Worldwide Satellite Magazine – March 2018

SatMagazine

The SpaceX sendoff of their impressive Falcon Heavy launch vehicle Photo is courtesy of SpaceX.

GaN BUCs

for your mission-critical applications

The last word in GaN BUCs from the first name in HPAs.

CPI GaN BUCs are an excellent choice for maritime, oil and gas, milsatcom, IFE, SOTM, and other uplink applications. Built in lighter and smaller packages than comparable GaAs-powered BUCs, CPI GaN BUCs run cooler and consume less power, resulting in longer life and a better ROI. Whether your system is radome-based, exposed to the elements or is in an air-conditioned shelter, our GaN BUCs are a reliable, efficient solution.

Call CPI today or visit **www.cpii.com/buc** to learn more about our GaN BUC product line, and how we are uniquely qualified to provide you with the most appropriate technical solution for your desired frequency range, power level and bandwidth.

80 W Ku-band BUC 160 W Ka-band BUC

Download our new app! Search: CPI Satcom

Download on the App Store GET IT ON Google Play

Communications & Power Industries

satcom products

CPI SMP Division | San José, CA | www.cpii.com | satcommarketing@cpii.com. | +1 (669) 275-2700

MEET NEWTEC DIALOG THE PLATFORM THAT EMBRACES CHANGE

FLEXIBILITY • SCALABILITY • EFFICIENCY

NEW RELEASE 2.1
HUB PORTFOLIO FOR
SMALL TO MULTI-SERVICE
HTS & GLOBAL NETWORKS

NEW COMPLETE
DVB-S2X WIDEBAND
MODEM PORTFOLIO

VISIT US AT

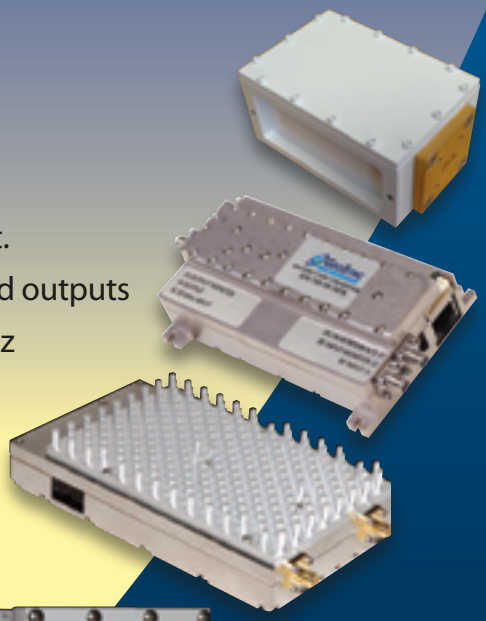
SATELLITE 2018
MARCH 12 - 15
BOOTH 2001
WASHINGTON

NAB SHOW 2018
APRIL 9 - 12
BOOTH SU1516
LAS VEGAS

#NewtecDialog
www.newtec.eu
Follow Newtec Satcom on

Newtec Dialog®

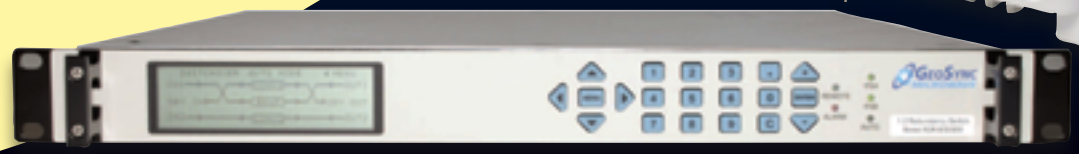
10th Year with the best yet to come, GeoSync Microwave Satcom Products.



- Multi-frequency, Ku or Ka-band Block Converters
  - Upconverters with 2 or 3 L-band inputs and one wide band RF output.
  - Downconverters with one wide RF input and 2 or 3 independent L-band outputs
- Ka, 27.5 - 31.0 GHz Synthesized Frequency Upconverters and 17.0 – 22.0 GHz Synthesized Frequency Downconverters.
  - Step sizes as small as 1 Hz
  - Integrated Phase Noise over 1Hz to 100 MHz ≤ 0.5°
- Hot Swappable, C, X or Ku-band Up and Down Converters
  - 2 independent converters in a 1 RU chassis
  - 10/100 Base-T Ethernet standard, amplitude slope adjust.
- LNAs and Redundant LNA Plate Assemblies
  - C thru Ka-band LNAs with superior low noise figures.
  - 1:1 & 1:2 Redundant Antenna Mount LNA plate assemblies / 1RU controllers.

...and now, a new, 20,000 square foot facility to support our growing capabilities

New GeoSync Headquarters, 320 Oser Avenue, Hauppauge, NY



See us at Satellite 2018 Booth # 1925 Washington, DC

For more information:

E-mail: **sales@geosyncmicrowave.com**
Phone: **631.760.5567**

GeoSync Microwave™


AvL
TECHNOLOGIES
avltech.com
Visit AvL at
SATELLITE
Booth #417
AvL
AvL
ENABLING COMMUNICATIONS IN ANY SITUATION
AvL'S FAMILY OF INTEGRATED TERMINALS (FIT)
• Ultra lightweight - meets IATA requirements for carry-on or checked baggage
• One person set-up in less than 10 minutes
• Carbon fiber reflectors - sizes range from 45cm to 1.35M
• All-in-one positioner system & switchable manual or motorized operation
• Quick change tri-band feed and RF kits
• AvL AAQ computer-assisted pointing and acquisition
• Beacon receiver, ODU/modem integration and BUC/LNB integration
• Watch the video at avltech.com/media

SatMagazine

March 2018

Table of Contents

More Coverage. More Throughput. More Services. Across the Middle East, Europe, Africa and Asia.

Spacecom's AMOS satellite constellation, consisting of **AMOS-3** & **AMOS-7** co-located at 4°W and **AMOS-4** at 65°E, provides high-quality broadcast and communications services across Europe, Africa, Asia and the Middle East. With **AMOS-17** planned for launch to 17°E in early 2019, Spacecom will further expand its reach, reinforcing its position as a leading satellite operator.

AMOS by Spacecom

MAKING SPACE FEEL CLOSER

www.amos-spacecom.com

Advertiser Index

CUSTOMIZABLE SATELLITE COMMUNICATION SOLUTIONS.

EXPERTLY DESIGNED TO FIT YOUR NEEDS.

Custom Packaging Options
IATA-compliant options including hard packs, soft packs, and backpacks.

Custom LNB Options
Offered in X-, Ku-, and Ka-bands. Functionality in multi-band frequencies available.

Custom SSPA Options
Offered in X-, Ku-, and Ka-bands. Standard power options from 4W-160W.

Certified to Military Standards
Designed to meet military standards including MIL-STD-810, MIL-STD-461, and WGS.

Norsat International's in-house experts can design custom satellite solutions to fit your needs. Learn why Norsat is the industry leader in satellite customizations by visiting us at **Satellite 2018** at booth #1332 or on the web at **www.norsat.com/customization.**

SATELLITE COMPONENTS | PORTABLE SATELLITE TERMINALS | MARITIME SATELLITE TERMINALS | REMOTE NETWORK SOLUTIONS

Private Cellular Networks

Coverage. Done right.

Deploy our mobile terminals to rapidly and flexibly serve your customers on demand.

Our solutions offer:

- Portable cells for LTE over SKYWAN
- Meshed cells over terrestrial and SKYWAN links
- OPEX-optimized LTE over HTS satellite
- Voice and data services for closed enterprise networks

SKYWAN – Expand your horizons.

For detailed information use the QR code or visit our website:

www.ndsatcom.com

Star Full Mesh Multi-Star Hybrid DVB S2X

ND SATCOM

Meet us at Satellite 2018 in Washington, Booth #2319

SANTANDER TELEPORT

THE TOP TELEPORT OPERATOR

Leader of the Fast 20 Teleport Operators ranking as published by WTA

Top Operator
WTA
2017

SATELLITE 2018
IT STARTS WITH A CONNECTION
BOOTH 731

InfoBeam

Launch services continue to be an obstacle for SmallSat market growth

Nintey-eight percent of satellite industry representatives attending the *3rd Annual SmallSat Symposium* in the Silicon Valley, USA, are unanimous in their view that launch services continue to be an obstacle for the small satellite market growth.

In agreement with them are delegates from space launch industries represented by launch service providers and launch brokers from Russia, USA, Europe, Japan and New Zealand.

Officials from Arianespace, GK Launch Services, Spaceflight Industries, Rocket Lab, and Mitsubishi Heavy Industries addressed this and other topics at the panel discussion "*Launch Opportunities and Payload Differences.*"

Alexander Serkin, CEO, addressed the Panel on behalf of GK Launch Services.

"*Supply side of the launch market has grown; nevertheless the launch prices still remain unchanged*," said Alexander Serkin.

Space access capacity keeps on increasing and with emergence of new superlight rockets this trend will continue.

However, despite all these processes, the economics remains invariable, i.e. a micro- or nanosatellite launch price remains within the range of $30,000 to 50,000 per kg. The amount of technical obstacles decreases, but the price doesn't go down.

Mr. Serkin shared his vision of the smallsat market outlook in the near future and for the first time he publicly set forth GK's goals in terms of pricing of micro- and nanosatellite launches using Soyuz-2 LV.

Emerging launch vehicles will facilitate timely satellite launching and will allow the micro-/ nanosat market to rely on the smallsat-oriented vehicles capable to deliver them to target orbits.

Having several players with new LVs will enable a predictable dedicated access to space. However, it still looks more practical to solve the price issue by piggyback/rideshare launching on a vehicle ike Soyuz-2.

Today, GK works with all types of Soyuz LV and each launch assumes the accommodation of piggyback payload.

"*Launch services for smallsats are critical, let alone the fact that for the satellites of 1 to 50kg launch cost in average amounts to about 50 percent of the entire mission budget. The major issue here is how it will affect the capacity of the smallsat market which was, in particular, looking forward to launch economic changes. The segment of smallsats (1-50kg) is less predictable*," said Alexander Serkin.

In conclusion Mr. Serkin voiced a launch price: a kilo of a payload will cost less than $30,000, and the company is taking efforts to further decrease its prices. In addition, the more standard solutions are used, the better the price will be for customers.

GK Launch Services was established upon ROSCOSMOS decision to commercialize launch services.

GK Launch Services is a launch service provider authorized to conclude commercial contracts for satellite launching on Soyuz-2 launch vehicles from Russian spaceports.

gklaunch.ru/

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

Es'hailSat سهيل سات
Qatar Satellite Company الشركة القطرية للأقمار الصناعية

HIGH QUALITY PREMIUM CONTENT AT 25.5° / 26° E MENA BROADCAST HOTSPOT

Es'hailSat high powered satellites provide the key infrastructure to media networks and broadcasters to distribute services such as linear TV, video on demand, high definition TV and 4K TV, across the region.

Es'hailSat Key Services include:

- TV Broadcasting
- Newsgathering
- Business Communications
- Corporate Networks
- Telecommunication Services
- GSM Backhauling
- IP Trunking Services
- Government Services

Space to deliver your vision

www.eshailsat.qa

InfoBeam

Heavy lifting accomplished by SpaceX

The SpaceX launch of their Falcon Heavy (FH) rocket on February 7 was an accomplishment of mammoth proportions.

This launch portends huge benefits for the future exploration of space as well as for incremental payload size increases. And then, to top it all off, there is now an Elon Musk Tesla en route to Mars... a bright red Tesla "asteroid," complete with a "driver"... could this be the start of a new spatial highway?

The real purpose and goal of this pioneering test mission will have significant implications for the future of deep space exploration.

The launch offers the United States a heavy-lift capability in space, with the ability to lift more than twice the payload of other launch vehicles, at one-third the cost of competing launch solutions. Only the Saturn V moon rocket, last flown in 1973, delivered more payload to orbit.

Three cores make up the first stage of Falcon Heavy. The side cores, or boosters, are connected to the center core at its base and at the vehicle's interstage.

With a total of 27 Merlin engines, Falcon Heavy's three cores are capable of generating more than 5 million pounds of thrust.

For this test flight, Falcon Heavy's two side cores were both flight-proven. One launched the Thaicom 8 satellite in May 2016 and the other supported the CRS-9 mission in July 2016.

SpaceX successfully landed two of the three Falcon Heavy's first stage cores post-launch.

The payload for Falcon Heavy's demonstration mission is SpaceX CEO and Lead Designer Elon Musk's midnight-cherry Tesla Roadster.

Demonstration missions such as this one typically carry steel or concrete blocks as mass simulators; however, SpaceX decided it would be far more worthwhile to launch something fun and with irreplaceable sentimental value: a red Roadster for the red planet.

Following launch, Falcon Heavy's second stage placed the Roadster into a processing Earth-Mars elliptical orbit around the sun.

SpaceX noted that all should remember that this mission is a test flight. Even if all of the experimental milestones that are being attempted during this test are not completed, critical data throughout the mission is being gathered.

Ultimately, a successful demonstration mission will be measured by the quality of information gathered to improve the launch vehicle for the company's existing and future customers.

Space Florida congratulated Elon Musk and SpaceX on this momentous achievement — a spectacular launch and landing and added...

POWERING A CONNECTED FUTURE.

CONSUMER | ENTERPRISE | GOVERNMENT | DEFENSE | CARRIERS | MOBILE SATELLITE

HUGHES®
An EchoStar Company

Learn more at hughes.com
#ConnectedFuture

The Falcon Heavy's success is another SpaceX contribution to the rich history of the Cape Canaveral Spaceport and has enhanced the State's aerospace legacy and position with this successful launch.

The Falcon Heavy rocket rose from LC-39A and then landed two first stage boosters. With 27 Merlin engines and more than five million pounds thrust, the Falcon Heavy changes the landscape for global space launch and creates bold new capabilities for the Cape Canaveral Spaceport.

The National Space Society (NSS) has also congratulated SpaceX on the first flight of the Falcon Heavy (FH).

At 3:45 pm EST on February 7, 2018, the most powerful U.S. liquid-fueled rocket to fly since the Saturn V roared off Launch Complex 39A at the Kennedy Space Center in Florida with 5.5-million pounds of thrust.

NSS believes that the first flight of the FH is an important step toward achieving Milestone 2: Higher Commercial Launch Rates and Lower Cost to Orbit in the NSS Space Settlement Roadmap (*www.nss.org/settlement/roadmap/RoadmapPart2.html*) .

According to NSS Senior Vice President Bruce Pittman, the FH will enable concept studies such as the Evolvable Lunar Architecture to become a reality, allowing the U.S.A. to return to the Moon within the current NASA budget, while maintaining a balanced space program.

Pittman added that NSS members look forward to seeing NASA join the U.S. military in making use of the commercially competitive FH, now the most capable rocket currently flying.

And, Elon Musk's Tesla, is now en route to Mars, courtesy of the SpaceX Falcon Heavy launch on February 7, 2018.

Later in the evening of February 3, a final burn blasted the Tesla and its "driver" on a path toward Mars and the asteroid belt. In addition to being really cool, this mission profile demonstrates the ability of the FH to launch large satellites directly to geosynchronous orbit after significant coasting periods.

Dale Skran, NSS Executive Vice President and Chair of the NSS Policy Committee, noted that SpaceX achieved a lot of firsts — the FH was successfully boosted off the pad with 27 engines firing simultaneously, a new record for the U.S.A.

Additionally, Skran said that the return to the launch site of two side boosters has never been done before.

Most importantly, the FH opens an era of lower launch costs that will enable a wide range of new endeavors in space, including an affordable return to the Moon.

Space Solar Power expert and member of the NSS Board of Directors John Mankins added that the reduction in launch costs that will be achieved with the FH was not just unrealized ten years ago, it was actually characterized as impossible by leading aerospace engineers.

He noted that the targeted prices that SpaceX promises with the FH — below $1,000 per pound — will be a breakthrough moment in the realization of ambitious future space business sectors such as Space Solar Power.

The National Space Society congratulated all at SpaceX who work every day to make humankind a multi-planetary species by creating a spacefaring civilization.

www.spacex.com

www.nss.org

Story by Silvano Payne, Executive Writer

InfoBeam

Ten Ariane 5 ECA launchers ordered

ArianeGroup and their Arianespace subsidiary have announced an order for 10 Ariane 5 ECA launchers — the 10 launch vehicles covered by this "PC batch" will be deployed from the Guiana Space Center starting in 2020, coming after the launches of 18 Ariane 5s ordered in 2013).

This production order represents a total value of more than one billion euros for the European space industry, involving more than 600 companies in 12 European countries[1], including 350 small and medium-sized enterprises.

The order's size is aligned with the ramp-up for the next-generation Ariane 6, which is scheduled to make its first flight in mid-2020, reaching full capacity in 2023

With this latest order, there are now 23 Ariane 5 launchers in production or to be produced, from the PB+ and PC batches.

With this latest "PC batch," the industry confirms its commitment to consolidate the competitiveness of the European launch offer even before the arrival of Ariane 6.

The decision follows the commitment made by Arianespace in December 2016 to initiate the procurement of long lead items (LLI[2]). It also allows ArianeGroup, industrial prime contractor for the development and operation of the Ariane 5 and Ariane 6 launchers — as well as its European partners (over 600 companies in 13 countries1, including some 350 small and medium-size enterprises) — to start initial production activity for these additional launchers.

This new batch also guarantees the durability for launch service offerings by the European operator Arianespace for institutional and commercial clients until the end of the transition phase with Ariane 6 — with this launcher's full operational capacity to be reached by 2023.

Ariane 5, which chalked up its 82nd successful launch in a row in December 2017, has undergone continuous performance improvements since the beginning of the Ariane 5 ECA program.

As a result, Ariane 5 set a new record in June 2017 by lofting 10,865 kg. into geostationary transfer orbit (GTO).

From this payload lift record, Ariane 5's performance will be increased another 250 kg. by 2020 as part of an ESA-funded program — with the PC production batch taking full advantage of the improvement.

[1] 12 European countries are involved in the industrialization of Ariane 5, 13 for Ariane 6.

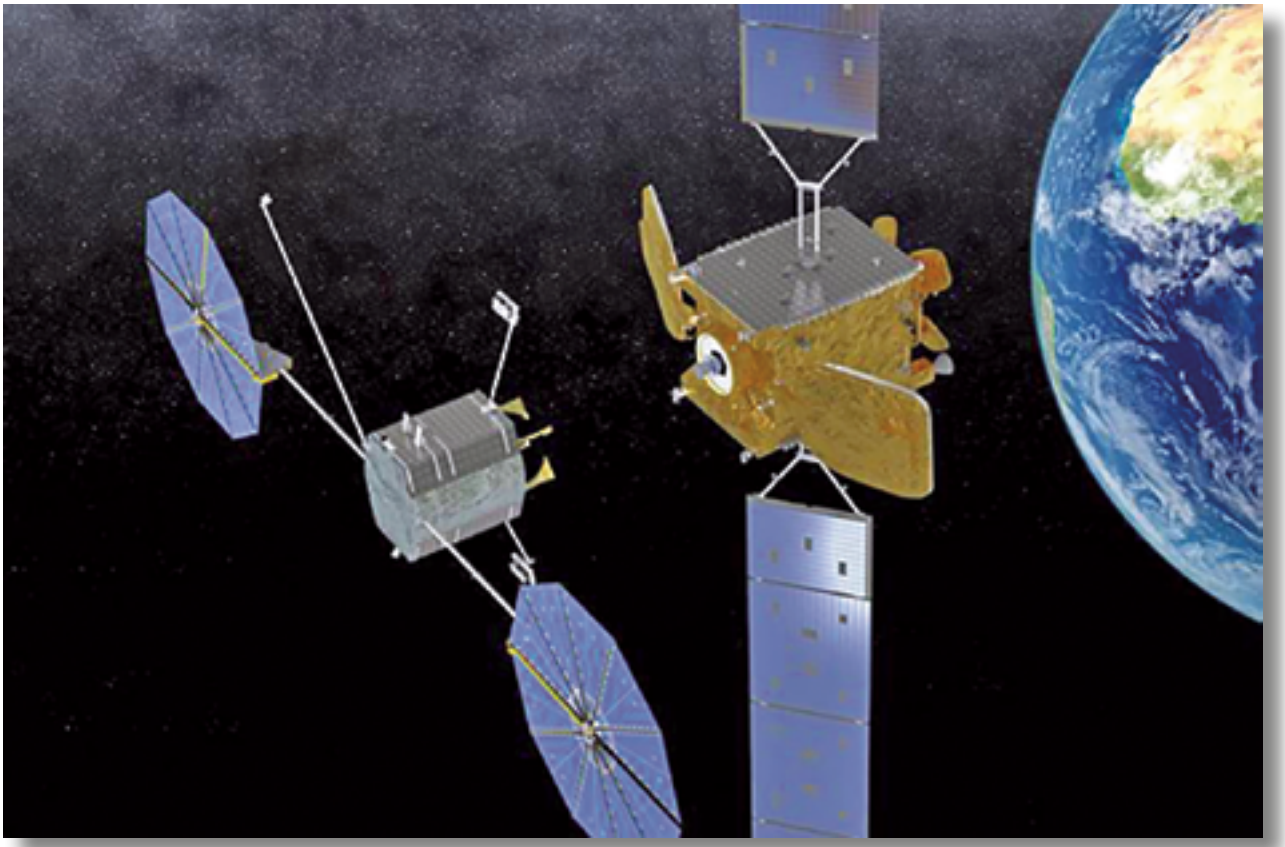
[1] The raw materials and unmachined elements are required to be ordered ahead of time.

www.arianespace.com

Story by Richard Dutchik, Sr. Contributor

InfoBeam

Intelsat orders a second Orbital ATK Life Extension Mission Vehicle



Artistic rendition of an MEV spacecraft approaching a satellite in need of servicing. Image is courtesy of Orbital ATK.

Orbital ATK has been awarded a contract for a second Mission Extension Vehicle (MEV-2).

The vehicle was ordered by Intelsat S.A. to provide life extension services for an Intelsat satellite. Orbital ATK is now producing MEV-1, the industry's first commercial in-space satellite servicing system, for Intelsat with a launch scheduled for late 2018.

Under this new agreement, Orbital ATK will manufacture, test and launch MEV-2 and begin mission extension services in mid-2020.

The production of the second MEV is part of Orbital ATK's longer-range plan to establish a fleet of in-orbit servicing vehicles that can address diverse space logistics needs including repair, assembly, refueling and in-space transportation.

Through its Space Logistics subsidiary, Orbital ATK will introduce in-orbit commercial satellite servicing with MEV-1 late this year.

The MEV is based on the company's GEOStar™ spacecraft platform and controlled by the company's satellite operations team.

The MEV uses a reliable, low-risk docking system that attaches to existing features on a customer's satellite, and provides life-extending services by taking over the orbit maintenance and attitude control functions of the client's spacecraft.

