latency-sensitive applications such as signaling and voice could be carried over a primary terrestrial channel while delay-insensitive traffic travels over satellite. Furthermore, adding a satellite backhaul terminal to an existing cellular tower installation also provides redundancy for disaster recovery when the microwave link and/or fiber goes down.

The Beast — Tamed

Making all this work over a mix of fiber, satellite and microwave links is difficult and requires systems designed for high reliability in the network operations centers, data centers and the field, as well as a unified management platform for hybrid connectivity. Most important will be the expertise of people who know how to integrate it all and make the network optimize itself for cost and performance from moment to moment.

Meeting the fronthaul and backhaul capacity demands of 5G will be one of the biggest but least visible challenges of the next generation of mobile technology. While carriers joust with spectrum owners and regulators over access to attractive blocks of spectrum, their engineers will put as least as much time and energy into ensuring that the underlying fronthaul and backhaul networks can support the explosive growth of wireless services.

The Capacity Beast will strike — not in the major markets where fiber is plentiful and capacity expandable — but in the markets where half of Americans demand the same level of capacity and service as their more urbanized counterparts.

To tame the Beast, network engineers must expand their definition of the technologies that make a cost-effective network and turn to experts who can make microwave and satellite technologies deliver on their promise in the 5G revolution.

www.globecomm.com

Sathya Maruthi is a Sales Engineer and John Geasa is Director of Solutions Engineering at Globecomm.

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Opening The Door For Content

A Speedcast Focus

By David Hochner, Vice President, Media and Broadcast Services, Speedcast

Tchoukball is a niche sport that was created in the 1970s by a Swiss biologist — every year, the Fédération Internationale de Tchoukball, the sport's highest governing body, helps organize regional and world championship matches; teams from the Ivory Coast to Argentina and China battle it out for the top podium spot.

Although it's not as universally recognized as the English Premier League or the United States' National Football League, tchoukball is played around the globe. However, most media coverage would indicate otherwise. Tchoukball just doesn't make the world's major sport networks.

That might be about to change. After four years of development, Speedcast has now rolled out the Speedcast Media Network, a secure live video distribution service over a hybrid solution of satellite and public internet. Compared with traditional satellite and fiber networks, the Speedcast Media Network offers global coverage, dramatically lower costs and greater flexibility. These competitive advantages in the next generation of media will allow users to both distribute and access content from anywhere in the world.

The Speedcast Media Network takes advantage of the company's expertise in working with data and IP solutions. Speedcast employs its own in-house technology to create the Speedcast Media Network, which is a cloud-based, over-the-top (OTT) solution to produce reliable HD video distribution.

The Speedcast Media Network also uses an innovative remote site aggregation system to process content in Speedcast media hubs located in Singapore, Miami and Italy for distribution. This cloud-based IP solution allows Speedcast to offer tailored content packages at dramatically lower costs than traditional satellite. It also builds on major developments by companies such as Netflix, Hulu and Apple to invest in IP broadcasting.

As more people travel, work across country lines and move abroad, the demand for local content has grown. The Speedcast Media Network will provide people with the incredibly diverse array of content they crave, from

newscasts to live disaster coverage, local cooking shows, foreign cartoons and other channels from home.

The Speedcast Media Network's IP-based solution makes it possible to distribute this content globally to regions that fiber can't reach. The maritime and energy industries are prime markets for the Speedcast Media Network, as it will allow companies to tailor content packages for crews working on oil rigs or in remote areas. A more diverse and customized content solution will allow companies to attract the best crews, and provide those crewmembers with content from home and in their own language.

Although demand has grown for an array of content, demand for sports content has especially surged around the world. In response, content distributors have begun to move from HD coverage to bandwidth-heavy 4K to provide a higher-quality viewing experience. While many premier sports content providers can afford to distribute on a protected video circuit, other OTT content providers push sports coverage directly to mobile devices. While less expensive, this OTT solution is a lower caliber than HD and 4K coverage.

Through the Speedcast Media Network, OTT providers will be able to distribute high-bandwidth, broadcast-quality content at a lower price. The Speedcast Media Network will also make it easier to livestream sporting events, another capability that users have begun to expect. By removing the barrier of cost, the Speedcast Media Network will also allow smaller entities, such as universities and tchoukball leagues, to livestream games from around the globe.