Each MEV vehicle has a 15-year design life with the ability to perform numerous dockings and repositionings during its life span.

The work performed on MEV-2 will span multiple locations across the company.

Orbital ATK's spacecraft components division will be responsible for manufacturing the structures, propellant tanks and solar arrays at the company's locations in San Diego and Goleta, California.

The Rendezvous, Proximity Operations and Docking (RPOD) laboratory, located at the company's headquarters in Dulles, Virginia, will test the sensors, actuators and control algorithms that allow the MEV to approach and dock with the client spacecraft.

Orbital ATK plans to expand its satellite servicing capabilities to address additional in-orbit needs of customers.

The company is investing significant internal capital and, through a NASA Space Act Agreement, working with U.S. government agencies to develop and implement new capabilities for the MEV fleet. These include next-generation life extension and repair vehicles, on orbit assembly of large space structures and cargo delivery and related services to deep space gateways, such as in lunar orbit.

Ken Lee, Intelsat's SVP, Space Systems, offered that Intelsat was an early proponent of the potential for mission extension technology.

On orbit life extension, such as that provided by the company's two contracts with Orbital ATK, provides additional flexibility to Orbital ATK's fleet management, allowing the firm to direct capital to new satellites while continuing to generate economic value from satellites on orbit.

Tom Wilson, President of Orbital ATK's Space Logistics, LLC subsidiary, added that work on MEV-1 is progressing rapidly toward a late 2018 launch, with system-level testing starting this spring. With the launch of MEV-2, Orbital ATK will continue to pioneer in-space satellite servicing for commercial operators. Intelsat's commitment to a second MEV demonstrates the market demand for servicing vehicles as well as customer confidence in this product.

www.intelsat.com

www.orbitalatk.com

Story by Jill Durfee, Assoc. Editor

InfoBeam

Inmarsat mines info for new report

Businesses in the mining industry are backing the Internet of Things (IoT) to help them retain their market share, as competition in the sector intensifies, the quality of seams decreases and profit margins are put under pressure.

According to a recent research from Inmarsat, the Internet of Things (IoT) will play a critical role in helping mining businesses to increase the level of automation and improve production efficiency, enabling them to compete with rivals operating in lower cost markets.

Market research specialist *Vanson Bourne* interviewed respondents from 100 large mining companies across the globe for Inmarsat's '*The Future of IoT in Enterprise*' report (***research.inmarsat.com/about/)*** and found that 70 percent of mining businesses agree that IoT would give them a significant edge against their competitors.

Mining operators further identified how IoT would help them to bolster their competitive edge, with 41 percent reporting they would use IoT to increase the automation of business processes and 44 percent stating IoT would help them to identify cost saving and efficiency opportunities.

With many mines located outside terrestrial or cellular network coverage, satellite communication networks can offer more reliable connectivity that is central to profitable mining and crucial in an emergency event.

In addition, Inmarsat can provide connectivity in deep, open pit mines and even underground, using repeaters.

With up to 99.9 percent uptime, Inmarsat's L-band services are enabling IoT solutions in mines globally, even in the most remote and hostile environments.

Joe Carr, Director of Mining at Inmarsat, commented on the findings and said it is no surprise to see that mining businesses are looking to IoT to help them gain a competitive advantage. Mining businesses across the world are under constant pressure to produce the same product at a lower price than their rivals.

Carr added that at the same time, it is becoming harder to find high quality deposits in lower sovereign risk countries. This pressure is amplified in developed economies, such as Canada and Australia, where labor costs are much higher than in emerging markets, leaving operators in these territories at a significant competitive disadvantage.

These businesses must drive down operating costs and improve productivity to remain competitive, and the most effective way to do this is the adoption of IoT and automation.

www.inmarsat.com

Story by Pattie Lesser, Executive Editor

InfoBeam

UN aids refugees with TAC-PAK systems

Horrible reports of abuse and murder in the Central African Republic has motivated the United Nations International Organization for Migration(IOM) agency to help change and assist the victims of this civil war.

The humanitarian crisis in the Central African Republic (CAR) has received plenty of media attention in recent years.

Since civil war broke out in CAR, 115,000 Chad refugees have been displaced in the remote region, countless people have been killed and many more have been the victims of rape and other forms of abuse.

The situation in Chad would be worse were it not for the peacekeeping work of the United Nations International Organization for Migration (IOM) agency that is providing basic facilities such as temporary shelters, water and sanitation facilities, health centers, schools, children-friendly spaces, as well as vouchers for their food subsistence.

Following the massive influx from CAR into Chad, the Humanitarian Coordinator (HC) on behalf of the Humanitarian Country Team decided to reactivate the Shelter/Camp Coordination Camp Management (CCCM) cluster that is led by UNHCR and co-led by IOM.

The aim is to provide technical support for the management of both transit and temporary sites as well as to advocate for durable solutions for the displaced persons in the sites in the long run.

The IOM recognized the need for more communications resources in the remote communications sterile refugee camps.

The IOM selected the 308 SYSTEMS TAC-PAK videoconferencing kits for deployment to multiple refugee sites.

These "mobile command in a box" systems, manufactured by 308 Systems in Fort Collins, Colorado, are custom-configured to meet specific IOM Chad mission field communication requirements.

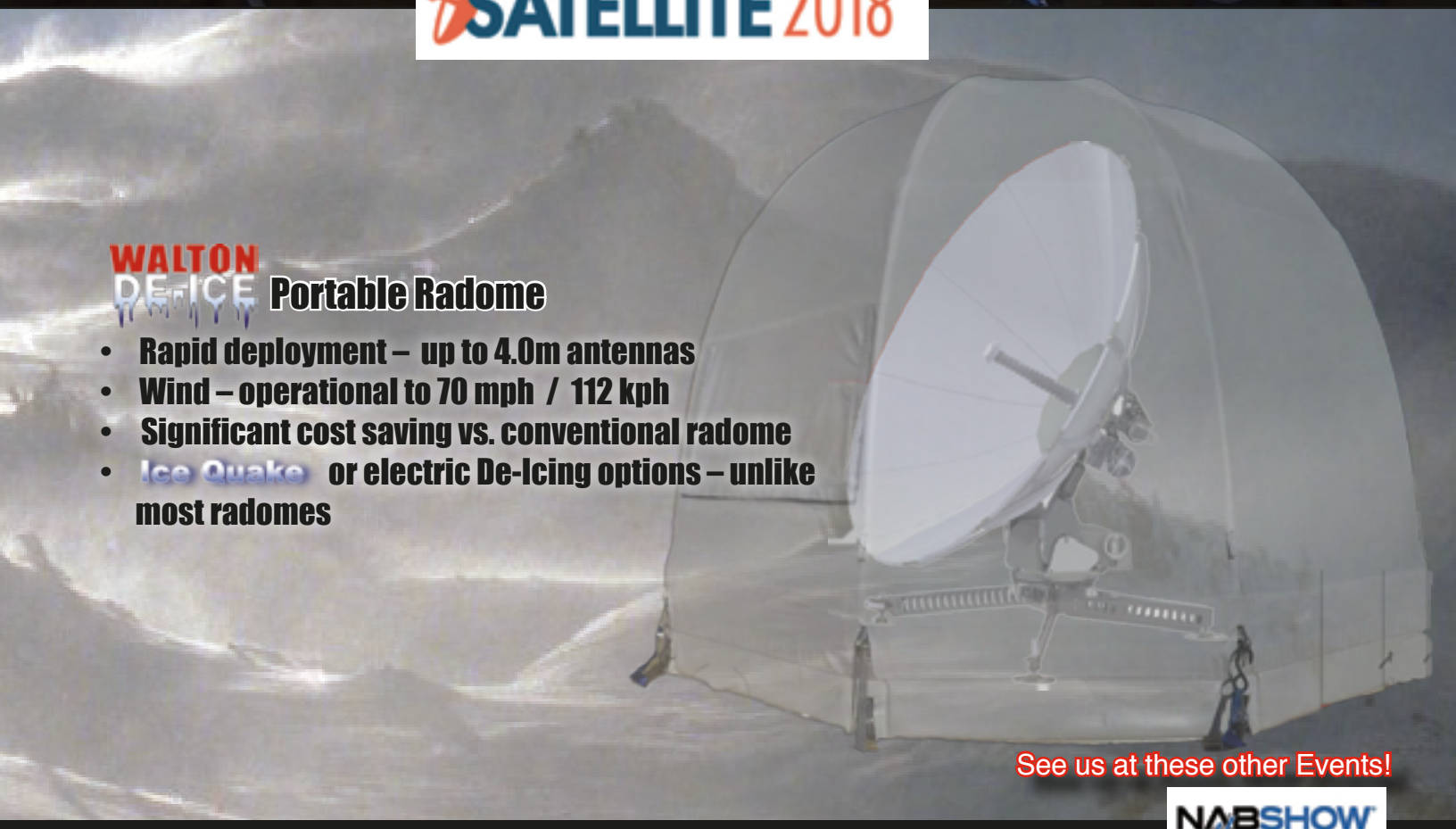
Deploying the TAC-PAK mobile command systems, the United Nations has been able to create a satellite and cellular communications based continent-wide wireless network.

This network enables Shelter/CCCM cluster teams to coordinate, share information and request support.

The TAC-PAK's have created an invaluable and fast communications infrastructure where, previously, none existed.

The IOM's TAC-PAK videoconferencing flyaway kit deployment addressed the shortfall of voice and data infrastructure and equipment experienced by the IOM teams on a daily basis in the remote refugee camps.

www.308systems.com/



WALTON DE-ICE **Portable Radome**

- **Rapid deployment – up to 4.0m antennas**
- **Wind – operational to 70 mph / 112 kph**
- **Significant cost saving vs. conventional radome**
- **Ice Quake or electric De-Icing options – unlike most radomes**

See us at these other Events!

NAB SHOW

34TH SPACE SYMPOSIUM

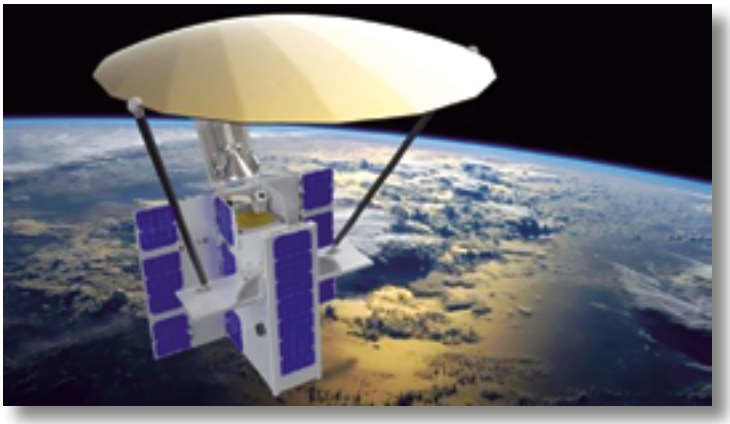
W.B. Walton Enterprises, Inc. | +1 (951) 683-0930
sales@de-ice.com | De-Ice.com

Protecting Military & Government SATCOMS From Rain, Snow, Ice, Wind & Sand
Industry leader.
Decades of field-proven experience. Veteran-owned.

InfoBeam

SmallSat milestone for Clyde Space

Clyde Space has completed their first milestone for the company's first launch contract for NSLComm — the contract encompasses everything from spacecraft design, manufacture, launch, on orbit maneuvers to operations to NSLComm's data provision.



Clyde Space, a subsidiary of ÅAC Microtec AB , received the order from the Israeli pioneering company NSLComm, which is a follow-on order from an initial 6U cubesat purchase. The contract is of strategic importance for the group and marks a key milestone as the firm's first end-to-end mission delivery.

A successful mission could potentially lead to larger constellation orders. With the launch confirmed for the end of 2018, the company stated that this mission is set to revolutionize the space communications network with the introduction of an innovative, patented high-performance antenna.

The ÅAC – Clyde 6U spacecraft, NSLSat1, will demonstrate this highly disruptive technology that will provide Ka-band communications from space. This ground-breaking dish-shaped antenna, which deploys itself once in space, is set to inspire a wide array of new applications within the industry.

Craig Clark MBE, CSO, said it's an exciting time and the company is proud to be at the heart of today's space technology revolution. Serving the fast-growing communications market, this strategic project is a great example of the value they can deliver with end-to-end mission services for their customers.

NSLComm's antenna solution will enable worldwide supercharged internet access to global satellite operators at a lower cost.

The cutting-edge self-correcting solution can turn smallsats into powerful transponders that are able to relay signals from LEO to provide worldwide communications coverage via a constellation of 60 to 100 6U cubesats.

The antenna deploys once in space and has built-in smart technology that increases performance as well as compensates for any imperfections.

The satellite will be able to electromagnetically adjust itself when encountering insufficiencies and change the ground patterns accordingly.

www.clyde.space/
www.nslcomm.com/

Story by Jill Durfee, Assoc. Editor

InfoBeam

Kestrel Eye launches from ISS

Adcole Maryland Aerospace, LLC and Quantum Research International, Inc. have revealed that the Kestrel Eye Block IIM smallsat is in orbit and functioning well following successful deployment from the International Space Station (ISS).

Photo of the U.S. Army and DoD's Kestrel Eye Block IIM launch from the ISS.

The Kestrel Eye imaging satellite is the first on orbit demonstration of an envisioned Department of Defense (DoD) constellation that may someday provide enhanced situational awareness to users on the ground through direct communications with tactical satellites under theater control.

The successful deployment and operation of Kestrel Eye is a major milestone for these two companies, as well as the U.S. Army Space and Missile Defense Command / Army Forces Strategic Command (SMDC/ARSTRAT), the DoD Space Test Program who sponsored the satellite launch and deployment, and the evolving DoD space enterprise.

This class of small, inexpensive, and yet highly capable satellites are expected to make space less expensive and more accessible, while simultaneously enhancing the resiliency and flexibility of future space architectures.

The mission operations team was able to communicate with Kestrel Eye on the first available pass less than four hours after deployment of the satellite on October 24th. When the team established contact with the vehicle, they found it in excellent condition with a nearly fully-charged battery, controlled attitude rates, and healthy communications' links. Over the next few passes, the team was able to command the spacecraft into the planned pointing mode and has begun working through on orbit test and commissioning plans.

Kestrel Eye Block IIM is designed to meet the U.S. Government's increasing demand for enhanced space capability in times of limited budgets.

The superior affordability of end-to-end microsatellite space solutions will help both government customers and private industry realize their mission goals in accelerated timeframes at a fraction of the cost of traditional space systems.

www.adcolemai.com/
quantum-intl.com/

Story by Silvano Payne, Executive Writer

InfoBeam

SmallSat market recognizes lack of launch services stymies segment growth

Alexander Serkin, the CEO of GK LS at the *3rd Annual SmallSat Symposium,* **which was held in Silicon Valley, USA, offered the following on behalf of GK Launch Services (gklaunch.ru) during the event regarding the smallsat industry.**

Ninety-eight percent of satellite industry representatives who attended the symposium were unanimous in their view that launch services continue to be an obstacle for smallsat market growth. In agreement were delegates from space launch industries represented by launch service providers and launch brokers from Russia, USA, Europe, Japan and New Zealand.

Officials from Arianespace, GK Launch Services, Spaceflight Industries, Rocket Lab, and Mitsubishi Heavy Industries addressed this and other topics at the panel discussion "***Launch Opportunities and Payload Differences.***"

"*Supply side of the launch market has grown; nevertheless the launch prices still remain unchanged,*" said *Alexander Serkin.*

Space access capacity keeps on increasing and with emergence of new superlight rockets this trend will continue.

However, despite all these processes, the economics remain invariable, i.e., a micro- or nanosatellite launch price remains within the range of $30,000 to 50,000 per kg. The amount of technical obstacles decreases, but the price doesn't go down.

Mr. Serkin shared his vision of the smallsat market outlook in the near future and, for the first time, he publicly set forth GK's goals in terms of pricing of micro- and nanosatellite launches using Soyuz-2 LV.

Emerging launch vehicles will facilitate timely satellite launching and will allow the micro-/ nanosat market to rely on the smallsat-oriented vehicles capable to deliver them to target orbits. Having several players with new LVs will enable a predictable dedicated access to space. However, it still looks more practical to solve the price issue by piggyback/ rideshare launching on a vehicle such as Soyuz-2. Today, GK works with all types of Soyuz LV and each launch assumes accommodation of piggyback payload.

"*Launch services for smallsats are critical, let alone the fact that for the satellites of 1 to 50kg launch cost in average amounts to about 50 percent of the entire mission budget. The major issue here is how it will affect the capacity of the smallsat market which was in particular looking forward to launch economics changes. The segment of smallsats (1-50kg) is less predictable,*" he said.

In conclusion Mr. Serkin voiced a launch price: a kilo of a payload will cost less than $30,000, and the company is taking efforts to further decrease its prices. In addition, the more standard solutions are used the better the price is.

GK Launch Services was established upon ROSCOSMOS decision to commercialize launch services and is a launch service provider authorized to conclude commercial contracts for satellite launching on Soyuz-2 launch vehicles from Russian spaceports.

gklaunch.ru

Story by Jill Durfee, Assoc. Editor

arianespace
arianeGROUP

REDEFINING SPACE The Vega's hot streak continues with its 11th successful launch in a row since the light lift vehicle entered service in 2012. On November 7, the Vega flawlessly orbited the MOHAMMED VI - A satellite for the Kingdom of Morocco, from Europe's Spaceport. The satellite was developed by Thales Alenia Space and Airbus. It's no surprise that institutional and commercial customers have rallied to the Vega, making it one of the most sought after systems in the industry. Already the Vega C, a new, more powerful and flexible variant set to debut in 2019, is attracting interest with Arianespace signing three contracts for this next generation player. With a combined backlog of nine missions, Vega and Vega C are positively redefining access to space.

#missiontosuccess

InfoBeam

SSTL and 21AT sign EO data provisioning contract

Surrey Satellite Technology Ltd. has signed a £25 million contract in Beijing with Twenty First Century Aerospace Technology Co., Ltd. (21AT) to provide data from a new Earth Observation (EO) satellite (SSTL-S1) that is due for launch via an ISRO PSLV launch vehicle mid-year.

The contract was signed by Sir Martin Sweeting, Executive Chairman of SSTL, and Mme. Wu Shuang, President and Chairman of 21AT and witnessed by the UK Secretary of State, Dr. Liam Fox.

As the manufacturer and owner of the SSTL-S1 satellite, SSTL will lease imaging payload capacity to 21AT for the lifetime of the satellite, designed to be in excess of seven years.

The SSTL-S1 satellite will contribute sub-one meter resolution image data into 21AT's existing TripleSat Constellation service, which is comprised of three SSTL DMC3 satellites that were launched in 2015.

The addition of the SSTL-S1 satellite will enhance both the revisit capability of the TripleSat Constellation and the constellation's efficient global high resolution remote sensing satellite data acquisition and operation services that support a wide range of existing successful user applications by 21AT's domestic and overseas customers.

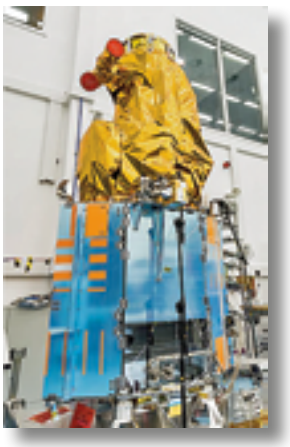
The design of the SSTL-S1 is identical to the present three satellites in the TripleSat Constellation that were launched in 2015. The satellite has a mass of 450 kg. and is capable of acquiring multiple targets in one pass, using spot, strip and mosaic imaging modes and 45 degree off-pointing agility for a range of applications including urban planning, agricultural monitoring, land classification, natural resource management and disaster monitoring.

The very high resolution imager on board the spacecraft has been designed by SSTL and will provide sub-one meter resolution images in panchromatic mode and sub-four meter resolution images in multi-spectral mode, with a swath width of about 24 km.

SSTL's Sir Martin Sweeting commented this contract extends SSTL's 15 year long-term UK-China partnership with 21AT and consolidates the success of the TripleSat Constellation service. Adding capacity to the constellation with a new satellite demonstrates the high fidelity of the imagery and the success of 21AT's business model.

www.sstl.co.uk/

www.21at.com.cn/



InfoBeam

Globecast leasing capacity from SES to serve Orange Romania

Artistic rendition of the SES ASTRA-5B satellite.

Globecast has extended their partnership with SES for the premium TV distribution services which that firm provides to Orange Romania using SES's satellite capacity.

Under the multi-year extension announced by SES, Globecast will lease several transponders on ASTRA 5B at 31.5 degrees East to serve Orange Romania, which uses the capacity to broadcast 112 channels, of which 52 are in HD, using the DVB-S2 and MPEG-4 technical standards.

Globecast manages the contribution, encryption and encoding for the entire TV package, as well as signal transport to the uplink facilities for ASTRA 5B.

Orange Romania's premium TV offer was launched in June 2013 with the support of SES, leveraging the high power and wide coverage of the ASTRA 5B satellite to deliver HD channels via the smallest dish in the Romanian market.

In a highly competitive TV market, with 98 percent payTV coverage and five operating DTH platforms, Orange TV's satellite platform has grown exponentially since its launch.

Biliana Pumpalovic, General Director of Globecast in Moscow, noted that the company has worked extensively with SES and this is another example of the benefits of this partnership for the firm's customers. In such a competitive market, quality of service is an essential factor in determining success, and Globecast is pleased to extend this specific part of the relationship.

www.globecast.com

www.ses.com

Story by Silvano Payne, Executive Writer

InfoBeam

Airbus joins EGNOS V3 consortium

Airbus has been selected by the European Space Agency (ESA) as the prime contractor to develop EGNOS V3, the next generation of the European Satellite Based Augmentation System (SBAS) planned to provide the aviation community with advanced Safety of Life services and new services to Maritime and Land users.

Developed by ESA on behalf of the European Commission and the European GNSS Agency (GSA), EGNOS V3 (European Geostationary Navigation Overlay Service) will provide augmented Safety of Life services.

These services will improve the accuracy and availability of user positioning services from existing Global Navigation Satellite Systems (Galileo and GPS) and provides crucial integrity messages to EGNOS users with alerts within a few seconds in case of system degradation, consolidating EGNOS' position as one of the leading edge GNSS Systems in the future. The A350 XWB is the first Airbus aircraft to offer SBAS operations supported by Airbus' Satellite Landing System (SLS) aircraft guidance function (certified on the A350 since EIS).

EGNOS V3 will offer improved Safety of Life (SoL) services performances (where people's lives are potentially at stake) over Europe to Civil Aviation community and new applications for Maritime or Land users, and will improve robustness against increasing security risks, in particular cyber-security risks.