The cost of satellite and terrestrial content solutions is often not only a barrier for those looking to consume content, but also those looking to produce and distribute it. However, the Speedcast Media Network costs only a fraction of the price of traditional satellite because it transmits over public IP. This low-cost option will benefit broadcasters that want to distribute their content globally but are struggling with high delivery costs. Through the Speedcast Media Network, broadcasters can more easily enter the market and see a faster ROI.

Channel aggregators will also see savings from the reduced costs of the Speedcast Media Network. Not only is demand for a greater variety of channels growing, so is the supply, as a more and more local media producers can now afford to distribute content. Channel aggregators are responsible for managing the bandwidth for hundreds to thousands of channels. The Speedcast Media Network can help these aggregators provide global distribution in a more cost-effective way.

Flexibility and reliability are also important factors for broadcasters looking to distribute content. The Speedcast Media Network's software-based technology makes the tough last-mile delivery a much easier process. Instead of waiting for up to three months for a dedicated fiber link to be set up, broadcasters can sign up for the Speedcast Media Network and running over the public IP usually within a few hours.

This fast-acting set-up gives broadcasters greater flexibility, as it can be used short- or long-term. For example, a broadcaster that would rather use a more traditional telco solution can first launch content through the Speedcast Media Network while waiting for their dedicated fiber line. Broadcasters also have the option to keep the Speedcast Media Network as a redundancy, so that they can continue to stream content if their main distribution provider unexpectedly fails.

Those that use the Speedcast Media Network can rest assured that the system will be compatible with upcoming new media systems as technology progresses, as Speedcast boasts extensive experience with IP and data solutions. With the Speedcast Media Network, broadcasters and small producers will be able to distribute content from everywhere to anywhere.

As more content comes online, the Speedcast Media Network will give people the freedom to find both familiar and exciting new content from around the world. People working far abroad will be able to access a slice of home through local channels.

The Speedcast Media Network will allow anyone to stream anything, anywhere: That includes livestream event coverage, local programming and, of course, tchoukball games.

www.speedcast.com

David Hochner was the CEO of SatLink Communications from 1995 through 2016 . During that period, SatLink became a global, tier-one leader for content management and satellite delivery, as well as many large-scale projects in Cyprus, Greece, Japan and the Philippines. After being acquired by RR Media in 2016, David served as the Deputy CEO at RR Media. David is a professional photographer and an experienced skipper.

Career Insight

Selecting the correct recruiting process

By Ian Stammers, Founder and Managing Director, Satellite Talent

For employers looking to outsource their recruiting for the first time, this guide compares the primary types of services — Retained Executive Search, Contingency Search and RPO.

Finding and securing top talent is no easy task and requires a deep understanding of the company culture and an expertise in assessing the skills, leadership style and cultural fit of candidates.

To gain a competitive edge in today's hyper-competitive job market, many leading satellite companies engage the services of external recruiters to match their open positions with the most-qualified candidates.

Working with an external recruiter who specializes in your industry is perhaps the most valuable tool in your hiring arsenal. Specialized recruiters recruit globally for a single sector. They work with all the leading companies in a given sector. Therefore, they know the compensation package a company should be offering to qualified candidates.

Specialized recruiters carefully cultivate relationships with the most competent candidates. They can reach out to their network of candidates within minutes, assess their interest and quickly provide CVs to employers – usually in less than 48 hours.

For those companies looking to outsource this critical function for the first time, here is a simple guide to the various types of services offered by recruitment agencies. Most recruiters offer at least one of these service types.

Retained Executive Search
Working on a retained basis means the recruiter will charge an upfront fee to the client to conduct a search. They will operate on an exclusive basis, meaning the job will only be filled through this recruitment company.

This is the most expensive type of outsourced recruiting. With Retained Search, recruiters work closely with their client and will take their time and use an agreed upon methodology to locate the best person for the job. The process is usually rigorous, with a shortlist of five to eight names being presented before the interviews start.

Contingency Search
Contingency search is a service performed by a recruitment agency at no charge, until the day a candidate represented by them takes a position with their client.