EGNOS V3 will ensure a full continuity of service for the next decade and will be the first operational SBAS implementing the dual frequency and multi constellation world standard, with both GPS and Galileo, replacing EGNOS V2. As Prime, Airbus will be leading a consortium with partners from France, Germany, Spain and Switzerland. Airbus will be responsible for the development, integration, deployment and preparation of EGNOS V3 operations, the overall performance of the system and the Central Processing Facility which is the heart of the real-time navigation algorithms.

During the 6.5-year contract, around 100 people and 20 subcontractors will work on delivering the EGNOS V3 system. In 2023, the single frequency version will be available to replace the current operational version and, 18 months later, the final version in dual frequency will be delivered.

EGNOS is composed of a large network of about 50 ground stations deployed over Europe, Africa and North America, two master control centers located near Rome and Madrid, and a System Operation Support Centre in Toulouse. EGNOS will also use geostationary satellites navigation payload.

www.airbus.com/

Specialists in Low/Medium Earth Orbit Satellite Tracking Systems and Radomes

Cost Effective
High Performance
Low Maintenance
High Reliability

X/Y ANTENNA PEDESTAL TECHNOLOGY
designed for precision tracking in support of Remote Sensing, Earth Observation, TT&C, and LEO gateway applications.

1.0-to-13 Meter Dish Sizes

L, S, C, X, Ku, Ka, Q and V Bands

Radomes Diameter Sizes: 1.5-13.5M (Larger on request)

Constructions Available: 'A' Sandwich, 'C' Sandwich, and Space Frame Design

Tuned for the Frequency or Frequencies of Interest

Space & Component Technology
www.TrackMySat.com

1-866-264-0793
trackmysat@telecomsys.com

COMTECH
Command & Control Technologies

InfoBeam

Post launch success for GOMX-4 SmallSats

ESA's biggest smallsat yet: the GomX-4B six-unit cubesat will demonstrate miniaturized technologies, preparing the way for future operational nanosatellite constellations. GomX-4B is double the size of ESA's first technology cubesat, GomX-3, which was released from the International Space Station in 2015. The contract with Danish cubesat specialist GomSpace is supported through the In-Orbit Demonstration element of ESA's General Support Technology Programme, focused on readying new products for space and the marketplace. Artistic rendition is courtesy of ESA.

Two GomSpace-built smallsats — GOMX-4 — were successfully launched from Jiuquan Satellite Launch Center (JSLC) in China early last month.

Approximately 12 minutes after launch, both satellites were successfully released from the launcher at an altitude of 503 km. in an inclination of 97 degrees.

At 15:05 (CET), the company established radio contact with the satellites from the company's HQ in Aalborg (Denmark) and the initial activities to ensure that the satellites are operating as planned have been initiated.

Testing each of the individual subsystems will begin after initial contact, which is expected to take three to four weeks.

Full mission operation will begin in March after completion of subsystems and payload testing.

The two cubesats will stay linked through a new version of the software-defined radio demonstrated on GomX-3, while their separation on their shared orbit will be controlled up to a maximum 4500 km.

Such intersatellite links will allow future cubesat constellations to relay data quickly to users on the ground. The same radio system will also be used for rapid payload data downloads to Earth.

Roger Walker, ESA's Technology CubeSat Manager, congratulated the GomSpace team and all the partners in the project for the successful start of the mission.

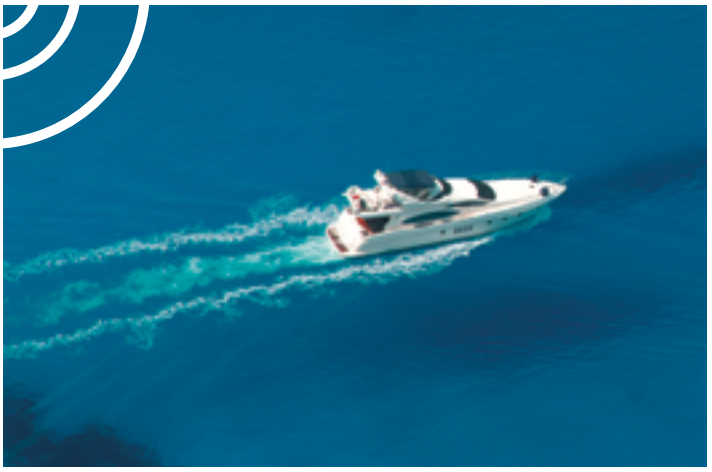
The company now looks forward to the satellite being commissioned and brought into service in the coming weeks in order to advance the state-of-the-art and demonstrate on orbit the key technologies needed for future smallsat constellations.

gomspace.com
www.esa.int

Story by Silvano Payne, Executive Writer

The Long March 2D launch of the GOMX-4 satellites. Photo is courtesy of Xinhua/Wang Jiangbo.

EXPERIENCE The **DIFFERENCE**



WHEN YOU WANT YOUR SERVICE TO STAND OUT
GILAT DELIVERS THE BEST USER EXPERIENCE

Our innovative satellite solutions for broadband access, mobility applications, and cellular backhaul keep you ahead of the pack.

To hear more, stop by and see us at Satellite 2018, booth #809

www.gilat.com | info@gilat.com

Gilat **GILAT** SATELLITE **NETWORKS**

InfoBeam

Collar to CEO of SES, Browne to CFO of SES

The Board of Directors of SES has appointed a new President and CEO as well as a new CFO, to take effect on April 5, 2018.

Steve Collar, SES President.

Steve Collar, who is currently CEO of SES Networks, has been appointed as the next President and CEO of SES, becoming CEO Designate with immediate effect.

Andrew Browne, who was until recently CFO of O3b Networks and the CFO of SES between 2010 and 2013, has been appointed as the next CFO of SES, becoming CFO Designate with immediate effect.

Over the coming weeks, they will work closely with Karim Michel Sabbagh, the current President and CEO, and Padraig McCarthy, the current CFO, in order to ensure a smooth handover.

The Board accepted the decision of Karim Michel Sabbagh to step down from his role of President and CEO, to take effect from the next Annual General Meeting (AGM) of SES on April 5, 2018, in order to spend time with his family and to pursue new interests. Furthermore, Padraig McCarthy, CFO of SES, has informed the Board of his intention to retire during 2018.

Andrew Browne, SES CFO.

The other members of the Executive Committee, being Ferdinand Kayser (CEO SES Video), Christophe De Hauwer (Chief Strategy and Development Officer), Martin Halliwell (Chief Technology Officer), Evie Roos (Chief Human Resources Officer) and John Purvis (Chief Legal Officer), all remain in place. A successor to Steve Collar as CEO of SES Networks will be appointed in due course.

SES Chairman Romain Bausch said, "*We are extremely excited to welcome Steve and Andrew as our next CEO and CFO. They each have extensive experience with SES and the broader satellite industry, especially also as the architects of O3b, the fastest growing and most successful satellite start-up. We have confidence that, with our leadership team, our industry position, our solid balance sheet and our differentiated assets and capabilities, we are well positioned to deliver on our objectives.*

Bausch added, "*Karim steered the strategic positioning of SES in a fast-changing environment, built world-class capabilities with the leadership team and restructured our business and organization to allow for full implementation of our strategy.* "

Steve Collar, the CEO Designate of SES, said, "*I am excited to lead SES into its next phase of development, building on the achievements of 2017 and the foundations that have been laid. I thank the Board for their trust and support. Our focus will be on strong execution in the short term, continuing to roll out differentiated services to our customers, and staying focused on the long term delivery of our forward-looking strategy.*"

www.ses.com

Story by Jill Durfee, Assoc. Editor

SpacePath COMMUNICATIONS

Best in class - size, weight and power performance

Outdoor High Power Amplifiers

- 1250W, 750W, 400W, 180W
- C, X, Ku, DBS, Ka, Q & V Bands

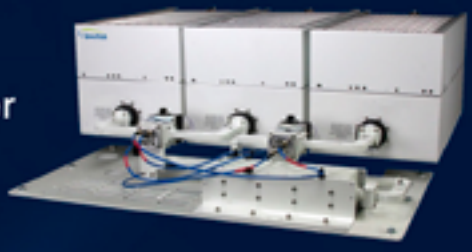
Indoor Touch Screen Amplifiers

- 1250W, 750W, 400W
- C, X, Ku, DBS & Ka-band
- 1:1 & 1:2 Systems

1.5kW Ku/DBS System

Outdoor HPA Systems

- 1:1, 1:2 Redundant & power combined systems
- Small, lightweight
- Easy maintenance
- Quick Installation



2.5kW Ku/DBS System

Outdoor SSPBs

- Ka-band 10, 20, 40W
- Ku-band 16-200W
- C-band 40-400W

Come see us at:

26th Convergence India 2018

Stand Number: E277

SATELLITE 2018

Stand Number: 114

NAB SHOW Where Content Comes to Life

Stand Number: OE20052

Spacepath Communications www.space-path.com / +44 1256 760525

34TH SPACE SYMPOSIUM

SPACE FOUNDATION

The Broadmoor Hotel • Colorado • USA • April 16 - 19, 2018

WE SHARE SPACE!

MAKE PROFITABLE CONNECTIONS

- Space Warfighters Luncheon
- General James E. Hill Lifetime Space Achievement Award Luncheon
- Women's Global Gathering Luncheon
- Space Technology Hall of Fame® Dinner
- Ball Aerospace Exhibit Center and Pavilion

TARGETED TRACKS

- Cyber 1.8 Classified
- New Generation Space Leaders
- Symposium Program
- Tech Track

The Premier Global Space Conference Year After Year!

JOINING US?

- Unsurpassed Networking Opportunities and Connections
- Influential Global Leaders and Decision Makers
- Global Perspectives and Critical Dialogue
- The Latest in Global Space Technology – Most Exhibitors in 34 Years

Official Media Partner

satnews

Satellite News · SatMagazine · MilsatMagazine

SpaceSymposium.org • +1.800.691.4000 • Register Early for Best Savings! Share: #34SS

InfoBeam

CETel is the latest WTA certified teleport

Another new member has certified with The World Teleport Association (WTA), the company is CETel.

The WTA has announced that CETel has achieved provisional certification of its German Teleport located near Cologne under WTA's Teleport Certification Program.

Since its introduction at IBC 2015, the Certification program has quickly grown in popularity, with 15 teleports currently engaged in the quality evaluation process and certifications already issued to teleports owned by Eutelsat, du, Signalhorn, Optus, Globecomm, Media Broadcast Satellite, Horizon, Elara Comunicaciones, GlobalSat, Talia, Telenor, Speedcast, Batelco, Planetcast, VIVACOM, Etisalat and Arqiva.

To achieve Provisional Certification, a teleport operator completes a +170 item questionnaire and submits it to WTA.

The Association analyzes the data based on standards established by its Certification Committee and issues the Provisional Certification based on the self-reported information. The teleport then has six months to achieve Full Certification.

To achieve Full Certification under WTA's program, an auditor is dispatched to visit the teleport, provide independent validation of the data submitted in the questionnaire, and identify additional factors that may positively or negatively affect the score. Full Certification is issued at a Tier number from 1 through 4, of which 4 represents the highest degree of excellence, and remains in effect for three years.

Sergey Raber, Chief Operating Officer at CETel Germany said they are delighted to receive the WTA Certification for our Teleport.

The certification is an important indicator to their prospective and existing customers and demonstrates the crucial importance of quality and security in their daily operations.

WTA Executive director Robert Bell added that certification supplies the crucial missing answer to the teleport customer's biggest question: what quality of service will they really receive? Independent, standards-based evaluation and validation sets teleport operators apart and assures customers that they will receive the price-performance outcome they expect.

WTA's Teleport Certification Program serves both teleport operators and their customers by creating an objective, transparent, and internationally accepted method for teleport operators to document the quality of their operations for customers and strategic partners. It also provides a means for customers to select teleport vendors delivering the price-performance level that is appropriate for their applications.

www.ce-tel.com/

www.worldteleport.org/?page=Certification

Industry Update

The North American Ground Segment

By Dan Freyer, Managing Partner of AdWavez Marketing LLC

Satellite ground segment products are evolving at an exceptional pace, tracking the innovations in space systems that have been introduced with High Throughput Satellites (HTS). In this issue SatMagazine looks at market developments and speaks with a number of key ground segment suppliers about trends in North America. To get a handle on what's hot, and the challenges and opportunities going forward, we spoke with them about how customer needs are shaping the businesses and the industry.

Today, North America generates approximately 20 percent of global ground segment equipment revenues. According to ***Claude Rousseau***, Research Director at **NSR**, "*A key vertical for growth is Consumer Broadband, with a global growth rate of 17.3 percent in the next 10 years. The Satellite TV reception equipment vertical, largely the province of consumer electronics suppliers, is still the largest market for ground equipment by a wide margin, but will remain flat.*"

Mobility services continue to receive lots of attention, as satellite providers seek sweet spots service as terrestrial competition encroaches. "*The underlying trends, addressable markets and statistics on mobility show that it is growing fast across all platforms. This is particularly true for in-flight connectivity (IFC) and cruise ships where passenger demand drives a lot of the capacity demand*," according to Rousseau.

In terms of ground segment markets, "There are major steps forward across all verticals and product segments. Baseband equipment and modems are making major leaps to accommodate the new technological requirements. Throughput capabilities are skyrocketing. Today, there are modems that can support above 1 Gbps of capacity which was unconceivable just some years ago," said Rousseau.

Other products, such as power amplifiers and antennas, are introducing innovations as well. Solid State power amplifiers are growing in power and compactness, enabling new "use cases". The mobility vertical is triggering new architectures like and flat panel antennas.

As satellite operators have been innovating to bring to market high-speed capacity, ground infrastructure providers are transforming the VSAT remote and antenna to leverage this new capacity — introducing more compact and powerful technology

offerings that improve hardware economics, increase data throughput, and make installation and maintenance more efficient.

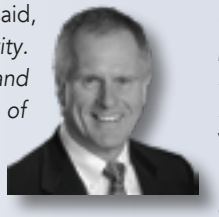
Aeronautical Services, Inflight Broadband: Flying Fast

Aeronautical SATCOM is a low volume but high value vertical, generating tremendous opportunities for equipment manufacturers.

According to Rousseu, "*The North American passenger IFC (in flight communications) market is the largest region with more than 77 percent of the installed units in-service which generated last year 72 percent of global retail revenues. NSR forecasts that overall retail revenues in North America will top the $1B mark this year.*"

NSR projects $4 billion in retail revenues by end of 2026, with North America accounting for 25 percent of that total. The addressable market in North America will scale from 6,800 to 8,000 commercial aircraft in the same period.

NSR projects that the aero market will experience skyrocketing growth as more airlines and business jets incorporate satellite connectivity, generating attractive revenues for all steps of the value chain. Industry players echo this view.



Mike Cook, Executive Vice President at **Hughes** said, "*We see exploding demand is for in-flight connectivity. Working with such leaders as Global Eagle, SES and Thales, Hughes is delivering the next generation of broadband performance for nearly 1,000 connected aircraft in service around the world.*"

Cook also noted, "With a leading 50 percent market share of the global VSAT market, Hughes is also a leading integrated technology partner for in-flight connectivity for commercial, government and private aircraft."

Hughes is leveraging its consumer broadband experience providing its Ka-band HTS HughesNet® high speed satellite internet services to more than one million residential subscribers (60 percent of the consumer satellite internet market in North America), its JUPITER™ System technology and its experience delivering managed network services to over 250,000 retail locations via satellite and terrestrial capacity.

Another major global VSAT supplier, **iDirect**, powers the networks of leading operators in the aero segment, such as Inmarsat's Global Xpress Network, Panasonic, GoGo and SES, with more than 1000+ planes flying iDirect and hundreds in backlog.

"*iDirect is the leading modem equipment vendor in the aeronautical SATCOM market, with 53 percent of commercial aircrafts with installed iDirect modems onboard,*" according to ***Nikola Kromer***, Senior Director of Product Marketing for iDirect. In addition, leading satellite operators such as Inmarsat, Intelsat, SES and Telenor, have selected iDirect as their ground segment partner to power their managed network offering.

"*This selection is based on the critical technological advantages offered by iDirect, including advanced mobility features like beam switching and a robust Network Management System,*" Kromer added.

Sharing excitement about the market was ***Keven Lippert***, president of the Broadband Services at **Viasat**, a global communications company leading the design and development of Ka-band High Capacity Satellites.

"*Commercial aviation is a really, really hot market, partly because it is still evolving, as airlines and customers continue to understand the value of having high-speed internet on the plane. In fact, it's becoming much more than just 'checking the box' that the aircraft has Wi-Fi onboard; it's now about how can airlines optimize the bandwidth for pilots, passengers and crew. For Viasat, we want to connect the entire aircraft — from cockpit to tail; that's why we're bringing the highest-capacity system to airlines at the best economics.*"

Viasat's high-speed, high-capacity satellite service has been supporting airlines for years, including JetBlue, United Airlines, Virgin America (now Alaska), Qantas in Australia, and EL AL Israel Airlines in Europe. In the U.S., the Company signed major deals with American Airlines and two expanded relationships with JetBlue and United. And in Europe, Viasat signed important contracts with SAS, Finnair and Icelandair, in addition to a new contract with EL AL.

Lippert continued, "*We have a strong pipeline of new potential partners — it's an exciting time for us and our airline partners. Our satellites can offer a similar in-home internet experience for all passengers and crew on our network — with similar speeds and full streaming video and content capabilities they expect on the ground. We are ensuring all passenger and crew devices are simultaneously supported. This is no small feat, but that's why we developed the highest capacity satellite systems with the best spacecraft and antenna technology on the market.*" Viasat announced the company will be starting residential service on its ViaSat-2 satellite in February 2018; with service for the commercial aviation market soon to follow. When asked about the American Airlines contract, Lippert said, "*It's a great opportunity for us, and we are truly pleased they selected us. They'll be able to use the ViaSat-2 equipment that is forward and backward compatible with Viasat's satellite system. Installs have started on some American Airline's Boeing737 MAX aircraft.*"

With ViaSat-2 at 69.9 degrees West, Viasat will be able to extend service beyond its current U.S. and Canadian markets into international coverage of Mexico, the Caribbean, and across the Atlantic to serve more airline routes.

iDirect's Kromer observed that, "*In the aero market, airlines are moving beyond an exclusive focus on the customer's entertainment, connecting the entire aircraft to enable digital applications and connect to operations on the ground. 'Fully connected' now means cockpits with electronic flight bags to improve aircraft operations. It means increasing communication between the crew, cockpit, and ground maintenance teams to allow for better predictive aircraft management and repairs. Kromer then noted, "It means equipping cabin crews with the latest mobile technology to improve customer care, increase on-board credit card transactions, and offer real-time authentication to help reduce fraud, all of which lead to increased revenue. And of course, it means high-speed connectivity and premium content to satisfy passenger demands.*"

Advancement in aeronautical flat-panel antennas can increase network speeds and reduce airline operation costs. Electronically steered flat-panel antennas can be smaller, thinner and more aerodynamic, offering reduced fuel drag and weight, and higher performance than traditional gimbaled and mechanically steered antennas.

Today there are more than 10 manufacturers and developers of flat-panel antenna models for air and other mobility uses, including large defense avionics players, and long time satellite antenna players such as Boeing, Lockheed Martin, Rockwell Collins, and Gilat, as well as newer entrants and upstarts in the field such as ThinKom, Kymeta, Phasor, Inc., Isotropic Systems and C-COM.

According to ***Eric Liu***, Business Development Manager, **ThinKom Solutions**, "*The area of greatest growth for us has been the commercial aviation sector where consumer demand for in-flight connectivity has driven a great need for high-speed bandwidth in the sky. This demand is spilling into many other areas such as rail, maritime, and other land mobility.*"

ThinKom, which manufactures the ThinAir® Falcon-Ku3030 and ThinAir® Falcon-Ka2517 system for airborne SATCOMs, has over 500 of its Ku-band products flying, with 1,000 delivered for GoGo Inflight Internet. With over 2,000 aircraft antennas awarded, GoGo's 2Ku, powered by ThinKom's ThinAir® Falcon Ku3030 low profile antenna, is the most rapidly adopted satellite-based broadband antenna in aviation, according to GoGo. The antenna has been selected by airlines in North America, South America, Europe and Asia.

On the Seas and On the Waters

The maritime market is noting two distinct forms of growth, analysts say. Some segments are ready to adopt VSAT on a larger scale, while others require faster throughput levels for increasingly higher traffic networks.

NSR projects that the transition to broadband connections will accelerate over the next ten years, impacting all market segments. VSAT will represent nearly 50 percent of all broadband links by 2026. NSR also forecasts that the growth rate for VSAT-equipped maritime vessels will jump from 14,200 in 2016 to over 37,000 by 2026, representing a 9.1 percent CAGR. In North America, the number of in-service units will increase from 5,000 to 10,000 in the same period.

Commercial shipping will continue to be the largest growth segment, growing from 6,900 VSAT-equipped vessels in 2016 to more than 25,100 by 2026 — a 12.4 percent CAGR, according to NSR. Key applications for growth will be crew welfare, electronic charting and weather, remote IT services and electronic port and customs documentation.

The cruise line segment has relied on VSAT for many years and now demands continually higher data rates. Vessels today are akin to floating communities, a dense concentration of thousands of people who want to stay connected at the same level they have come to expect on land.

"*As traffic demands surge and the number of devices per passenger per ship increases, cruise liners are upgrading their VSAT networks to support higher-speed internet, onboard wireless service, entertainment and streaming video*," added iDirect's Kromer.

According to ***Steve Good***, Senior Vice President, Premium Enterprise, **Comtech EF Data**, a key provider of satellite networking platforms, link optimization devices, modems, converters and RF equipment, "*The maritime market has seen a severe increase in throughput, especially in the inbound direction from ship to shore, and overall performance demands. Cruise ship operators are not only allowing but aggressively leveraging inbound upload and streaming of content as both an elevated on-board service as well as a marketing agent for future potential passengers.*"

NSR has forecast that superyacht and general leisure markets will remain strong, with new ship orders demanding higher bandwidth options. Passenger markets are poised to move over to HTS-based offerings in GEO and Non-GEO, with almost 47 Gbps of demand by 2026, in addition to 79 TPEs (transponder equivalents) of FSS Capacity, according to NSR.

HTS services are predicted to drive significant adoption with better coverage, more affordable bandwidth and lower-cost equipment. In the passenger ship segment, HTS is opening the lower-end ferry market where peak consumption for passenger vessels can be explosive.

Reduced crude oil prices have put pressure on offshore operations, leading to reduced support vessel activities, and rigs operations. This highly penetrated market for VSAT is set to be the slowest growing of all segments, moving from 2,400 in service vessels in 2016 to 2,500 in 2026 — a 0.4 percent CAGR, according to NSR. On the other hand, the growth story for oil and gas/offshore is the average Mbps per site growth is at 3.5 Mbps in 2016 to 22 Mbps by 2026 — an 18 percent CAGR in usage, according to NSR.

Half of all VSAT terminals installed on maritime vessels are made by iDirect, according to VSAT research firm **Comsys**. Nine of the top ten maritime satellite service providers, according to NSR, rely on iDirect's platform to deliver the services needed for the fully connected vessel. iDirect's range of terminals covering customer segments are as varied as superyachts with **OmniAccess**, cruise ships with **Speedcast**, merchant shipping with **Marlink** and **GLOBECOMM**, and oil and gas with **RigNet**.

Higher throughput VSATs are helping to spur growth in maritime. For example, according to iDirect's Kromer, "*Partners like Marlink are seeing tremendous growth*," by leveraging iDirect's 9350 remote to debut new broadband, triple plan, and HD/4K TV streaming, and VOIP services in the superyacht and merchant markets."

The VSAT antenna industry in the maritime sector is innovating even further by offering an ultra-compact integrated terminal (a router board embedded in flat-panel antenna) and through multi-band antennas in order for vessels to be able to connect to the best available network.

Looking Ahead

With business models changing, and the disruption coming from growth in HTS capacity, industry players are not without their concerns. Lower bit costs for HTS capacity could enable new applications; however, new entrants are changing some business models and the resulting competition can be fierce.

For example, according to ***Assaf Cohen***, General Manager, Satellite Networks Business Unit, **Advantech Wireless**, a provider of VSAT hubs and terminals, HPAs, SSPAs, modems, antennas and microwave radios, "*Traditional satellite operators are putting some of the industry in stress, in the sense that they are trying to engage with downstream customers now in order to fill up satellites as fast as possible before the HTS supply glut. There are lots of satellites, plus a lot of HTS capacity that has not yet fulfilled the promise of massive bandwidth utilization*," he said. As a result, traditional value chains are being ignored, so a satellite operator may partner with hardware and software providers to target end-users directly, instead of selling capacity via its traditional service provider channel.

Comtech EF Data's Steve Good agrees that the bandwidth issue affects the hardware marketplace and, like Advantech Wireless' Cohen, remains bullish on market prospects. "*While there are certainly concerns within the satellite market as the industry moves into a satellite bandwidth oversupply condition, we are confident in the fact that our purpose-built products are capable of allowing service providers to meet the increased demands of their end-user base.*"

There are also concerns about possible shake-outs to come as markets mature. As a tech supplier, what amount of resources should be invested into developing of solutions with customers who may not survive in the long term? Critics say not all of the Low Earth Orbit (LEO) satellite constellations proposed by companies such as OneWeb, SpaceX, Boeing, Telesat, LeoSat, and so on, are likely to succeed.

Industry concerns aside, one executive who seems less worried about the risk and more enthusiastic about the potential is ***Mike Cook***, Executive Vice President, **Hughes**. *"Perhaps the most exciting news in this area came in November of 2017 when Hughes announced a new contract for $190M with OneWeb for the production of the ground network system to support OneWeb's constellation of Low Earth Orbit (LEO) satellites. The agreement includes equipment to support multiple access points in gateway locations around the world and will help achieve one of the biggest global technology goals today: closing the digital divide,"* he said.

Technical challenges are numerous, as satellite uses and segments evolve, but so are the opportunities to provide new solutions.

"The satellite connectivity world of today is one in which an increasing number of elements have become mobile. More and more remote sites are in motion and being supported through demand and technology synergies, including vehicular and flat panels teamed with powerful satellites," explained Comtech EF Data's Steve Good. *"In addition, bandwidth demand is increasingly mobile with static sites seeing greatly varying hourly bandwidth demand as people move through coverage and content goes IP and surges depending on what's interesting, including sport events, news, etc. And now the satellites are also moving."*

Good added, *"The satellite industry is at a tipping point in 2018 as new satellite constellations at different orbits continue to fill while new constellations with very optimistic business plans start their launching phase. Looking ahead to 2018 we are extremely excited by the opportunity to enable our satellite service providers at any orbit to truly realize the increased performance levels of the new spacecraft innovations in the market."*

There is much action in play for ground technologies that can help operators best address challenges in mobility, throughput as well as new space architectures. The North American market is expansive and is certainly leading the industry in many of the industry's market segments.

www.adwavez.com

Dan Freyer is the Managing Partner of AdWavez Marketing LLC, a marketing agency uniquely focused on helping satellite industry clients build and defend market share with strategic, marketing and communications services. He has helped top satellite manufacturers, operators, service providers, equipment suppliers, and associations.

Dan can be reached at dan@adwavez.com in Los Angeles.

Perspective: SES

The Transformative power of satellite

By Nicole Robinson, SVP of Global Government at SES Networks and Managing Director of SES Techcom Services

From wildfires in California to hurricanes in the Caribbean, 2017 was reminder of how easily terrestrial connectivity can be disrupted.

Satellite communications technology is playing an increasingly more significant role in connecting communities, governments and institutions around the world. That same connectivity is also helping to advance scientific research and healthcare initiatives, providing critical communications services to first responders in remote and devastated areas and bridging the digital divide across countries.

Satellite connectivity is key to enhancing and informing our human experience. Together with the company's partners, SES has been able to fundamentally improve — indeed, transform — those crucial efforts.

Supporting Humanitarian Operations

With evolving technologies, people often take for granted the ability to quickly get online or effortlessly make phone calls. But what happens when disaster strikes?

Earthquakes, wildfires, floods and hurricanes can, and often do, decimate a country's telecommunications infrastructure. In those situations, reliable connectivity is absolutely critical to safeguard life. Emergency first responders must have access to reliable networks through which they can communicate and coordinate in order to bring help as quickly as possible.

This need led to the creation of the emergency.lu in 2012. The emergency.lu platform is specifically designed for first responders working in ravaged areas.

Emergency.lu employs satellite connectivity to provide emergency response teams with communication capabilities, even in the hardest hit areas. This service results from a public-private partnership between the Luxembourg Government and three Luxembourg companies (SES, HITEC Luxembourg and Luxembourg Air Ambulance), and is supported by various partners SES contributes satellite-enabled connectivity and services to the effort.

Over the past several years, emergency.lu has been successfully deployed to various geographical areas, including Haiti and the Philippines. Most recently, the portable terminals were used to re-establish communications at the airport in Saint Martin and coordination centers in Dominica, following the devastation brought by Hurricanes Maria and Irma.

Photo of the Sand Fire in California.

Faster Network
More Reliability and Security
Better Responsiveness

As the world becomes more and more connected, Globecomm is leveraging advanced RF and IP-centric technologies to help customers implement enterprise-level solutions that expand throughput, increase secure connectivity and enhance the overall user experience.

A trusted partner for managed network services, network system design, integration and operation, we provide:

- Satellite, Fiber, Cellular and CDN global networks that are fully integrated and always expanding
- 24/7 Network Operations renowned for managing the world's most complex communications challenges
- Robust communications solutions featuring Globecomm's hallmark resiliency

Talk to us about your communications needs.

GLOBECOMM®

The Smartest Connectivity.
Anyone to Anything, Anywhere.™

Visit Us at Satellite 2018, Booth 519

Emergency.lu portable communications station. Photo is courtesy of SES.

Satellite-enabled solutions offer more than just immediate disaster response connectivity. They can also support high throughput data applications and mobile backhaul, which can assist in connectivity restoration efforts.

In Hurricane Maria-ravaged Puerto Rico, SES Networks' FastConnect satellite-enabled network was used in conjunction with Project Loon to restore 4G/LTE connectivity on the island.

Bridging the Digital Divide

Beyond times of crises, modern connectivity is essential to development of economies and access to jobs.

Yet whether running a fair trade e-business, accessing a world-class education site via distance learning, or simply surfing the internet, many countries still cannot fully leverage modern communications technologies and applications, due to lack of connectivity.

For example, residents in some parts of Africa or South America are relegated to using dial-up internet speeds — other countries enjoy 4G/LTE connectivity. While some countries lack access due to their economic state, there are places that lack connectivity due to significant geographical challenges. Those locations and residents have very limited or, in some cases, no access to modern communication technology. However, satellite-enabled connectivity solutions can bring changes to these areas. SES Networks has made the commitment to connect the unconnected, to bring communication opportunities to everyone, regardless of their geographical location.

One such example is the SES Networks effort in Burkina Faso — a landlocked country in Africa with a population of more than 17 million residents.

The terrain in Burkina Faso, spanning 274,000 square kilometers, makes communications between various points within the country difficult and unreliable.

Government, educational and healthcare institutions had difficulties in delivering services and learning tools. SES Networks, supported by the local Burkinabe Government and the Government of Luxembourg, devised a viable, future-proof infrastructure to deliver high-speed communications to connect government entities of Burkina Faso, enabling better coordination and quality services to the residents.

SES Networks' solution integrates wireless terrestrial communications and available fiber-optic networks into a satellite-enabled infrastructure. The networks will connect nearly 900 sites across the country. SES Networks' O3b terminals, which will bring Medium-Earth Orbit (MEO) connectivity, are already being installed as part of this multi-phased project. SES Networks is also helping to develop local expertise to make this multi-phased project locally sustainable. Upon completion of the project, Burkina Faso will enjoy cutting-edge connectivity.

Satellite-enabled communications technologies also provide researchers, government representatives, humanitarian workers or exploration entities with vital communications capabilities that work just as well as those offered through traditional fiber networks in big cities.

For instance, SES Networks is currently involved in supporting connectivity service for several hundred members of an expedition in Antarctica. High-speed satellite connectivity solutions have also been deployed for peacekeeping missions in some of the most challenging areas of Africa.

Satellite connectivity can also make a difference in the field of e-health and contribute to the achievement of the UN Sustainable Development Goals. The SATMED e-health platform, established with the support of the Luxembourg Government and SES and supported by partner NGOs, connects doctors and nurses who are based in remote locations, with other healthcare professionals.

The platform has been deployed over the past several years in various parts of Africa and Asia. Additionally, SATMED provides access to medical applications such as e-training, accessing patients' e-medical records, virtual consultation, and video conferencing.

Enhancing Space Missions

There are even more remote regions, far beyond the Earth, where satellite technology is playing a critical role in advancing humanity forward.

Satellites are helping governments, researchers and scientists to gain a better understanding of the vastness of space and the processes that are taking place there. To explore these vast regions and to power various other missions, SES is providing timely and cost-efficient access to space for governments through the use of commercially hosted payloads.

For instance, the SES-14 satellite carries NASA's Global Scale of the Observations of the Limb and Disk (GOLD) hosted payload. GOLD's mission will provide scientists with information and revolutionize our understanding of the nearest reaches of space. It fills a critical gap in knowledge of the Sun-Earth connection by observing a dynamic area in Earth's upper atmosphere that responds both to space weather above and the lower atmosphere

SECURING A LEGACY

BY UNVEILING THE FUTURE

Introducing M-Series – The Industry's Lightest Wideband Ka Carry-On-Compliant 90cm Antenna

Incorporating over a quarter-century of modularity and precision engineering, DataPath's M-Series is the world's most portable 90cm terminal - capable of fitting in an airline's standard overhead compartment or ship's berth.

In addition to industry leading service and support, DataPath's powerful MaxView® Enterprise™ network monitor and control software comes standard. When bundled with your choice of network, professional or our award-winning Cyber Security services, the M-Series outweighs anything in its class.

DATAPATH

Terminals to Teleports and All the Tools In Between™

ATLANTA GA | ABERDEEN MD | WASHINGTON DC | DUBAI | NEW DELHI | SINGAPORE | STOCKHOLM

866.855.3800 | datapath.com

below. Within its mission, GOLD will provide unprecedented imaging of the Earth's upper atmosphere from the Geostationary orbit.

SES-14 isn't the only example of smart, cost-efficient mission-enabling collaboration between SES and governments. SES-15, for example, hosts a Wide Area Augmentation System (WAAS) hosted payload to enable the U.S. Federal Aviation Administration (FAA) to enhance Global Positioning Systems (GPS) with the goal of improving the accuracy, integrity and availability of the system for the aviation industry.

SES's satellites also carry hosted payloads for the European Geostationary Navigation Overlay Service (EGNOS), which helps to verify, improve, and report on the reliability and accuracy of positioning signals in Europe. The applications for satellites and hosted payloads are virtually endless, in space and on Earth.

Building Capabilities for Current and Future Needs

Many of the benefits of connectivity and the applications these technologies empower are made possible thanks to a unique combination of SES's Geostationary and low-latency, high throughput, MEO satellites. That diversity is a technological and industry advantage that supports both traditional and innovative communication solutions.

To serve the growing demand in various sectors, including governments throughout the world, SES is launching more MEO and Geostationary satellites, including High Throughput Satellites (HTS). In addition, SES recently announced the O3b mPOWER, the most powerful, flexible, and scalable satellite network ever. O3b mPOWER will deliver multiple terabits of throughput to connect more people, communities, and businesses.

This network will be a significant step forward for satellite technology as well as the next phase of connectivity for global, high performance network communications.

As satellite technology continues to move forward, people around the world will be able to avail themselves of more benefits derived from better and more reliable connectivity and applications.

More individuals will be able to communicate with one another other without struggle. First responders, scientists, doctors, government workers and many others will find their jobs more fulfilling, no matter their global location.

This is the transformational power of connectivity in the government and institutional sector. Satellite-enabled solutions are playing a key role in these endeavors, making the world increasingly connected and opening an array of opportunities for millions of the world's citizens.

www.ses.com

Nicole Robinson serves as the Senior Vice President of Global Government for SES Networks and the Managing Director of Techcom Services. In this position she is responsible for the company's global business portfolio of government customers in the areas of defense, security, humanitarian, federal, civilian and institutional organizations

In the 10 years since Ms. Robinson joined SES, she has served in a variety of Executive roles leading teams in the area of government product development, business development, government affairs and marketing. Prior to joining SES, she served as the leader of the Strategic Communications function for the U.S. Joint Forces Command's Standing Joint Force Headquarters (SJFHQ) with General Dynamics as well as the U.S. Army Center of Military History.

Ms. Robinson is known in the satellite industry for serving in a variety of leadership positions including two terms as Chair of the Hosted Payload Alliance as well as Vice Chair, Board level positions for the Washington Space Business Roundtable, Techcom and others. She was the recipient of the 2012 Future Leaders Award by the Society of Satellite Professionals International and is a member of "The FEW," an invitation-only assembly of senior executive women.

Ms. Robinson is certified in Federal Financial Management by the Federal Training Center, completed her bachelor's degree in Communications at Radford University, earned an MBA from Liberty University, and is a graduate of the Senior Executives in National and International Security Program at Harvard University, Kennedy School of Government.

Focus: Comtech EF Data

Meeting the demands of the N.A. service provider

By Andy Lucas, S.V.P., Comtech EF Data

The demands that North American satellite service providers are placing on their ground equipment providers have increased substantially over the past few years in terms of product performance and ongoing support.

Satellite service providers of 2018 are relying heavily upon their ecosystem vendors to enable them to stand out and offer clearly differentiated service products from their competition. Being limited to simply lowering price to win projects via a "*me too*" service is simply not acceptable as service providers need to bring to the table a platform on which they can team an enhanced service level with their own value-added services. Their main demands center around enhanced performance — increased throughputs of highly dynamic traffic flows with stronger application support — teamed with a robust and intuitive network analytics engine that allows complete, centralized control and command of a network to maximize service uptime.

While satellite bandwidth prices continue to decrease, resource efficiency continues to be a necessity to open new markets while keeping satellite relevant in existing markets. The advent of High Throughput Satellite (HTS) options, through the implementation of a variety of spot beam approaches, has driven the potential price per Mbps of satellite services significantly lower.

However, the challenge remains to team the correct ground platform with these new satellite innovations to realize these savings as fixed monthly costs will always continue to be tied to long term MHz procurements while service revenues are directly tied to the amount of "*deliverable Mbps.*" The definition of deliverable Mbps varies based upon the selected platform. Those that will succeed in this new satellite communications landscape will select a ground platformthat performs high horsepower multi-layer optimization abilities and realize the network efficiencies that enable a profitable business in this increasingly demanding environment.

WORK MICROWAVE

we are the wave –
excellence in high frequency

REALIZING THE FUTURE

500 Msps

End-to-End Wideband

Transmit and Receive Solution

Full throughput with 256APSK Up to 3 Gbps per direction

DVB S2X

High-Throughput Satellite Point-to-Point

A-Series. AX-80 All IP-Platform

... highly flexible architecture for future-proof applications

www.work-microwave.com

The New Sweet Spot of Performance

Today's end users are demanding unprecedented price for performance numbers that the industry hasn't seen before, and it's on the vendors to make this happen.

The maturation of North American satellite service provider demands has created a new sweet spot that ground equipment manufacturers are targeting. This combination of performance level and target service price point is beyond the abilities of many of the traditional products on the market as platforms designed for best effort connectivity are no longer robust enough to support the application mix of the markets where these service providers participate.

This sharp increase in performance demands has been seen across the North American service provider landscape, including by government and commercial providers of fixed and mobile services, mobile network operators, telecom companies along with systems integrators and resellers. Service providers in all vertical markets are demanding an increased Quality of Service (QoS) level to allow them, in turn, to offer the best Quality of Experience (QoE) to their end users.

End users have come to expect robust connectivity at all times, rendering best effort simply not good enough. Ground equipment manufacturers that serve these markets have addressed these demand increases via a combination of technical and commercial elements.

"Mobility" is The New Normal

The satellite connectivity world of today is one in which an increasing number of elements have become mobile. More and more remote sites are in motion and are being supported through demand and technology synergies, including vehicular and flat panels teamed with powerful satellites. In addition, bandwidth demand is increasingly mobile with static sites seeing greatly varying hourly bandwidth demand as people move through coverage, content goes IP and surges depending on what's interesting, including sport events, news, etc.

And, now the satellites are also moving. Any ground station of today must be designed with the assumption that mobility (on many levels) is the future and any satellite solution implemented today must be future-ready.

In the mobility space, the maritime market has seen a severe increase in throughput requirements, especially in the inbound direction from ship to shore. The acceleration of performance demands is created as end users within this space require an enhanced Quality of Experience.

Those in the shipping industry need to reliably transmit an increasing amount of on board content from thousands of machines and sensors that track the health and efficiency of equipment en route.

Cruise ship operators are not only allowing, but aggressively leveraging, inbound upload and streaming of content as both an elevated on-board service as well as a marketing agent for future potential passengers.

The industry has seen a substantial increase in the number of rollouts of 3G and LTE as the communication standard of not only a Mobile network Operator (MNO) solution, but also for non-MNOs that provide fixed and mobile network services. Today's challenge is to implement a purpose-built ground equipment solution that understands these standards, optimizes the traffic flow and provides the right mix of latency and jitter to allow these protocols to function correctly at any throughput.

Collaboration is Key…

While throughput requirements have continuously increased in the satellite communications industry year over year, the last couple of years have seen a significant increase in throughput demands, especially in the inbound direction. This is due to the sheer amount of content that needs to be gathered, analyzed and acted upon from both human and, in growing numbers, non-human users.

Customers in all verticals are demanding an increased QoS level to allow them, in turn, to offer the best QoE to their end users. End users have come to expect robust connectivity at all times, rendering best effort simply not good enough.

Comtech EF Data continues to innovate and adapt its product suite to the demands of targeted markets, spending a great deal of time listening to real-world problems and enhancing its solutions around these use cases through collaborative means.

The results? The Comtech EF Data product suite has pushed satellite network efficiency and resulting revenue to cost ratios to new heights. All traffic is classified, prioritized, traffic shaped and compressed at speeds of hundreds of Mbps, offering the highest Router Mbps to Satellite Mbps ratios in the industry. At the same time, a dynamic and graceful bandwidth allocation engine is used to allow a service provider to share fixed monthly costs across its remote end user population.

From a technical perspective, the outcome of Comtech EF Data's collaborative work has resulted in ground-breaking platform performance levels. The company introduced the H-Pro into its Heights Networking Platform remote gateway family and has pushed its industry leading CDM-760 Advanced High-Speed Trunking and Broadcast Modem to optimized data speeds never before seen in our industry.

From a commercial perspective, service providers in the ground segment and mobility markets have demanded a platform that allows them to minimize operational costs while also providing the ability to tie service revenues to their fixed costs through network scalability, which is a core attribute of the Heights Networking Platform.

As the industry flocks to Washington, D.C. in March for the annual SATELLITE Conference, these collaborative conversations will continue around exciting new additions to the Heights Networking Platform that increase the applicability of the platform across multiple vertical markets. In addition, as the world of static and dynamic bandwidth solutions continue to merge, so do the different product offerings and network growth paths that allow service providers to offer an array of service levels, each tailored to end users' needs.

These new offerings will provide yet additional options to service providers that wish to leverage network assets as long as possible and as end user demands for connectivity change over time.

What's Next??

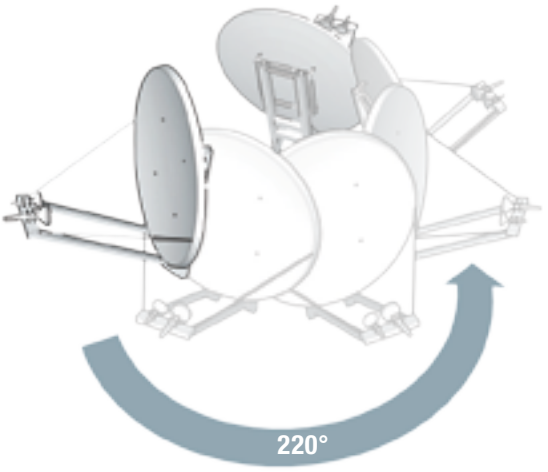
The satellite industry, especially markets served by North American service providers, is at a tipping point in 2018, as new satellite constellations at different orbits continue to fill the sky while new constellations with very optimistic business plans start their launching phase.

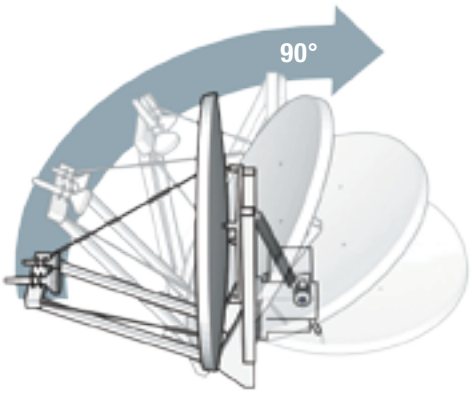
Looking ahead into 2018, ground equipment manufacturers are excited by the opportunity to enable satellite service providers at any orbit to truly realize the increased performance levels of the new spacecraft innovations in the market.