Once the candidate is hired, the recruiter using Contingency Search is paid a percentage of the candidate's first year's salary — typically about 25 percent.

Recruiters working on this basis often have to compete with the client's internal HR department, advertising, direct applicants and typically one or more other recruitment companies.

The trick here is to represent the best candidates and to fill the vacancy faster than the other channels. If the vacancy is hard to fill, chances are there will only be a few candidates qualified for the position. Getting to these candidates first is vital for the successful contingency recruiter.

When to Use Which Search Process
Retained search is generally viewed by most experts as delivering the best result. However, in order to do so, this is usually the more expensive method. That being said, there are times when one process makes more sense than the other.

The contingency search process is geared to identifying qualified candidates — but not necessarily the most-qualified candidates. Contingency recruiting is appropriate in the following situations:

- *When the salary level of the position is less than $100,000*
- *When many people are likely to be qualified for the position*
- *When multiple vacancies with the same job description are being filled*
- *When the hiring organization wants to take more responsibility for screening, interviewing and negotiating with candidates*

Retained executive search consulting will, in most cases, identify the most-qualified candidate — thanks to the lengthy process of searching and interviewing.

There is also a critical difference here. The contingency process will identify candidates with the appropriate skill sets and experience. The retained search process will also probe for the best fit. Retained search recruiting therefore is appropriate:

- *When the salary level of the position is above $100,000 and when it is critical to hire not just any qualified person, but the most-qualified person available*
- *When you need a recruiter who will make a dedicated effort to filling the position, and who will take into account nuances of your organization's culture and other critical issues*
- *When you need an independent third party to thoroughly screen candidates, through in-person interviews, before finalists are presented*
- *When the situation requires a go-between to help persuade an executive to leave a desirable position for a better opportunity, and to help negotiate the terms of the move*

Another Option: Recruitment Process Outsourcing (RPO)
RPO is a form of business process outsourcing (BPO) where an employer transfers all or part of its recruitment processes to an external recruiter.

For this function, an RPO recruiter can use their own staff, technology, methodologies and reporting — or use those provided by the employer.

In most instances, RPO is favored by large corporations that employ thousands of individuals. However, recently some highly progressive recruiters have begun offering RPO programs specifically designed to help start-ups and early-growth companies meet large recruitment challenges — typically within limited budgets.

One example of these innovative RPO programs is a new program offered by Satellite Talent. For a flat monthly fee, Satellite Talent can use an RPO program to place 40 to 150 candidates into an organization over a period of one to two years.

When compared with retained search and contingency search, this discounted approach can save an employer hundreds of thousands of dollars a year in recruitment fees.

Armed with these guidelines, satellite companies can select the right recruitment process to help them compete against other tech firms for the brightest candidates.

Ian Stammers founded Satellite Talent in 2012. It is now one of the leading recruitment firms for the global satellite and space industries. He has more than 20 years of tech-industry recruiting experience. He can be reached at ***ian@satellitetalent.com****.*

Facing the Future

What's next for satellite in a 5G and OTT Era

By Hans Massart, Market Director, Broadcast, Kerstin Roost, Strategic Marketing and PR Director, and Semir Hassanaly, Market Director, Mobile Backhaul and Trunking, Newtec

Change is in the air across the world — 5G is set to revolutionize our lives and Over-The-Top (OTT) broadcasting is entering a golden age. With billions of connected devices set to burst onto the scene and into people's hands, network boundaries will be pushed further than ever before to enable new types of applications and services across almost every industry and market growth is only set to increase.

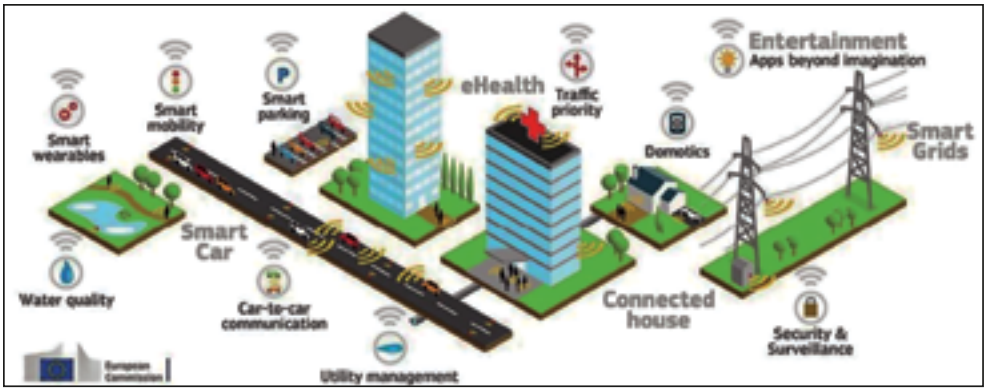
At the heart of enabling and enhancing these rapid developments is satellite connectivity — and the industry had better be ready.