While HTS options offer the market an entirely new price for performance equation, only through the proper ground equipment solutions can these benefits be realized.

www.comtechefdata.com

Fast and precise positioning with tracking, amazing 220° azimuth range and 90° elevation range. Available for a wide range of antennas with up to 3.8 m reflector.





High Speed... Three Axis Antenna Mount

Accuracy meets Robustness!

Hiltron offers one of the worlds best motorized antenna mounts: SORBAS!

As a leading Satcom systems manufacturer we know the checklist, and we know that the heart of the system must offer **speed**, unique **accuracy** and **reliability**. We engineered all our know-how into the ultimate project at a competitive price point and with renowned **German build quality** as a must.

HILTRON
Communications

Leading SATCOM Systems Manufacturer

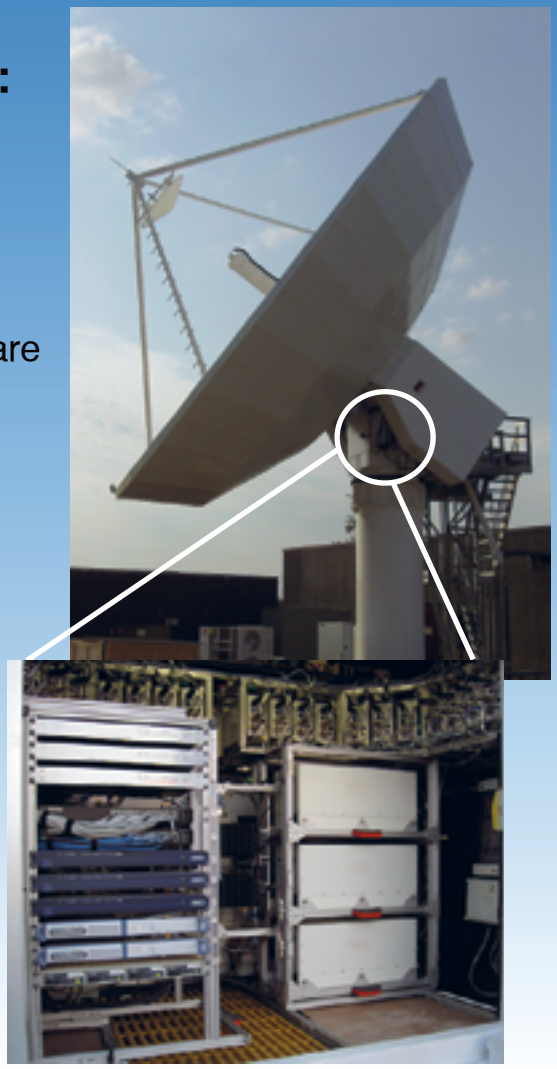
info@hiltron.de · www.hiltron.de

The Premier Provider of RF Systems

Complete turnkey systems, civil works, infrastructure and IFLs

SED's innovative technology increases performance, reduces costs and eliminates risk:

- Optimized low loss hub implementations
- Low maintenance antenna de-icing and hub HVAC
- Low cost uplink power control and carrier monitoring
- Flexible, adaptable Mon-A-Co M&C, integrated with hardware



Full range of applications supported:

- HTS and MSS communications gateways
- Telemetry Tracking and Command (TT&C) systems
- Earth Observation and data reception
- Broadcast uplinks
- In-Orbit Test (IOT) systems

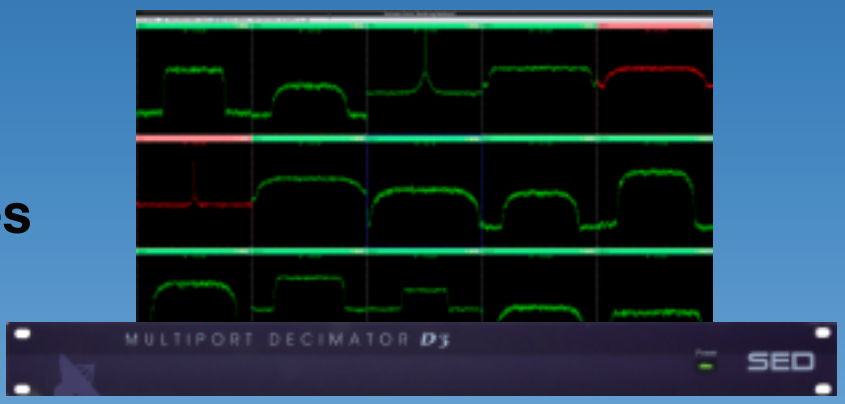
State-of-the-art COTs products when possible, customized hardware designs when necessary.

SED
a division of CALIAN Ltd.

For additional information contact:
commsystems@sedsystems.ca
www.sedsystems.ca/satellite-communications

High Performance Products from SED Systems

Decimator D3
Spectrum Analyzer Series



- High performance broadband 5MHz to 3GHz digital spectrum analyzer
- Sophisticated yet easy to use web based GUI
- Integrated applications for cross-pol & carrier monitoring with API, SNMP traps and email alarms
- Available in 4 and 8 port, PCIe card and portable models
- View up to 100 carriers on a single screen with CarrierWatch software

Check out our other high performance products:

Gemini
DVB-S/S2/S2X Modulator
Superior RF performance and flexibility

Defender
Spectrum Protection
Cost effectively occupy unused spectrum

Spectare
Low Cost Spectrum Viewer
Ideal for viewing L-band signals on a budget

Itus
L-band Redundancy Switch
Intelligent signal analysis based switching

Visit us at Satellite 2018, Booth 1432

For product information contact:
satcom@sedsystems.ca
www.sedsystems.ca/satcom

SED
a division of CALIAN Ltd.

Evolution: Newtec

How to maximize business potential

Bart Van Poucke, V.P., Product Management, Newtec

As the satellite industry continues to be marked by uncertainty, service providers are looking for solutions which deliver increased efficiency and performance in order to maximize their businesses' potential.

This applies during every phase of satellite network implementation — even before it begins, service providers have many difficult decisions to make.

During this planning phase, there are so many unknowns which must be addressed, with every single one having a possible impact on the business potential.

Fast-forward to when the satellite network is up and running, and there are still options to consider as the network grows, new technologies emerge, and the business and market conditions change. While the best solution to this challenge might be a crystal ball, a more realistic option is to choose technologies which deliver the highest efficiency and performance, and enable the business potential of the network to be analyzed for maximum return.

Maximizing Potential

When launching a new service, early insight is perhaps one of the most important elements to ensure operators are aware of the return on investment through potential areas of growth will bring and how this insight can be maximized.

Targeting new markets comes with many unknowns; what technologies should be used and how will they impact the service plan? Which satellite will be used? What will be the satellite's characteristics? What profiles will be offered to customers? And so on. To cope with these different levels of the unknown, Newtec has developed the innovative Satellite Network

The Drop-in Replacement for Legacy Control Systems.

Radeus Labs 8200
Antenna Control System

Quality
Delivery
Support

Contact Us

Reduce your operating and maintenance costs today.
Learn more at Radeuslabs.com

(858) 602-1255 • 12720 Danielson Court • Poway, CA 92064 USA

RADEUS LABS, INC.

Calculator (*see the infographic below*) to give customers the power to analyze performance and evaluate potential gains to be made by their satellite network in any market.

If the satellite to be used is not known, this tool allows operators to see how different elements of the network would affect bandwidth consumption and, therefore, cost and capacity. If the satellite is already known, the calculator can make detailed analysis and indicate what types of terminals could be used for certain service profiles to give an idea of the overall cost. Providing unparalleled depth of analysis, the Satellite Network Calculator can be used from the planning stage of a new network, all the way up to optimizing and implementing an established network.

This is a particularly relevant tool for the industry in light of the new satellite transmission standard, DVB-S2X. The exact benefits this new standard can bring to specific applications is still unknown by many operators, despite the vast amount of communications on the subject. DVB-S2X uses finer granularity for MODCODs; that could mean service profiles can be provided with higher availability or it could mean the coverage area can be extended, but the exact impact on each individual network and any secondary benefits are not clear prior to installation. Now, with the Satellite Network Calculator, the outcome of a DVB-S2X implementation can be shown for specific customers and use cases.

The application of Newtec's award-winning, dynamic Mx-DMA® bandwidth allocation technology can also be demonstrated through the Satellite Network Calculator, with one customer in the maritime sector seeing a 36 percent gain in capacity.

Due to the higher throughputs cellular backhaul now requires, mobile operators can now see how the application of this dynamic bandwidth allocation will impact the network and, therefore, optimize their businesses.

Effortless Efficiency

Optimum efficiency and performance are also key to success and new satellite solutions continue to emerge to address these areas. Here, the mobility market is a particular area of focus, as cruise ships and super yachts push the limits of existing satellite platforms. With thousands of users onboard, some of these vessels are like floating cities, consuming hundreds of megabits of bandwidth as they move around the world.

As customers' demands in this area shift from basic connectivity to always on, high-speed and capacity broadband, the advent of High Throughput Satellite (HTS) networks promises more bandwidth at lower costs for mobile VSAT operators. However, maximizing the benefits of these new satellites will require some important changes on the ground. To meet the demand for on-the-move communications, ground segment equipment must be able to switch seamlessly between different satellite beams. Previously, this process didn't take into account additional metrics, for example, route planning, but solutions have now evolved from doing basic switching to a more sophisticated switching logic.

The Newtec Dialog® Mobility Manager, for example, incorporates a rich set of APIs to provide unprecedented control over beam switching logic, facilitating network load balance, low-cost routing and regulatory compliance.

Sharing capacity brings further efficiency gains, with the maritime world bringing various traffic dynamics to address. Ships in the harbor, for example, require different services to ships at sea, where there is a lot of dynamic traffic. Here, our dynamic Mx-DMA technology can share a certain amount of satellite capacity over different ships and provide the capacity needed at a certain moment in time. This results in high efficiency gains because there is no need to provide fixed, dedicated pipes for every ship.

Premier Performance

The need for shared capacity and higher speeds is also related to performance and with the increasing demand for high throughput from cruise ships, the performance of modems within the network is key. Operators should look for modems which fully support DVB-S2X and provide a choice of return technologies to ensure the best performance for all applications.

At Newtec, our DVB-S2X Wideband Modem portfolio fulfills these demands but also brings the added benefit of wideband. This implements more MODCODs, increasing the granularity and gain, but also enables 500 Mbaud capabilities for transmitting DVB-S2X. This is important as HTS introduces 500 MHz transponders. Using wideband to separate the transponder gives a 3dp gain, which equates to about 10 percent more throughput.

The need for shared capacity and higher speeds is related to performance and with the increasing demand for high throughput in mobility, the performance of modems within the network is key. Operators should look for modems which fully support DVB-S2X and provide a choice of return technologies to ensure the best performance for all applications.

Intricate Insight

As the satellite industry continues to evolve, these new tools will become more and more essential in order to help customers realize areas of growth and maximize the full potential of their businesses.

Those involved in the satellite industry are correct to be mindful of new standards; however, the unknown is scary and Newtec's tools help customers uncover the huge gains that can be achieved with these new standards and technologies. While it is true there is no crystal ball, intricate insight in the planning phase and throughout, the lifespan of satellite networks is improved, allowing various scenarios to be tested before implementation.

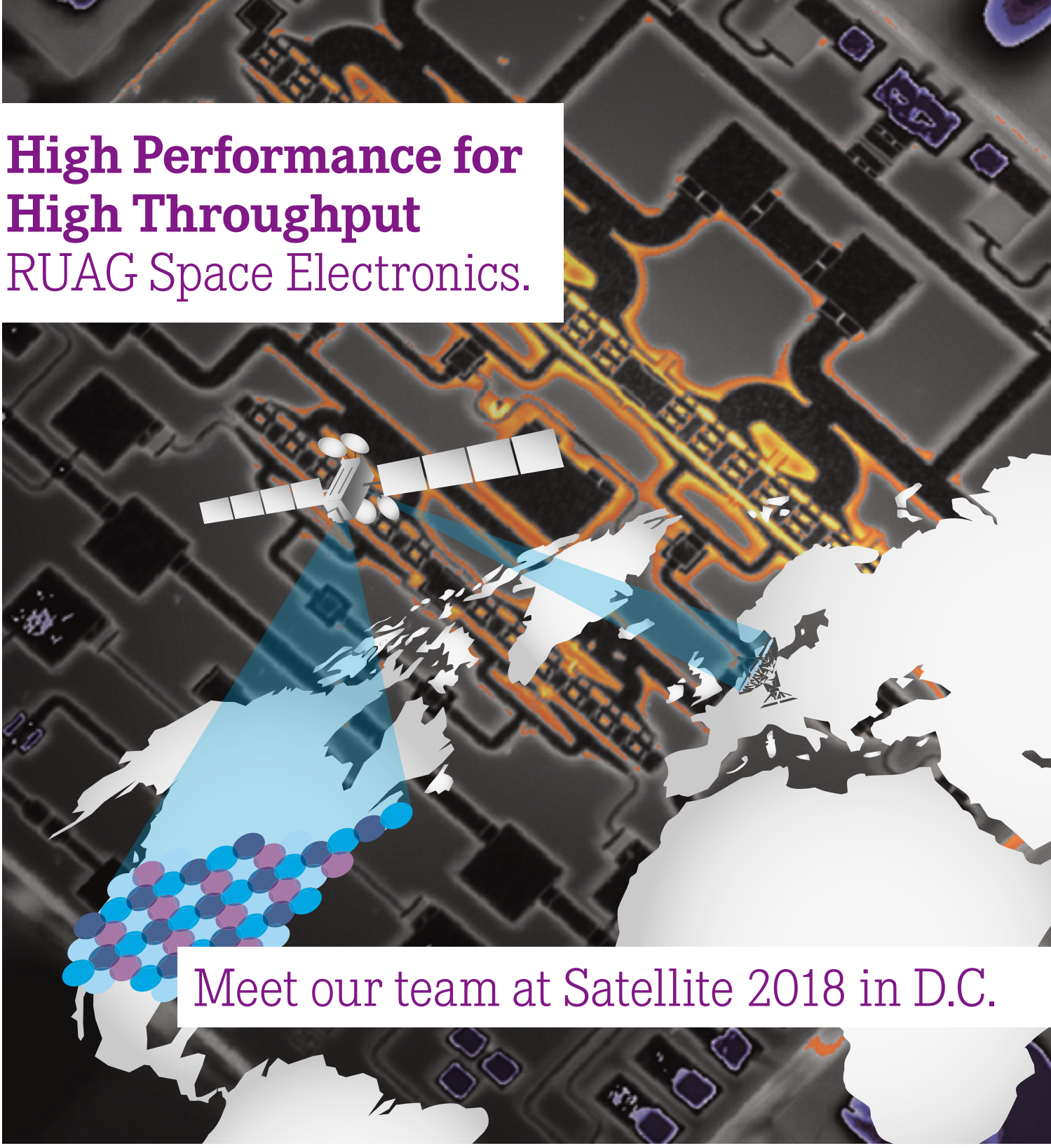
With tools which enable this, we will continue to encourage our customers to aim high and push the limits of both their businesses and the satellite industry as a whole.

Bart Van Poucke, VP Product Management, joined Newtec in 2010 as product manager for Sat3Play, a broadband access platform by Newtec for B2C and B2B connectivity. Later on, he was responsible for the Newtec Dialog multiservice platform. In 2016, Bart became VP Product Management.

Bart obtained his electrical engineering degree at the KIHO in Gent, Belgium, in 1996. After several years at Siemens Private Networks, he joined the imec in Leuven, Belgium, to work in wireless R&D. In 2006 he moved to business development at imec to drive, expand and coordinate business generation in the field of smart systems.

High Performance for High Throughput

RUAG Space Electronics.



Meet our team at Satellite 2018 in D.C.

At RUAG Space, we specialize in developing and manufacturing satellite and launcher products, including high precision electronics. Our electronics portfolio features computer systems, navigation receivers, microwave and antenna products. A particular focus is on developing powerful electronics for High Throughput Satellites.

@RUAGSpace

www.ruag.com/space | info.space@ruag.com

Together ahead. RUAG

Focus: GLOBECOMM

Delivering the Big Data Revolution to O&G

The first known use of hydrocarbons dates back 6,000 years to an oil seep on the banks of the Euphrates River in what is now Iraq.

The oil bubbled up to ground level, evaporated and left behind asphalt, which people used as mortar between building stones. Over the next few thousand years, Babylonians and Mesopotamians put it to the same use. The pyramids of Egypt were held together with it. It was not until about 2,000 years ago, we think, that the Chinese began using oil and natural gas for heat and light, bringing it into their homes through bamboo pipes.

Two thousand years later, the world depends on fossil fuels to meet 82 percent of its energy needs. We use oil, gas and coal to heat and cool our homes, cook our meals and move our vehicles. Renewable energy is on a major growth track; in 2016, renewables accounted for 55 percent of all new electricity generation capacity and almost 17 percent of global power capacity, up from 15 percent the previous year.[1] However, experts still predict that fossil fuels will be meeting 75 percent of world energy needs in 2035.[2]

The world's emerging economies are the reason why. In developed nations, demand is largely flat, except for transportation. But emerging economies are growing fast, lifting billions out of poverty, and the rise of their middle classes is powered by fossil fuels. There is no end in sight to the quest for the Earth's hydrocarbon wealth.

If our dependence on fossil fuels changes slowly, the technologies for finding it, recovering it and transporting it change fast. Most of that technology innovation — from horizontal precision drilling to analytics based on real-time monitoring — rests on a foundation of digital communications. In an energy industry undergoing seismic changes, the value of that digital foundation grows by the month.

Challenge, Change and Opportunity

For all its vast wealth and global reach, the petrochemical sector faces a set of converging challenges today. Lower oil prices have become the new normal and oil and gas companies are feeling the heat. Plunging prices increase the pressure to reduce costs and increase productivity. Meanwhile, environmental, safety and security pressures are pushing in the opposite direction, and the turbulent state of international politics adds to the challenges of exploring and producing.

And, if that were not enough, the availability of skilled personnel is reaching new lows. Having laid off nearly 300,000 workers worldwide at the beginning of the oil price declines in 2014, the industry is now facing the retirement of the Boomer generation. In the U.S. alone, the industry needs to hire 100,000 new workers for jobs with uncertain prospects that require long periods away from home.[3]

The industry has talked for years about the "digital oilfield" — shorthand for bringing the Big Data revolution to the exploration, production and transport of oil and natural gas. While progress has been made, these converging challenges are providing fresh motivation to turn that concept into an every day reality.

Substantial investment has gone into data technology over the past decade. In shale gas extraction, data from seismic monitoring helps producers adapt their drilling and fracking processes based on a better understanding of the structure of shale basins. Sensors deep in drilling equipment or producing wells send a stream of information that tells producers how equipment is performing. Sensors in pipelines measure stresses and allow operators to perform preventative maintenance or shutdowns.

In fact, the industry is nearly drowning in the output of such data, and the next big opportunity is to make sense of it all through sophisticated analytics. The goal is to capture and analyze data from all parts of the oil and gas value chain and analyze it in real-time to optimize performance. There is another goal as well: to address the talent shortage by making scarce expertise in exploration and production go further. The upstream divisions of oil super majors each currently spend $1-3 billion per year on acquiring data. Investments in the digital oilfield are projected to surpass US$30.7 billion per year by 2020.

Big Communications for Big Data

Data gains value when it moves. The Big Data revolution rests on a foundation of communications, and the realities of oil and gas exploration, production and transport mean that satellite plays a major role. For production rigs moored conveniently close to coastlines, it can make economic sense to run fiber-optic cable under the water, because that rig is likely to be in place for years. Point-to-point microwave is also suitable for rigs located within line of sight of each other and the land. But in deepwater, as well as the kind of remote land where most petrochemicals are found, only satellite can move the digital bits.

The communications requirements have a very wide range in terms of bandwidth and cost. At one end of the rate are pipeline networks, which typically transmit data from pressure, temperature and vibration sensors using traditional and inexpensive SCADA technology at very low bandwidth measured in kilobits per second. Because the sensors are polled by the network rather than reporting continuously, a few megabits per second of bandwidth can serve a large number of sensor locations.

At the other end of the range is real-time remote monitoring and operation of down-hole drilling, which requires a continuous stream of data and video in both directions. When remotely monitored and operated systems are at work, the bandwidth required can climb into dozens or hundreds of megabits per second.

Despite the challenges of low prices, oil and gas companies continue to invest substantially in data technology and communications to optimize their operations. Frost & Sullivan estimates that the offshore oil and gas communications market spend will exceed $460 million per year by 2020, up 28 percent since 2014, when oil prices first began to plunge.[4] What are companies doing with that money?

Asset Tracking

Exploration, production and transport require a large number of high-value movable assets on land and offshore. Many of them carry volatile, potentially explosive petroleum products. Those facts have made oil and gas companies major users of satellite asset tracking technology, which uses thin-route data and GPS coordinates to map asset locations.

Shell is one company that has deployed a tracking and asset management system based on the Globalstar satellite data network. After deploying 250 tracking devices, it achieved a positive return on investment in just three months.

Petrochemical producer SABIC used a Globalstar-based solution to ensure that its 500 rail tank cars, many filled with explosive chemicals, move through its European supply chain safely and on schedule.[5]

Even relatively fixed assets benefit from big data. Remote surveillance of drilling and production platforms no longer requires continuous monitoring of video screens, either onboard or remotely. Instead, a local network of proximity detectors can monitor movement and build a profile of normal traffic patterns. When movement is detected where it should be taking place, the system can activate a camera to provide visual inspection. The business case for centralizing this surveillance is strong, because a single small team can remotely monitor multiple installations.

Preventative Maintenance

As companies use sensors and communications to monitor temperature, pressure and flow data, they can do much more than gain minute-to-minute status updates. As they amass data over time, it creates the opportunity to correlate the information with maintenance and shutdown experience. Big data analytics can then move from monitoring to prediction to reduce downtime and make maintenance more effective and less expensive. A leading compressor manufacturer developed customer sensor models and used predictive analytic software to actively monitor the readings from these sensors and schedule preventative maintenance for its midstream customers.[6]

There are 2.9 million kilometers of pipeline in just the ten countries with the biggest networks. By 2022, there are expected to be 90,000 sensors in pipelines and another 200,000 in electricity grids around the world.[7]

Crew Welfare

Life at the wellhead can be tough. Isolation, long-hours and dangerous work take their toll on workers and their families. Connectivity, however, makes a massive difference, whether it is email and social media or sports and entertainment streamed from the internet. They are not big data applications, strictly speaking, but are a high-value addition to the digital toolkit.

Accidents or illness impose a big burden not only on workers but on their employers, too. Transporting a sick crew member just 50 miles by helicopter for medical care can cost up to $10,000. A boat ride from the Gulf of Thailand and emergency jet to Singapore can cost up to $150,000. Remote medical systems let medics at the wellhead collect health data and share it with faraway doctors, who can diagnose, prescribe care and make the decision to evacuate if needed. According to one firm, InPlace Medical, telemedicine lets teams resolve 80-85 percent of situations quickly without the need for transport, which delivers better care as well as saving money.[8]

Remote Analytics

Better analytics can improve the way companies manage the entire process of drilling and connecting a well, which reduces lag time and minimizes the number of wells being drilled at the same time. Transmitting microseismic 3D images over high-bandwidth connections, for example, can substantially improve new well delivery and optimize reservoir, well and facility performance.

Down-hole multiphase sensors and measurement-while-drilling applications send a constant stream of information that, effectively analyzed, improves calibration and visualization capabilities to reduce risk and increase success rates.[9]

Integrated Operations

Today's energy companies need the talents of engineers, geologists and data analysts in more corners of the world than ever before. But that demand far outstrips the supply. Big data and communications let experts work on multiple sites at the same time without ever leaving home. Making it work requires a complex array of sensors, real-time analytics to interpret the data, high-quality video, and remotely controlled equipment, from valves and motors to remotely operated submersibles. By spreading the talents of their best people around the globe, energy companies can run more of their operations at peak performance and reduce their risks.

One UK-based oilfield services company created a network that connected all of the client's offshore rigs to a single global service center. The company estimated that centralizing support for the rigs reduced overall costs by 30 percent.[10]

Higher Throughput at Lower Cost

One barrier to the digital oilfield has been the cost of communications via satellite. Until recently, satellite operators have successfully defended a business model that limited capacity in order to maintain premium prices. That tended to limit the spread of applications requiring high throughput to the biggest companies and projects.

The introduction of High Throughput Satellite (HTS) systems in 2004, and their rapid acceleration beginning in 2010, is changing that dynamic. They use narrow spot beams to deliver more bandwidth at much lower cost-per-bit, which offers much more attractive economics. Rather than committing to a lump of capacity measured in megahertz, customers can now buy bandwidth by the megabit, just as they would do over a terrestrial connection.

All of the HTS satellites currently in operation or construction will more than triple the current bandwidth available from satellites — two HTS satellites launched over North America more than doubled capacity over the continent. Throughput will range from 10 to 140 Gbps per beam, which will deliver the major bandwidth that big data requires at a fraction of the typical cost of satellite. Market demand for HTS service is expected to reach 1.5 terabytes by 2024, according to NSR and Euroconsult.[11]

Making the Digital Oilfield a Reality

GLOBECOMM has provided communications and connectivity services for oil and gas producers around the world, from North America to Africa, Europe to Asia. For much of that time, the digital oilfield seemed more talk than action — but only because transmission technologies were not mature enough to support the applications that customers needed at a price they were willing to pay. That long-standing situation is now changing rapidly through advances in signal processing, compression and encoding. The new generation of HTS satellites will push the price-performance equation even further in the customer's direction.

As digital becomes the new driver of exploration, production and transport, however, it is probably due less to technology change than to the way that mobile devices have entrenched themselves in our lives. Mobility is the new reality for workers, from their phones to tablets and laptops. Companies understand how much more productive these technologies make their employees, and that recognition is gradually toppling barriers to what might have been seen as "unnecessary" spending on digital frills.

Suppliers like GLOBECOMM will continue to innovate in the applications needed to make the oil and gas business more efficient, productive, safe and attractive to employees. But it is the changing nature of work in the digital age that will ultimately make the digital oilfield an everyday reality for most of the industry.

GLOBECOMM, headquartered in Hauppauge, New York, is a trusted global connectivity partner for designing, managing and distributing voice, video and data solutions to the most remote locations on Earth with company locations in Texas, Florida, Maryland, New Jersey, Virginia, the Netherlands, South Africa, Germany, Singapore, Hong Kong, the United Arab Emirates, Indonesia and Afghanistan.

The company's multi-network Satellite, Fiber and Cellular Infrastructure is the backbone of mission-critical RF and IP communications for Government, Maritime, Media, Enterprise and Oil & Gas customers in over 100 countries. GLOBECOMM designs and integrates best-of-breed broadcast and OTT media solutions; complete enterprise communications and data management systems including Internet of Things applications; and on-premise and cloud-based enterprise video platforms.

www.GLOBECOMM.com

Intro image, Pipelines, Data Analyst, O&G Platform: iStockPhoto.com
Teleport: GLOBECOMM

References

[1] "Renewals Growth Breaks Records Again Despite Fall in Investment," by Jocelyn Timperley, CarbonBrief, June 4, 2017.

*[2] World Energy Outlook, November 12, 2013, International Energy Agency (**www.worldenergyoutlook.org**)*

[3] "Energy Jobs: Oil and Gas Industry Could Hire 100,000 Workers – If It Can Find Them," CNBC, July 8, 2016

[4] "Offshore Oil and Gas Satellite Communications Market to Steadily Increase, Reports Claim," Offshore, November 3, 2015.

[5] "In the Oil and Gas Recovery, Satellite Will Rise," by Adrienne Harebottle, Via Satellite, November 2016.

[6] "Big Data Analytics in Oil and Gas," by Riccardo Bertocco and Vishy Padmanabhan, Bain & Company

[7] "Don't Forget the Kbps in the Energy Markets," by Brad Grady, NSR, January 27, 2015.

[8] "Healthcare Delivery for Oil Rig Workers: Telemedicine Plays a Vital Role," Telemedicine and E-Health, July/August 2010

[9] Big Data Analytics in Oil and Gas."

[10] "Case Study: Stallion Oilfield Services," SES, January 2014

[11] "Getting the Most Out of High Throughput Satellites," by Joe De Loor, Newtec, June 13, 2016

Euroconsult
Research Products

Unparalleled expertise in assessing trends in the satellite industry

Key reference tool used by most public and private stakeholders

Research based on over 30 years of data and highly refined models

Thousand of data points and the expert interpretation for specific verticals and sectors

Full list of products available at

www.euroconsult-ec.com/shop

Purchase publications individually or take advantage of preferred rates on multiple products with a corporate agreement.

"Better Satellite World"

Satellite serves a thirstier world...

By Angela Davis

Water. We are literally made of the stuff. That's why we can survive for weeks without food but only days without water.

We drink it, cook with it, bathe in it, grow food with it, clean with it, swim in it, and use it in almost every kind of industry. After the air we breathe, it is the ancient element we can least do without.

New attention is now focused on water. As the planet warms, faster evaporation and changing weather patterns are making the dry parts of the world even dryer. Political turmoil and human migration follow, with talk of "water wars" in the places where countries share a water supply.

Ensuring that enough of the world's population have access to enough water is now a challenge with severe global consequences. Fortunately, there is a global technology ready to help — satellite.

Finding Water

The planet's fresh water comes from two sources: surface water in lakes and streams, and underground water in aquifers.

For centuries, lakes and rivers have been mapped — but it is only recently a fundamental question has been answered: how much fresh water is there on Earth?

The answers come from a U.S.-German satellite mission named GRACE, which makes precise measurement of changes in gravity below them as they pass over the Earth. As water is less dense than rock or soil, there is less gravitational pull. Human beings can't tell the difference, but GRACE can use the lack of gravitational pull to detect the presence and depth of surface water and provide the first accurate global inventory of this life-sustaining fluid.

Scientists are even finding ways to use satellites to find water hiding underground, which comprises as much as 40 percent of the global supplies. Using a NASA radar satellite, a team from Stanford University recently achieved the first success in predicting the amount of groundwater beneath locations in California. Another research team has proven that areas of lower temperature on the ground signal supplies of water below that are close to the surface.

Knowing where the groundwater is near the surface can make a life or death difference for developing nations. Laborers with hand tools can dig shallow wells, while deeper supplies require costly mechanized drills.

Protecting Purity

Having a source of water nearby does not guarantee an end to thirst. For much of the world's history, water has also been the place where waste winds up, whether from sewer systems, factories or farmers' fields.

Images from satellites provide a cheap and powerful way to track pollution in real-time. LANDSAT is the original network of Earth Observation (EO) satellites, first launched by NASA in 1972. Newer competitors include DigitalGlobe, BlackBridge, Google's Skybox and Planet Labs.

Through satellite images, it is possible to determine water quality by measuring its load of algae, which feeds on sewage and nitrates. A company called Blue Water Satellite has turned that technology into a business that identifies leaks, monitors potential pollution sources and assesses industrial impacts on water supplies.

Drought is part of the natural cycle in many places and the rise in global temperatures appears to be making those cycles worse. When the rain fails, the natural impulse is to pump more water from the ground to make up the difference. That's especially true in agricultural regions, where 60 to 70 percent of groundwater targets irrigation.

The trouble is, more water can be drained from the ground than nature is able to restore. The result is the same as overdrawing a bank account. Satellite data has revealed the impact of pulling too much water from the ground. California's Department of Water Resources reported in 2015 that parts of the state's agricultural San Joaquin valley are sinking at the rate of 2 inches (5 cm) per month. The information came from a NASA radar satellite called InSer, which measures elevation with precision. That sinking has already damaged thousands of wells. By compressing layers of soil and rock, the storage space available for groundwater can be permanently reduced.

The good news is that knowledge can lead to change. Parts of California's Santa Clara Valley sank 13 feet in the first half of the 20th Century, but smart policies — diversifying water supplies and allowing the aquifer to recharge — stopped subsidence in its tracks.

Too Much of a Good Thing

As essential as it is, water can also be too much of a good thing. Flooding kills more people than any other natural disaster.

Imagery from satellites is playing a key role in reducing the death toll and minimizing damage. In 2015, the African nation of Malawi began using data from the European Space Agency's Sentinel 1 radar satellite to map massive floods occurring on the Zambezi River. In addition to providing accurate maps to guide disaster response, the data is being used to develop a flood forecasting tool that will alert communities to danger before it strikes.

In 2000, the United Nations set development goals for the new millennium. One of them was to cut in half the number of people without access to clean water and sanitation. That goal was met. From 1990 to 2015, 2.6 billion gained access to clean water and 2.1 billion to sanitation. However, the UN also expects that, by 2025, water scarcity will affect 1.8 billion people and access to water will be an occasional issue for a remarkable two-thirds of the global population.

With water becoming more precious by the year, satellite will help to find and protect this valuable resource—and sometimes defend Earth's citizens from it—for decades to come.

Produced for SatMagazine by **Space & Satellite Professionals International** *— please see more stories and videos of satellite making a better world at* ***www.bettersatelliteworld.com****.*

Sources

"Satellite Missions Improve Water Estimates," by Matteo Luccio, Sensors & Systems, June 17, 2013.

"Satellite Data Provides Picture of Underground Water," Stanford University, ScienceDaily, June 18, 2014.

"Potential for Satellite Remote Sensing of Ground Water," by Matthew W. Becker, Ground Water, March-April, 2006.

"Locating Shallow Water Using Satellite Imagery," by Paul Knerr, AfricanWaterProjects.org, March 15, 2015.

"Groundwater Pumping Speeding Subsidence in Central California," Reuters, August 19, 2015.

"The Hidden Costs of Groundwater Overdraft," by Tara Moran, Jenny Choy and Carolina Sanchez, Water in the West, Stanford University, September 9, 2015.

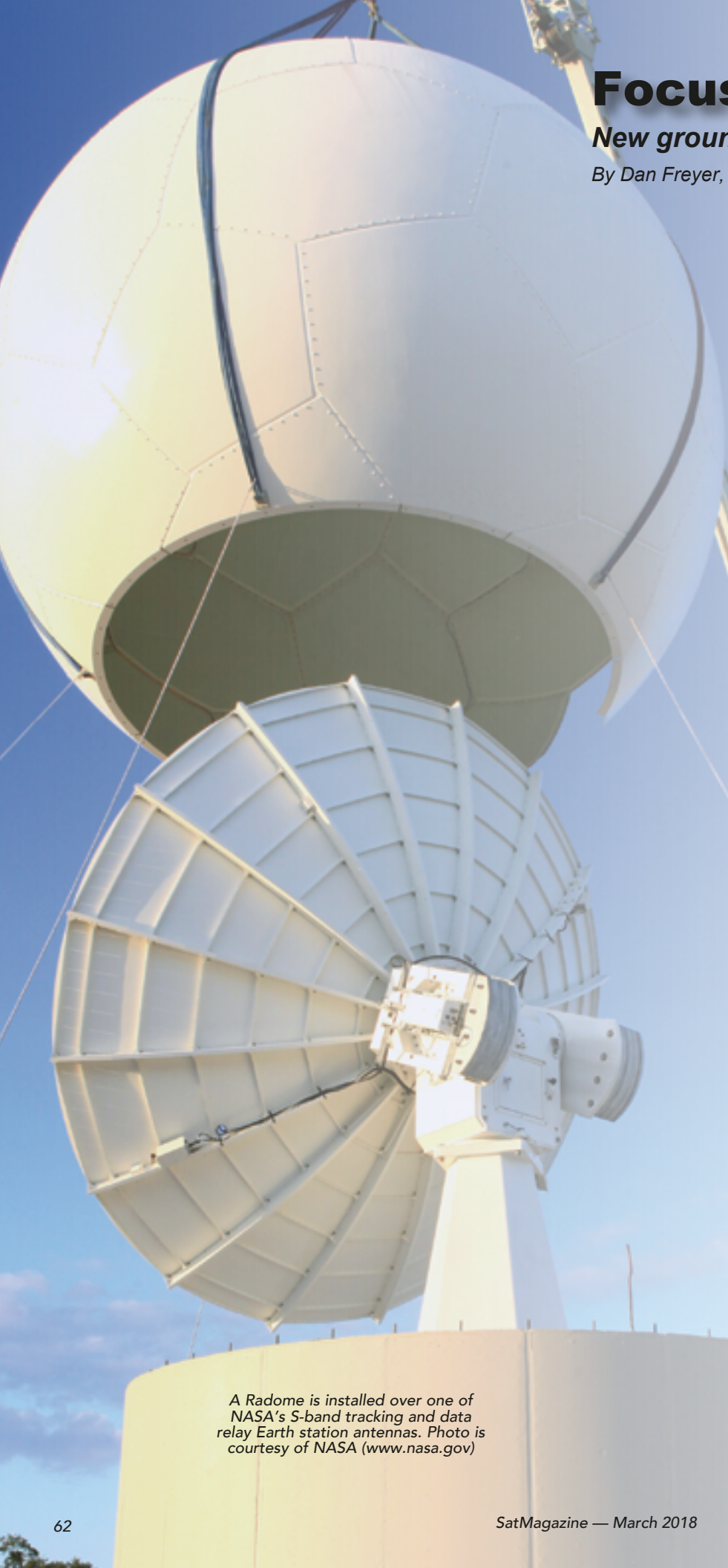
"California is Sinking Faster Than Thought, Aquifers Could Permanently Shrink," by Tia Ghose, Science, September 15, 2015.

"Sentinel-1 Monitors Floods in Malawi," European Space Agency, January 20, 2015.

Focus: W.B.Walton

New ground segment developments

By Dan Freyer, Managing Partner, AdWavez Marketing LLC



A Radome is installed over one of NASA's S-band tracking and data relay Earth station antennas. Photo is courtesy of NASA (www.nasa.gov)

Satellite land mobile applications

Satellite services that employ rugged, portable, antennas and broadband terminal equipment are a small but distinct segment within the growing land mobile satellite market. Portable satellite terminals have proven effective for use in military applications, where battlefield strategies continue to require mobility, flexibility, and rapidly deployable high bandwidth. Other uses include contingency and support operations, and intelligence. Applications in the civil arena include homeland security, disaster and emergency response, humanitarian aid, remote oil & gas exploration, as well as broadcast SNG.

The market segment includes "flyaways" which can be checked into airline baggage and easily deployed in the field, as well as vehicle mount antennas, "driveways", and SNG (satellite newsgathering) terminals.

System suppliers in this field include AVL, Norsat, C-COM, Cobham, GD Satcom Technologies, ASC Signal, ND Satcom, Airbus DS-GS, and Sat-Lite Technologies. Some systems come with motorized tracking antennas, and/or auto-pointing for easy satellite access, or to meet requirements for tracking non-geo satellites, such as SES' 03b, and LEOs for communications, navigation, and Earth sensing.

A new market report (***http://www.nsr.com/research-reports/satellite-communications-1/land-mobile-via-satellite-5th-edition/***) from industry analysts NSR, ***Land Mobile via Satellite, 5th Edition***, forecasts in-service units, equipment and service revenues, as well as capacity demand for land-mobile satellite-based mobility, including land-vehicular, SNGs and Comms-On-The-Pause (COTP) segments.

According to the report's lead author Alan Crisp, Senior Analyst with NSR, "*For the Comms-On-The-Pause segment, we saw around 60,000 units at EOY2016, increasing to around 109,000 in 2026 (across all regions and frequency bands), with retail revenues increasing from around $129 million to around $200 million over the same time frame.*" (***See Figure 1 on the next page.***)

"*The SNG market is much more niche, increasing from ~2,700 units in 2016 to ~6,200 units in 2026, with a large share of this growth coming from Ku-band VSATs and HTS terminals,*" according to Crisp. (***See Figure 2 on the next page.***)

Comms-On-The-Pause

Customers desire light weight, rapid setup, with auto-pointing and/or tracking antennas, and secure high bandwidth communications packages, say industry suppliers. For military and remote applications, terminals need to be rugged and compatible with

Organized by Euroconsult EC

WORLD SATELLITE BUSINESS WEEK

Sept. 10-14, 2018 / The Westin - Paris

The unique executive meeting place for the leaders of the global satellite communications and information business

Register today at www.satellite-business.com

22nd Summit for Satellite Financing

Sept. 10-13

Focus: Satellite communications & connectivity

Participants: 800 executives

3rd SmartPlane Summit

Sept. 10

Focus: In-flight entertainment and the connected aircraft

Participants: 150 executives

10th Summit on Earth Observation Business

Sept. 13-14

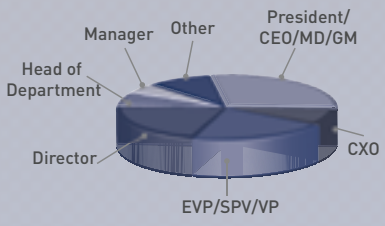
Focus: Satellite imagery & analytics

Participants: 200 executives & government officials

1,000 executive-level participants

5 days of high-level networking & business meetings

130+ senior-level speakers



Don't miss Finspace & the Start-up Village

- Meet with entrepreneurs & investors
- Discover the most innovative projects
- Conclude new partnerships
- Stay on top of the competition

5th annual

LATSAT

May 15-16, 2018 / Mexico City

Organized by Euroconsult EC

Bringing together Latin America's satcom & connectivity leaders

- Meet and do business with over 200 public & private decision makers
- Consolidate existing and new partnerships
- Attend top-level social events attended by participants and speakers alike
- Discuss key issues such as national satellite programs, universal access/service obligations, national security and enterprise usage

200+ EXECUTIVE-LEVEL PARTICIPANTS

40+ SENIOR-RANKING SPEAKERS

29 COUNTRIES REPRESENTED

Endorsed by

SCT Secretaría de Comunicaciones y Transportes

Telecomm

For more information and to sign up to the mailing list, visit www.latsat-congreso.com

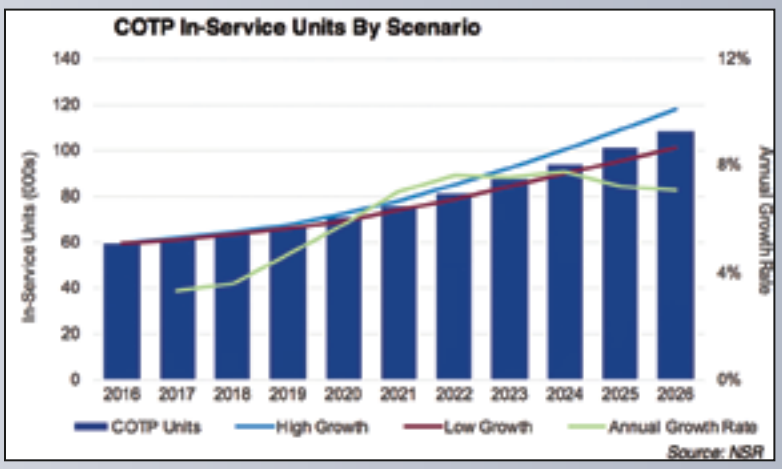


Figure 1. Coms-on-the-Pause Market Forecast 2016-2026. (Graph is courtesy of NSR).

Figure 2. SNG terminal market forecast 2016-2026. (iGraph is courtesy of NSR).

terminal and encryption systems, and operate in multiple frequency bands. For example, U.S. WIN-T (warfighter information network – tactical) terminals of this kind can operate at Ku-, X-, and Ka-band for WGS (wideband global satellite) systems to support U.S. Army, Marine Corps, and other commands.

Deployment challenges

Some military, first responder, and even SNG applications can be subject to extreme weather conditions including snow, heavy rain and moisture, ice, wind and sand storms. All-weather operations pose unique challenges in deployment of portable terminals. For example, in sand storms, antennas, feeds, auto-track drive systems and reflectors must be protected from dust and sand, and extreme winds that can cause signal interference or outages and damage. In harsh snowstorm, windstorm, rain storm, and hurricane-like conditions, antenna feeds and reflectors must be protected from snow, ice, rain and wind.

Radomes

A traditional approach to protecting antennas from these challenges is to shield the antenna from the environment using a Radome cover. In satellite communications, a radome is a weatherproof, structural enclosure designed to protect an antenna from winds, rain, moisture, dirt, ice, etc. It is constructed of material that interferes minimally with the electromagnetic signal transmitted or received.

A Radome protects the transmit antenna. It can also improve antenna performance by preventing high winds or temperature variations from distorting the shape and pointing direction of the reflector. Radomes can also protect electronics and mechanical parts that must be located near the antenna. This is especially significant in extreme environments such as blowing sand or dirt, salt spray, and freezing rain. In addition, the dome structure can be more aesthetically pleasing and also conceal the equipment inside the dome from unwanted observation.

Inflatable Radomes

Several years ago, transported air-supported or "inflatable" antenna-plus-radome combinations were introduced commercially. They offer very light weight flyaway and portable antennas that can be set up in half an hour, and weigh less than half that of conventional "rigid deployable" antennas of similar size, according to suppliers. The inflatable system auto-inflates into a spherical balloon-like structure that encloses and supports the antenna. When properly anchored with spikes, these inflatable antennas can operate at up to 40 mph (64 kph) winds and survive up to 60 mph (97 kph) wind.

An air-supported radome must be inflated at all times. Operation depends upon a non-interruptible power supply and blower systems. With inflatable systems, a powered blower must stay on in order to keep the structure inflated so that the antenna continues pointing to the spacecraft properly. If the power is cut and the blower backup battery (typically rated for up to 6 hours) runs out, the "balloon" will deflate. This can cause off-pointing of the transmit antenna and knock satellite service off the air.