The Impact of 5G

5G, should the technology's full potential be realized, will radically transform our personal and work lives, our homes and even whole cities, enabling newer types of applications and services across health, transport, entertainment, machine-to-machine (M2M) communications and security industries, to name but a few.

5G will lead to a huge shift toward a landscape dominated by wireless connectivity. Major architectural changes are already taking place to accompany this shift, with virtualization playing an integral role.

Architectures leveraging Network Functions Virtualization (NFV) and Software Defined Networking (SDN), both at the core and edge of the network, are being deployed to provide increased computing power, scalability, reduced operation costs, with creative business



Satellite communications will be an essential part of the 5G infrastructure.

models being empowered that enable differentiation. The satellite transport conduit will be integrated into the overall available communication map. Service providers will need to provide seamless terrestrial and satellite connectivity.

Traffic will be dynamically steered to the best transport options available according to bandwidth, latency, network conditions and other application-specific requirements. At the helm will be a suite of orchestrators making this steering decision.

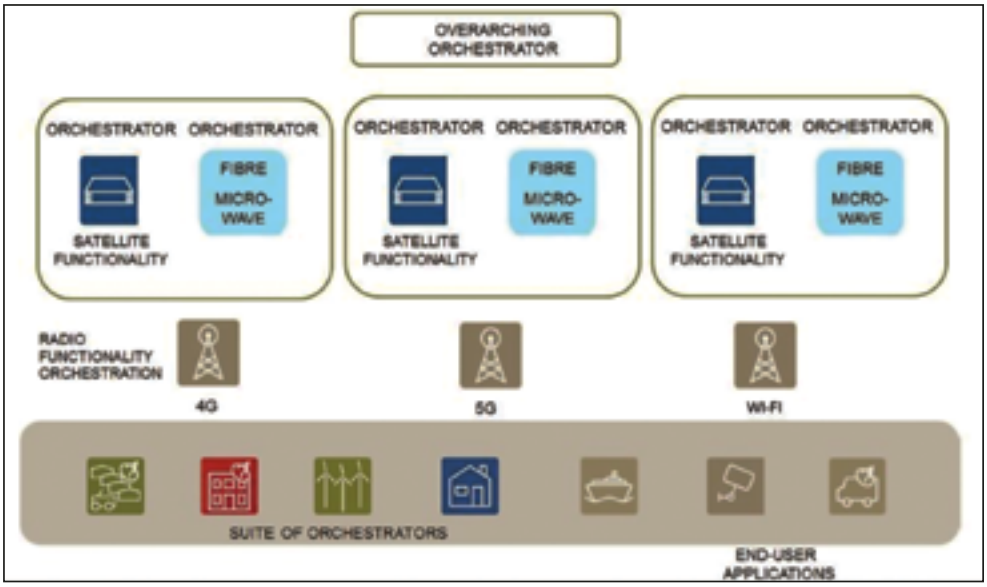
Full integration within the virtualized architecture will apply to satellite as well, starting with the network core and then expanding to the edge. Management of this NFV infrastructure will be performed through a Management and Orchestration (MANO) framework. This allows for easy integration of multiple applications.

A virtual Evolved Packet Core (vEPC) application could extend local call switching possibilities and a Mobile (or Multi-Access) Edge Computing (MEC) platform could host different applications such as caching and multicast, which can help reduce latency and improve Quality of Experience (QoE) for the users.