Figure 4. Walton De-Ice's new Portable Radome. Image is courtesy Walton De-Ice.

THE M.E.T. EFFECT™

MEDIA. ENTERTAINMENT. TECHNOLOGY.

Content is embraced by listeners who can access programming anytime, anywhere. From ideas to inventions, NAB Show® delivers the world's most eye-opening, hands-on environment filled with the tools and tech to always keep your content in range.

THIS IS WHERE THE GLOBAL CONTENT ECONOMY THRIVES.

APRIL 7–12, 2018 | LAS VEGAS, NEVADA USA
REGISTER TODAY: NABShow.com
Free Exhibits Pass Code: PA23

NABSHOW®
Where Content Comes to Life

Figure 5. This image shows an example of field tests of a Portable Radome product for 1.8m antennas during wind survival testing. The photo shows a 2.4 x 2.9m (10' x 8') class Walton satellite antenna Radome that was tested with 85 mph wind loads.

A New, Portable Solution

Walton De-Ice, a leading designer and manufacturer of satellite Earth station antenna de-icing and weather protection systems, is leveraging its nearly four-decade heritage of Earth station antenna weather protection products with the introduction of an innovative new portable satellite Radome.

The first release of Walton's Portable Radome is designed to protect temporary, "driveaway" and coms on-the-pause (COTP) satellite terminals in the sub 4-meter class. (*See Figure 4*). It can also be used for permanent installations. The Portable Radome allows an enclosed satellite Earth station antenna to continue service during extreme weather conditions, such as sand, wind and rain storms. The Portable Radome first release is built for Ku- or Ka-Band antennas up to 2 meters in diameter. It supports operation during 70 mph (112 kph) winds and 85 mph (136 kph) survival conditions.

Video link:
http:// https://adwavez.wistia.com/medias/2acm7a5xac [Video link]

Unlike inflatable systems, the product requires no electrical power or loud air blowers to maintain structural integrity.

The dome-shaped architectural fabric is installed over a fiberglass frame and aluminum base mount. An entry flap offers easy access under the Portable Radome cover after it is installed, so operators can perform maintenance and service the antenna, RF and VSAT equipment under the cover.

Unlike air-supported Radomes, the Portable Radome requires no active air blower. The aluminum base with eyelets secures to the Portable Radome to an antenna pad or the ground.

Walton's new Portable Radome uses techniques that have been field-proven in protecting satellite signals in Earths stations at teleports, military facilities, and broadcast networks serving millions of users worldwide. The Portable Radome for Ku- or Ka-band employs the same field-proven virtually RF transparent and hydrophobic Architectural Fabric cover materials used in Walton's Snow Shield antenna covers, which are deployed in Ku-Band and Ka-Band de-icing weather protection systems around the world.

Figure 6 on the next page compares the RF signal receive power before and after the Walton De-Ice Portable Radome material is placed over an antenna reflector, illustrating that virtually no meaningful signal attenuation is introduced by the antenna cover.

The figure shows an example of test data at 20.7 GHz (Ka-band) measured at a satellite Earth station antenna test facility. The black signal pattern is the signal level measured with no radome covering the antenna. The Red signal pattern is an overlay of the signal level measured through the same ground antenna after it has been covered by material used in the Walton De-Ice Portable Radome. The Y-scale is power level (dB) relative to beam center; the X-scale is angle (degrees, AZ cosine corrected) relative to beam center).

The new Portable Radome will be offered in various sizes depending on customer requirements up to 4 meters in size. The Portable Radome will be offered in white only for Ka-Band (PTFE Fabric) and khaki, or green for Ku-Band or lower frequency (Kynar Material) civil or military applications.

De-Icing Challenges with Full Motion Earth Station Antennas

With the many new non-Geosynchronous comsat constellations under development, Earth station designers continue to look for more cost-effective solutions to deploy hundreds of gateway and traffic routing antennas around the world. Antenna de-icing and weather protection is an input to link performance and system costs. When large numbers of these stations have to be deployed in areas subject to alpine or similar extreme conditions, the radome costs element can add up.

Non-GEO ground antennas have to track the satellite as it moves "across the sky" over a few hours, or rapidly during a period of minutes. With a MEO in up to 12,000 km circular orbit, the time that an Earth station antenna has line-of-sight could range from 2 to 20+ hours. For LEOs traveling in a 500-1500 km orbit, an individual satellite's line-of-sight visibility may be only 10-40 minutes. Many systems use Ka-Band, which requires high antenna pointing accuracy, and is subject to high loses due to rain and water.

Bird Baths & Fish Bowls

During rain, if an Earth station's unprotected main parabolic reflector tracks a satellite points skyward towards zenith, water can accumulate in the reflector. Depending on the rain intensity and position of the antenna reflector, and its concavity, this can create a "bird bath" or "fishbowl" effect for several minutes or hours.

Rain and water from melted, partially melted snow accumulating in the concave portion of the Cassegrain or offset full motion tracking antenna can also create a "bird bath" or "fishbowl effect. The bottom portion of the parabolic antenna reflector can also fill with water if snow is present and active anti-icing melts the snow into the "bowl."

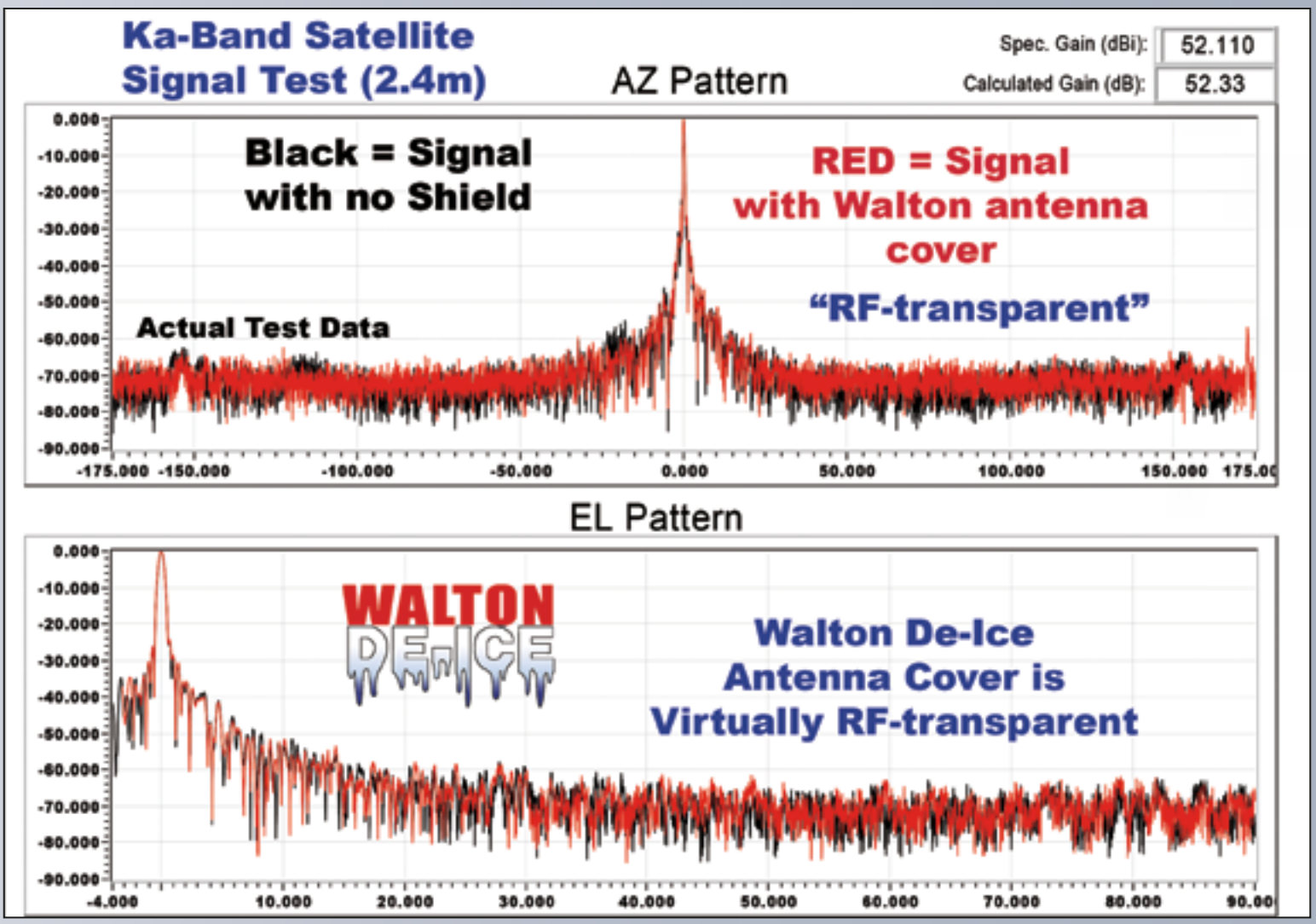
measat

Defining Ability

The region's leading video distribution partner continues to focus on customized and innovative broadcasting solutions.

With flexible service options and leading-edge technology, the MEASAT-3 / 3a satellites at 91.5°E are the premier choice for Asia's HD and UHD distribution needs.

Tel: +60 3 8213 2188 **Email: sales@measat.com**
www.measat.com



To prevent these negative effects and to protect the system from other effects of weather, a traditional solution has been to use a conventional radome. However, conventional radomes cannot be de-iced by heat transfer through the Radome's material. To solve this problem, manufacturers of the radomes offer as an option a "Snow Rope" allowing workers to manually remove the snow from a conventional radome. However, the "Snow Rope" option is not effective in removing accumulated ice from a radome, if compared with an automatic de-icing solution that provides electronic M&C and uses moisture and temperature sensors to trigger events.

Walton De-Ice's Satellite Portable Radome Evolution

According to David Walton, the company's new Portable Radome also offers potential cost-savings versus conventional radomes for some classes of LEO/MEO antennas. There are several reasons for these advantages.

"*The Portable Radome can be optimized for LEO/MEO tracking antennas at 35-40 percent lower cost than conventional radomes*," according to Walton. "*We can also use the Walton Ice Quake/Rain Quake system on our Portable Radome to eliminate water sheeting that other radomes experience, and shed off snow or ice. Walton's 10x8 Portable Radome only requires 45 Watts of power to keep water, ice or snow from accumulating.*"

Depending on the antenna size, The Walton De-Ice system can also be installed with less shipping cost and labor expense. For example, in under two hours the Portable Radome can be installed whereas a comparable size conventional radome may take a day or two with a crane. Another benefit of the Portable Radome is the reduced energy consumption required for de-icing the Portable Radome with electric heating systems.

"*The heat easily transfers through the Portable Radome to keep the Radome free of any ice or snow, with no strings (or snow ropes) attached*," said Walton.

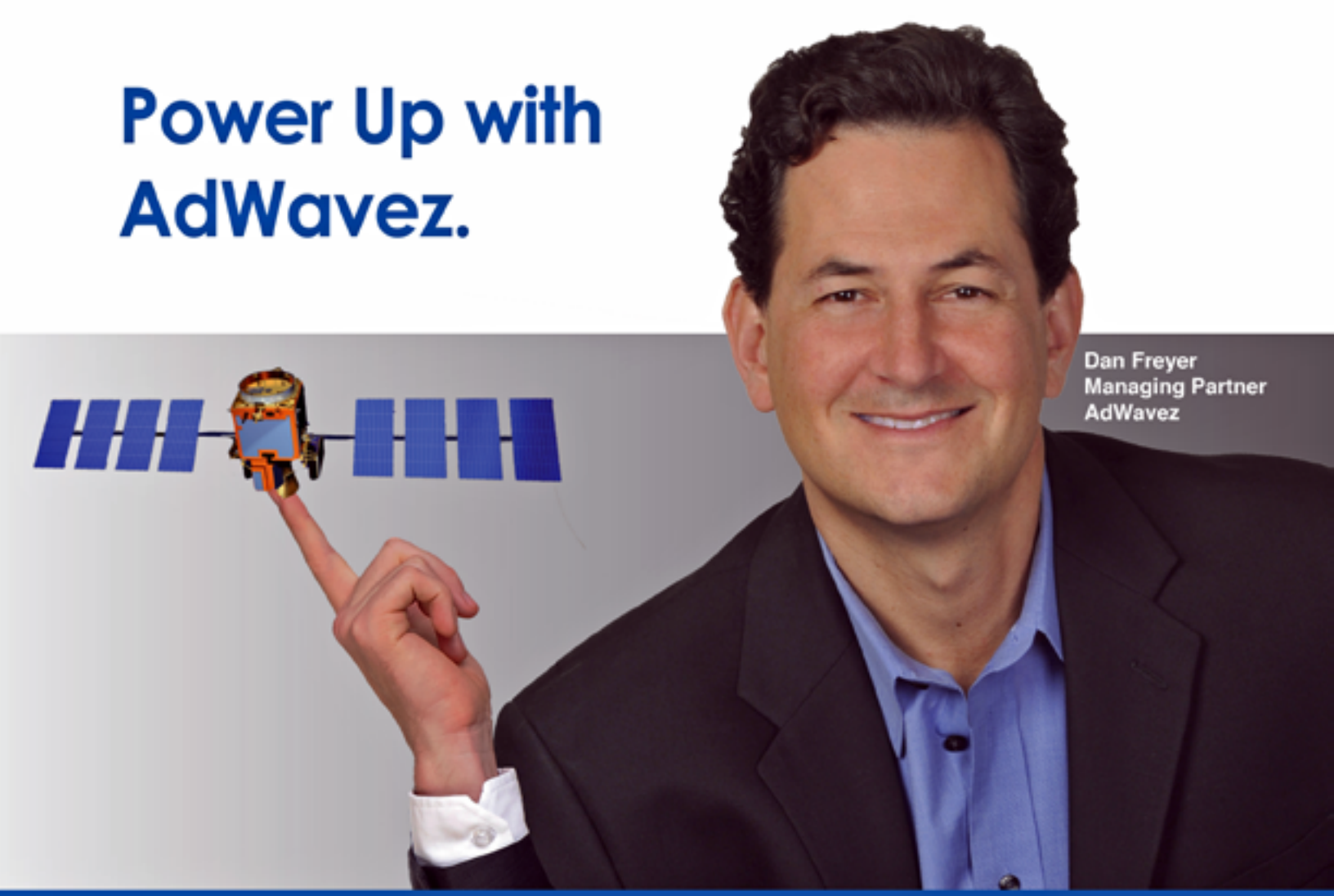
With its promise of cost-savings and survivability, the Portable Radome may soon become an essential element of the kit that ground segment designers and integrators need to consider for military, military, first-responder, and similar deployable satellite networks working extreme environments on land.

www.de-ice.com

*Dan Freyer is Managing Partner of AdWavez Marketing LLC (**www.adwavez.com**), a marketing agency uniquely focused on helping satellite industry clients build and defend market share with strategic, marketing, and communications services. He has helped top satellite manufacturers, operators, service providers, equipment suppliers, and associations.*

*Dan can be reached at **dan@adwavez.com** in Los Angeles.*

Power Up with AdWavez.



For outside Marketing and PR help, **AdWavez Marketing** offers unmatched expertise and global satellite industry experience.

- Press Promotion
- Brand Building
- Campaigns | Lead Generation
- Digital | Social | Media Content
- Strategy |Research | Biz Dev

U.S. Market entry help for importers

AdWavez MARKETING

For customer Success Stories and to learn how we can help you
Call Los Angeles or email:
424-241-3788 | dan@adwavez.com

MARKETING | COMMUNICATIONS | MEDIA RELATIONS

www.AdWavez.com

NASA GOLD's Journey

From a small lab payload to outer space

By Todd Gossett, Director, SES Government Solutions

NASA's Global-scale Observations of the Limb and Disk (GOLD) mission, which will study the weather at the boundary between Earth's atmosphere and space, was launched on January 25 aboard the SES-14 commercial satellite owned and operated by SES.

NASA GOLD will observe Earth's space weather in a very important region, where the part of the atmosphere that is ionized by radiation from the sun — called the ionosphere — is coupled with the unionized atmosphere, which is often referred to as the thermosphere.

While much has been written about the GOLD science mission and its contributions to a better understanding of how the weather of the Ionosphere impacts radio frequency transmissions and LEO satellites that use this region, little has been shared about GOLD's arduous journey from manufacturing to orbit.

That's a shame, as the process of building, mounting and then launching a payload aboard a commercial satellite is an interesting one — and one that we're now going to shed some more light on.

GOLD is notable, in part, because of the organizations working in concert to make the entire program a success. The mission represents the first time universities and a commercial spacecraft operator will team up to enable a NASA science program.

GOLD is being developed and operated by a team comprised of NASA, the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP), the University of Central Florida, Airbus Defence and Space, and SES. Each of these organizations played a role in taking GOLD from concept to reality.

Payload Integration and Testing

The NASA GOLD hosted payload was completed by LASP in late 2016 and delivered to the Airbus satellite integration facility in Toulouse, France, in January of 2017.

The launch of the SES-14 satellite. Photo is courtesy of Arianespace.

The GOLD payload is an ultraviolet (UV) imaging spectrograph designed to measure densities and temperatures in Earth's thermosphere and ionosphere. Photo of work on GOLD is courtesy of Airbus Defence and Space.

Airbus is SES' contractor to build and deliver GOLD's host spacecraft, SES-14. After assembling the main components of SES-14, Airbus integrated GOLD on the Earth-facing deck of the satellite in April.

Throughout the spring, summer and fall, SES-14 and GOLD underwent a series of tests to verify that the satellite met requirements for SES-14's communications mission and to verify both SES-14 and GOLD met mission compatibility requirements established early in the program. Both SES-14 and GOLD passed with flying colors.

SES-14 and GOLD underwent final preparations in Toulouse in December and were transported from Toulouse to the Guiana Space Centre near Kourou, French Guiana, aboard a contracted Antonov 124 aircraft on December 22, for the launch by the service provider for this mission, Arianespace.

Getting into Orbit

The Ariane 5 rocket placed SES-14 and GOLD into a transfer orbit. Over the next few months, Airbus will raise SES-14 to a geostationary orbit before handing off operations to SES.

After a few weeks of on orbit testing and checkout, SES-14 will commence its communications mission at 45.7 degrees West over Brazil, where is will serve video, mobility, and other customers over Europe, the transatlantic region and the Americas.

Once SES-14 is operational, the LASP team will commission GOLD for its science mission, which will start a few weeks after GOLD commissioning activities commence. As a geostationary satellite, SES-14 will provide GOLD a vantage point to constantly look at the same region of the Earth. GOLD's sensor will have a 30 minute cadence — observing the disk and limb of the Earth every 30 minutes.

This is the first time that NASA can study the ionosphere and thermosphere from a geostationary orbit. Previous missions have been in LEO, where the cadence to revisit the same region is once per day.

Ready for Transmission

From the satellite's orbit, GOLD will transmit its science data using one of SES-14's communications channels to an SES teleport at Woodbine, Maryland. From there, SES will route the data to LASP's GOLD Science Operations Center for initial processing.

The data delivered by GOLD will be a series of images — one produced every 30 minutes — which can be played as a movie. These images contain spectral information, multiple wavelengths or colors, as well as spatial information.

Overall, this data will provide key information about how Earth's upper atmosphere connects to the dynamic and complex system of space that fills the solar system.

Watch the latest GOLD video courtesy of NASA by selecting this URL: ***ses-gs.com/solutions/fixed-sat-solutions/hosted-payloads/global-scale-observations-limb-disk-gold-mission/***

This article is republished, courtesy of author ***Todd Gossett*** *and The Government Satellite Report (GSR). The Government Satellite Report is sponsored by...*
SES Government Solutions

www.ses-gs.com

Perspective: RSCC

Fifty years in orbit

This year will be quite remarkable — an entire series of landmark space-related anniversaries will be celebrated.

Sixty years ago, on October 4, 1957, the first artificial Earth satellite, Sputnik-1, was launched into space. Only ten short years later, in November of 1967, the first satellite-supported TV broadcasting network was deployed in the Soviet Union, based on the Molniya-1 spacecraft and the Orbita system, through which a signal was transmitted from Moscow to the Pacific coast of the Russian Far East. This event marked the beginning of a new satellite operator — the Russian Satellite Communications Company (RSCC).

Over the period spanning five decades, the company has traveled a difficult path from a satellite communication station to a successful multi-purpose satellite operator. Now, using 12 communication and broadcasting satellites and six teleports, the RSCC provides services to customers in 52 countries on all continents of the globe.

Starting in the 2000s, the Express-series satellites have replaced the less efficient spacecraft of the Gorizont and Ekran series. Using the new spacecraft, the RSCC has entered into a tough competition, gradually building its stature among the top ten international fixed-satellite service operators.

Replenishment and modernization of the entire fleet and ground infrastructure have allowed the RSCC to improve the quality and reliability of the services provided by the company as well as to move beyond the confines of home region directed services. The buildup of the infrastructure of direct satellite broadcasting and broadband internet access has initiated the formation of a segment of mass consumption products in the sector of fixed satellite communications and broadcasting services in Russia.

The deficit of satellite capacity, which was in evidence in the Russian market several years ago, was overcome in the 2013 to 2015 period thanks to the orbiting of seven new RSCC satellites.

Since 2000, the available orbital frequency capacity of the RSCC in traditional C- and Ku-bands has increased almost five-fold. In 2014, satellite operations started in the high-performance Ka-band, which was new for Russia. Over the past 17 year period, the company's revenues have increased 11 fold — in the last three years, the revenue has experienced a two fold increase.

However, the main result of the RSCC's operations is user satisfaction. In the context of an open market and potent competition, the RSCC operates successfully, having assumed a leading position in Russia and the CIS countries' regions.

In the early 2000s, Euroconsult offered a negative outlook for the further operational activities of the RSCC in the Russian market going forward. In fact, the RSCC's entry into the international markets was not even considered as viable.