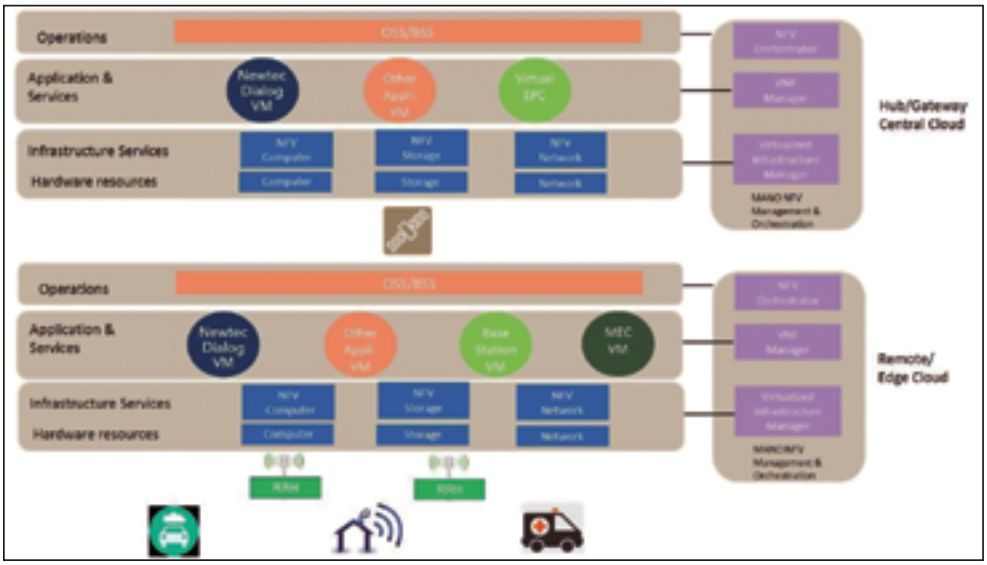
Opportunities, Opportunities, Opportunities

Quality of Service (QoS) and Operational Expense (OpEx) will also remain key as the landscape becomes even more competitive.

New opportunities for extending satellite services in urban and rural areas will emerge, enabling seamless connectivity for emergency services, broadcast or multicast and network offload schemes, aero and maritime mobility, connected cars and mobile backhaul. Newer Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) constellations will further expand the reach of satellite communications.



Opportunities to trial 5G are also becoming available. Newtec has signed a joint statement with the European Space Agency (ESA) and a number of industrial companies to demonstrate the functionality, performance and benefits of satellite when integrated and interoperating within the 5G environment. The first phase will leverage existing space and ground segment assets and further developments will be trailed after 2019.



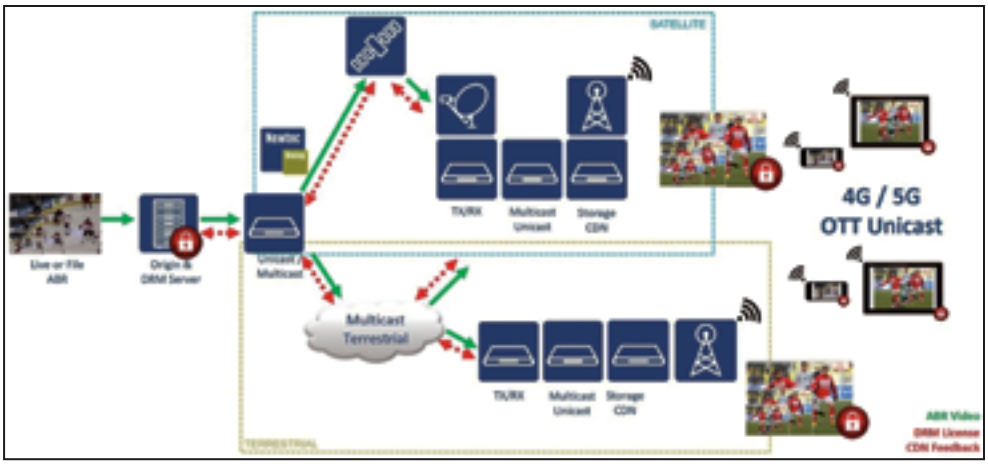
Newtec is also a key player in the Satis5 initiative, which aims to provide a testbed showcasing major technology progress and demonstrating the benefits of satellite technology for the main 5G use cases. The testbed includes live, over the air GEO and MEO satellite connectivity, in addition to laboratory emulations and simulations, and uses a federation of terrestrial locations. The activity drives the full integration of satellite in 5G through open and standard solutions, facilitated primarily through 3GPP standardization.

All of these initiatives leverage the Newtec Dialog® platform which enables the high efficiency, high performance, virtualization and multi-service capability paramount for 5G.

Changing Channels, Changing Habits

Unlike 5G which, although developing quickly, is yet to break onto the scene, OTT broadcasting is an advancement that is already finding its way into homes, businesses and screens.

Millions of subscribers continue to indulge in streaming sites such as Netflix, Hulu and Amazon Prime Video — the market is expected to grow even further during the coming years. Transmission is the key to successful content distribution, and at the heart of these transmissions is an often overlooked solution: satellite.



Blended transmission for OTT: Combining satellite, 4G/5G and Fiber.

According to a recent Unisphere report, when it comes to OTT viewership, the streaming media industry has a surprising prediction for the traditional cable and broadcast industries: OTT viewership will overtake traditional viewing before 2020.

The marketplace is already maturing at a rapid rate as more and more media companies begin the uptake to bring their broadcast A-game to a world of instant consumption. Not only does offering OTT attract new subscribers or customers, OTT is also a viable way to enhance a company's competitive profile and increase profitability.

In fact, people's video media and television consumption habits in general have really shifted in recent years as the wave of online and on-demand content forces satellite operators to question the long-term sustainability of the linear TV business that has traditionally been their bread and butter. Within the same time frame, OTT subscribers have doubled year-on-year to a point where certain video content today skips linear TV altogether and appears on an online channel instead.

Moving with the Times

Historically, satellite wasn't thought to be compatible with OTT services. However, the growing need for broadcasters to be on-site wherever and whenever breaking news happens to deliver quality broadcasts over multiple platforms means satellite has an extremely important role to play.

Broadcasters need to meet the demands of their viewers and share important real-time events with the best image quality, low delay and buffering to a global audience over the internet, no matter where the event is taking place. This is a challenge facing both broadcasters and satellite operators and the good news is that solutions have already arrived.

The Newtec Dialog multiservice platform, for example, which features Newtec's unique, award-winning, dynamic Mx-DMA® bandwidth allocation technology is an IP solution that enables on-demand bandwidth and reliable connectivity for seamless live streaming and general broadband applications. This gives broadcasters the flexibility to run additional communications and applications on top of live streaming such as live social media posting.

The platform has already been deployed by a number of Newtec's partners to deliver quality OTT broadcasts of live events in remote locations to a worldwide audience. This has included live streaming interviews and action video clips of the Punch Powertrain Solar Team as they competed in the Bridgestone World Solar Channel — a 3,000 km. solar car race across the Australian outback.

Pushed to the Edge

Growing traffic is also a fundamental challenge when broadcasting popular content — especially live — to a wide audience using a multitude of devices.

Bandwidth must be used effectively and traffic needs to be minimized. Satellite can be used here, thanks to the unique multi-cast potential that it bring broadcasting the content. To address unicast content, such as Adaptive Bit Rate (ABR), streams at the hub are converted to multi-cast, enabling efficient transportation, and then converted back to unicast at the remote site.

Satellite also feeds the Content Distribution Network (CDN), distributing and pushing popular content in ABR format to edge CDN-based on popularity software analysis. Different formats for distribution to multi-screen devices are also created and converted locally to unicast formats. Crucially, through satellite multi-cast distribution, terrestrial backbones can be offloaded to keep up with the demand from the edge which will be especially important in the 5G era.

Shaping the Future

For the satellite industry, these leaps forward in innovation have created exciting opportunities to wield the power of satellite technology that will continue to shape the future of satellite communications — a commitment Newtec intends to stand by in this ever-connected world.

www.newtec.eu

Authors, from left to right: Hans Massart, Kerstin Roost and Semir Hassanaly, Newtec

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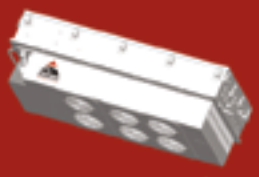

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