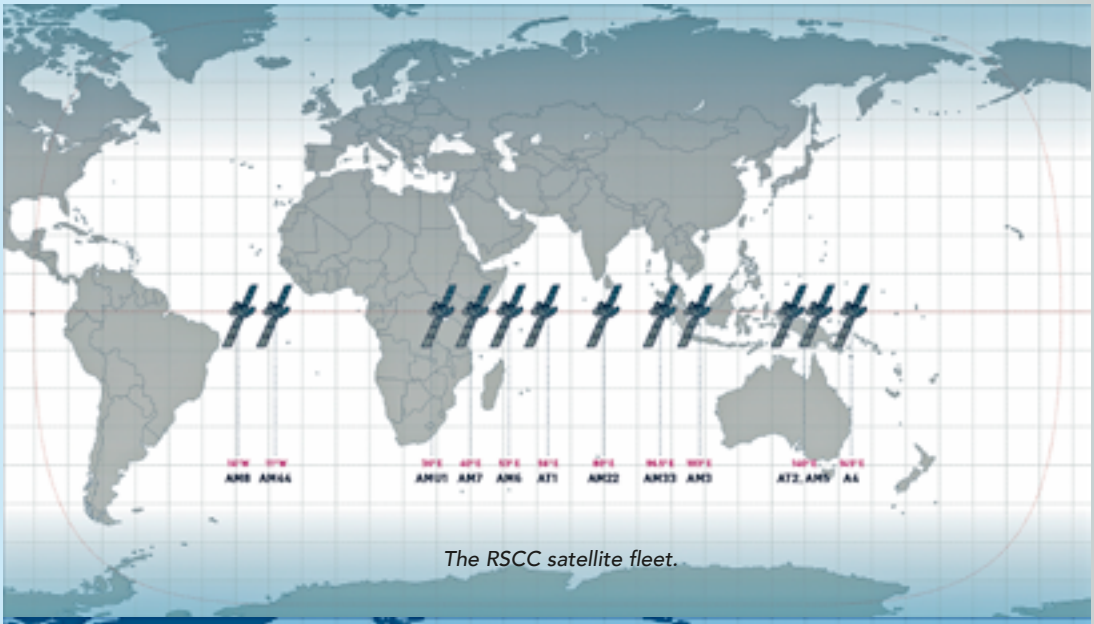
The technological and financial-economic comparison of the capabilities of the RSCC with competitors was clearly not in the firm's favor. However, time has shown that prediction to be erroneous.

Over the past several years, the RSCC has put into place a constellation of state-of-the-art satellites that cover the entire globe. Having won the trust of European users, the RSCC proceeded with an increasing presence in the Middle East, North and Sub-equatorial Africa, as well as South and South-East Asia. The company now operates in 52 countries. During 2017, the RSCC also entered the markets of Chile and Venezuela, Nepal and South Korea. Today, more than 40 percent of the company's revenues are derived from international sales.

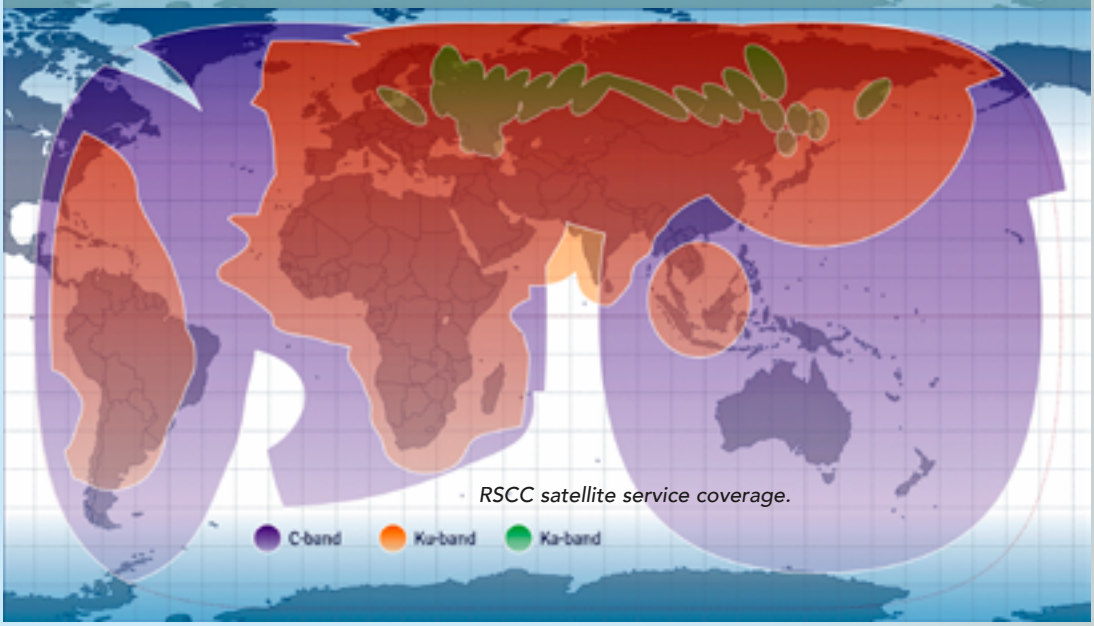
Another promising area for the company is the provisioning of broadband access for moving objects. Currently, RSCC provides services for sea-going vessels in the Atlantic, Arctic and Pacific Oceans, including: access to the internet, television programs, video surveillance, reception of meteorological data and telephony.

Based on the results of the company's successes, the *World Summit for Satellite Financing* in Paris in both 2009 and 2015 recognized the RSCC as the best regional satellite operator in the world. Today, the satellite constellation of the RSCC includes 12 spacecraft stationed in positions from 14 degrees West to 145 degrees East. The company's ground infrastructure includes the Shabolovka Technical Center in Moscow, five Satellite Communication Centers in Russia's Central Region, the Krasnoyarsk and Khabarovsk Territories, and the Vladimir satellite communications station.

By 2025, the RSCC plans to build, launch and commission five spacecraft for geostationary orbit and four satellites for high-elliptical orbits (plus one backup satellite on the ground). Plans also include the buildup of additional ground-based infrastructure. The orbital-frequency capacity available for use in the satellite communication networks



The RSCC satellite fleet.



RSCC satellite service coverage.

will increase by 1.7 times. Currently, two satellites — Express-103 and Express-80 — are already in full production.

In regard to RSCC's Development Strategy, the company is focused on several high-tech areas, which will soon influence the makeup of the satellite communications market in the context of rising market competition. These areas include:

- *The implementation of new projects to build spacecraft for both the geostationary and high-elliptical orbit, intended for addressing priority tasks of fixed and mobile satellite communications for public and commercial customers in Russia, including the Arctic region*

- *The adaptation of the existing space and ground-based infrastructure of the company to new agendas in providing communications of mobile objects and of the developing market of Big Data, including the Internet of Things (IoT)*

RSCC believes that traditional satellite services, such as television broadcasting and backbone communication channels, will continue to be in demand throughout the next ten years. In order to successfully support new broadcasting technologies, the RSCC plans to concentrate on developing convergent networks, multifunctional platforms and integrated media services.

The company also plans to advance cooperation with ground and cellular operators in network backup services as well as build hybrid networks that are designed to meet the requirements of today's economy and users in transmitting mass data from any covered location.

An important area for the RSCC will be the advancement of fixed and mobile communication services in the Arctic zone, based on the communication system of the Express-RV on the highly elliptical orbit. The implementation of this project will pave the way for providing new types of commercial services throughout Russia. Such services will cover the Arctic region and involve broadband access to moving terrestrial objects, including road, rail, river and sea transport.

A promising area for boosting satellite services, according to the RSCC, will be broadband data transmission services. These are intended, primarily, for solving social problems and providing access to the internet for private users. The company plans to carry out this work in partnership with operators of end-user services in the B2C sector.

In today's world, the tasks of analyzing and processing data are becoming particularly urgent. Encouraging opportunities exist for creating solutions and services — operators are moving toward clouds and individual solutions, based on smart data processing. Undoubtedly, this trend will have an impact on RSCC's business.

Satellite communications today are innovative segments of the modern economy, transformed from the sphere of governments and leading defense companies into a large operator business that is aimed at operating not only in the aforementioned market segments but also in the public services arena.

What will the industry look like in 50 years? Discoveries in related areas, a new generation of specialists, artificial intelligence, biorobots — all these factors will fundamentally change the satellite communications industry.

Satellite operators and service provider capabilities will be enhanced to support new methods of addressing one of the most important philosophical problems facing global citizens today — learning more about the world in which we live.

eng.rscc.ru/

Focus: Integrasys

The innovative world of satellite

By Alvaro Sanchez, Sales and Marketing Director, Integrasys

Over a several year time period, the satellite communications industry has come under threat by many new and emerging technologies. Thanks to some amazing innovations, satellite is fighting back. Now, the industry needs to continue to innovate directly through the development chain to maintain its leading position as a communications service.

An Industry Under Threat

There was a time when satellite was the only possible way to make connections. While this still remains the case within certain scenarios and environments, satellite communication (SATCOM) is becoming less so as more and more alternatives wend their way to market.

For example, broadband roll-outs are continuing in force on a global scale — governments are pouring massive budgets into fiber connectivity. Areas that have remained unconnected suddenly have an alternative to SATCOM. For many, satellite is considered to be the last resort where no other network technology is available — most consumers and businesses are now opting for other connectivity methods, when available.

The broadcast industry is an area where satellite is under enormous threat. Broadcasters have typically been one of the biggest users of satellite. However, the broadcast industry has itself seen a great deal of change over the last couple of years.

Only a few years ago, consumers would watch linear TV. Now consumers are watching more and more Over-The-Top (OTT) video content and less and less of the linear broadcasts. This is, quite naturally, having an impact on the relevance of satellite broadcast, with many traditional broadcasters now launching their own OTT services to remain competitive.

Even satellite newsgathering (SNG) is under threat, with the first all IP newsgathering trucks being deployed. As IP takes off, more broadcasters may look to convert trucks away from satellite and enjoy the cost savings that such moves can deliver.

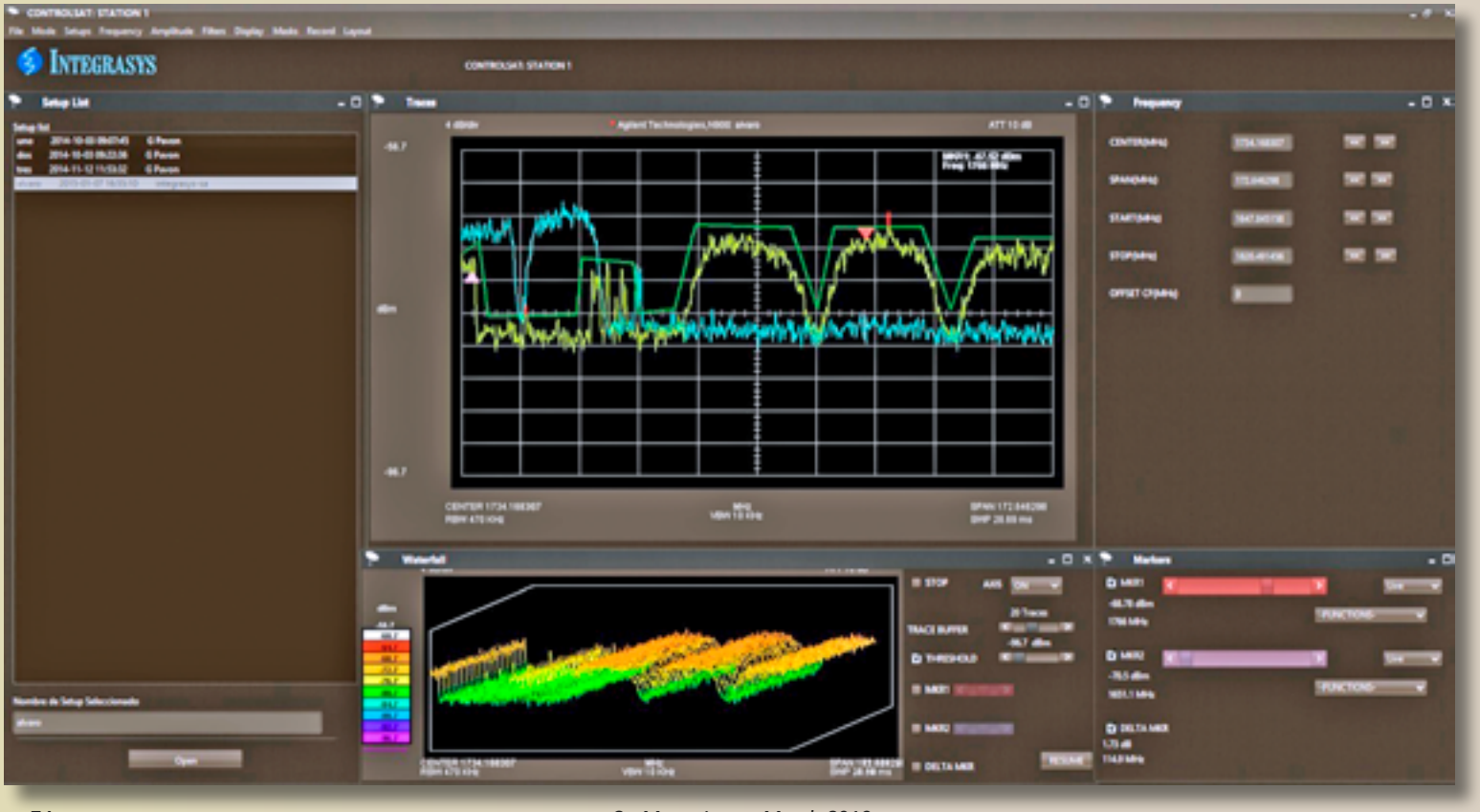
Another big challenge for the satellite industry is the potential for error. Satellite is a complex environment and a highly technical and challenging industry — it is far easier to "get it wrong" than with the more simple processes and workflows of IP.

While satellite equipment is sensitive equipment that needs to be used correctly to ensure accuracy, operators rarely have the correct level of training to avoid the errors that can plague SATCOM — not surprising, as most industries are faced with trying to accumulate cost savings, and that leads to less staff on site and less budget for extensive training in all operational areas.

The use of satellite equipment, for many is, rightly or wrongly, at the bottom of priority lists. And yet, a slight satellite pointing error or misuse of the equipment can create huge, negative consequences for the service being provided as well as affect other services, as well. The problem is that consumers and business users alike simply will not tolerate errors across their services. With an increasing choice of connection, any slight error could lead them to a different connectivity option.

Recent Innovations

In order to survive in this increasingly competitive landscape, something special is required — that something is innovation. Luckily, the satellite industry has not simply waited for their markets to disappear. There has been a phenomenal amount of innovation throughout the industry, cementing SATCOM's importance in the world for many years to come. Indeed, the satellite industry is much more exciting than ever before, thanks to the fast pace of innovation.



Take, for example, High Throughput Satellites (HTS) which connect more of the world, and at lower cost, then ever before possible. Thanks to HTS, more and more people now have access to much-needed services, whether that is an alternative to other technologies, connecting remote areas, or for mobility. Essentially, HTS makes SATCOM affordable, quick and easy.

There can be no discussion regarding satellite innovation without citing the new constellations in LEO and MEO. With 640 LEO satellites already on orbit, and an astounding 9,000 due to launch over the next five years, there will be some serious traffic and services debuting to address new business models. These satellites are designed to handle such needs effectively and therein rests a great deal of potential for the satellite industry. In particular, the demand for being connected everywhere is likely to cause a rise in demand for satellite connectivity and these satellites will be important for delivering those services.

The Challenge of Innovation

The problem with advancing technology is that it generally comes with a whole slew of new problems that were unknown before service implementations. These challenges need to be rapidly anticipated as well as fixed to ensure the trust of customers. In the case of HTS, the technology's success in delivering more connectivity at an affordable cost is leading to a veritable explosion in service provisioning. This, in turn, is creating a number of challenges for providers.

First, HTS means more services at lower prices. This is filling up available satellite capacity and that has implications for all of the other services as companies vie for bandwidth. Add to that the more services using satellite capacity, the added chance some of them will inadvertently cause errors to occur, such as pointing to an incorrect satellite polarization. That can lead to a whole slew of other problems, such as satellite interference, and that will drive a much lower SLA.

The other huge challenge relating to HTS is the very nature of many of those connections. The fact that HTS can connect easily and anywhere means there are lots of connections in remote and hard-to-reach areas. Often there is no other means of connectivity in these areas. This means that it is quite difficult, not to mention expensive and time consuming, for engineers to travel to a remote site to fix problems. In many cases, this can involve traveling for a day or more.

Comms-On-The-Move (COTM) is the other main user of HTS and continues to be a significant challenge. Faced with moving terminals and often harsh environments, there is little margin for error, but often a big chance that errors will be made on a regular, if not ongoing basis. This is about to get even more challenging as, over the coming few years, the emergence of connected cars will be witnessed. Consumers already expect constant connectivity wherever they are, such as on boats, so they will simply not tolerate any loss of signal in a connected car. That is a considerable challenge for satellites.

As for the LEO and MEO constellations, there will be quite literally thousands of new satellites that, while small in size, have the potential to mask the view for GEO objects and cause serious interference to one another if not properly managed. This is concerning to many who are fearful of the impact of so many constellations on the rest of the space environment.

Innovation Needs Innovation

While these innovations all offer great potential for the satellite industry, they also come with their fair share of unique challenges. Therefore, to ensure the satellite industry remains relevant, the industry must innovate — and innovate now. Innovation must occur not only at the satellite level, but directly through the market segment chains, putting in place the correct tools and solutions to provide better accuracy and cost efficiency.

Flat panel antennas will be absolutely crucial to these new developments, such as the aforementioned connected car. Eventually these antennas will need to be flexible enough to be used as plug and play, just like smartphones.

With new innovations and the increased traffic such portends, more important than ever will be to ensure correct installation of antennas. As mentioned above, HTS often includes installations in hard-to-reach areas — getting the installation correct can drastically reduce, or even avoid, expensive and time-consuming trips to the site to correct mistakes. The only effective way to ensure this occurs is with automated tools that ensure proper antenna installation and correct pointing.

As satellite bandwidth becomes more in demand, users want to be able to commission in multiple beams and hop from beam to beam depending on traffic demand. This need was the impetus behind the company's latest version of Satmotion which is Satmotion HTS.

Integrasys has major customers in EMEA using Satmotion for a number of applications. This includes Integrated Telecom Company (ITC) in Saudi Arabia and a government project for Detecon Al Saudi (Detesad). As well as having the same auto-commissioning features of Satmotion Pocket, this new version also supports multiple beams, allowing customers to use beam balancing and hopping and traffic sharing to resolve the problem of too many users within a particular beam.

Whatever the innovation or satellite type, continual monitoring will also become all the more critical if the satellite industry wants to remain competitive. Spotting errors or potential degradation with atmospheric attenuations, as soon as or even before they happen, will make all the difference to both accuracy and efficiency. That constant monitoring capability will be even more vital in the LEO and MEO space, especially as more and more services are added.

Saudi Telecom Company (STC) is a fine example of a telecom company that provides the highest quality of service (QoS). STC is using the best monitoring tools to ensure Service Liability Assurances (SLAs). Thanks to the Integrasys Controlsat solution, which centralizes the operation in the main NOC, telecom services of a consistently high quality and error free are provided and with a minimum of staff intervention and the use of smart alarm algorithms. Controlsat has enabled STC to monitor all its satellite services in a simple way in multiple satellites and locations in an affordable manner.

The more observant readers may have noticed that the company's slogan is: ***we are building success from innovation*** — exactly what the industry needs to accomplish.

The satellite industry has witnessed dramatic shifts over recent years and there are great opportunities ahead, driven by sets of unique challenges. By delivering innovative solutions to those challenges, the industry can continue to build on past successes.

www.integrasys.com

Focus: KORE Wireless

IoT enabling modern mining operations

By Vince Jager, Vice President, Asia-Pacific, KORE Wireless

The Internet of Things (IoT) is transforming the mining industry by enabling safer operating environments while increasing efficiency and profitability.

These advances are possible via the monitoring and managing of environmental parameters and events, as well as the tracking of materials and equipment, through IoT-powered solutions. Combined with powerful computing and communications resources, IoT empowers mining organizations to execute operational and management decisions based on accurate, up-to date information. The results include preventative maintenance programs for below-ground operations, as well as predictive models used to forecast future probabilities.

Today, data and information from mines is being aggregated and transmitted via back-haul communication channels to customer servers. Satellite communications are the preferred medium for this task since they provide truly global coverage, and are typically enabled through a combination of low and high Earth orbit services and complemented by cellular networks.

Two Domains

IoT solutions are divided into two domains: IT (Information Technology) and OT (Operational Technology). In the mining industry, the IT domain operates exclusively above ground and embraces enterprise computing.

The OT domain operates underground, turning event and parameter data into sector-specific information. Real-time data analytics operate below ground in the OT domain. Big data, which is a combination real-time and historical enterprise data, operates above ground in the IT domain (the cloud).

FIELD-PROVEN — 9900 SERIES
FREQUENCY CONVERTERS.

narda MITEQ

C-, L- AND KU-BAND CONVERTERS NOW AVAILABLE FROM STOCK FOR IMMEDIATE DELIVERY

L3 Narda-MITEQ frequency converters are the most trusted and reliable converters used worldwide. Available in DBS-, C-, L- and Ku-Bands*, our 9900 Series converters offer optimized phase noise, amplitude flatness and spurious outputs, and provide transparent frequency conversion for all video and data applications. With more than 10 years of field-proven reliability, backed by a three-year warranty, these converters are now available for immediate delivery. So if you want dependable equipment and need it now, then look no further than the Narda-MITEQ 9900 Series. Call us at (631) 231-1700. **nardamiteq.com/9900h**

L3 Technologies

L3T.COM

AEROSPACE SYSTEMS
ELECTRONIC SYSTEMS
COMMUNICATION SYSTEMS
SENSOR SYSTEMS

Narda-MITEQ

*DBS-Band not available from stock; please call for delivery estimates.

Operational Technology — Underground Communications

The primary network underground employs wireless mesh technology based on the Wi-Fi 802.11 protocol; a standard ratified by the IEEE that continues to evolve and improve.

WiFi delivers high performance and reliability at low cost over long distances. Multi-node mesh networks are intrinsically robust, like the Internet, where IP traffic can travel over different routes based on a priority or an optimized path. Therefore, if there is a broken link, traffic is dynamically redirected to the destination.

The same network can provide miners with Quality of Service (QoS) prioritized voice communications as well as video surveillance. Short-range technologies such as Bluetooth are also employed.

Information Technology — Communications Above Ground

Many mining organizations' data and real-time intelligence are transmitted to a cloud-based satellite or a cellular carrier network operation center before traveling over secure VPN communication pathways to an operation's facility where the data is aggregated and enriched before being sent on.

Clouds are a centralized communications and computing resource for mining companies, their customers, as well as transportation companies and other organizations. Satellite is the preferred medium, using both high and Low Earth Orbit (LEO) services, and cellular is employed for locations that provide good coverage. This combination ensures broad, worldwide connectivity at mine sites and for materials that are transported by road, rail, and sea.

Dual-mode cellular and Iridium short-burst LEO satellite services are capable of providing customers with 100 percent global coverage. Dual-mode devices and multi-network services blend cellular bandwidth with satellite coverage. If the Global System for Mobile (GSM) or Code Division Multiple Access (CDMA) signal is strong, communication is prioritized over the cellular network. If the signal fades or drops-off, the device switches automatically to satellite communication. When a strong cellular signal returns, the device will switch back.

Low-Earth and High-Earth Orbit Communications

The architecture of Iridium's low Earth constellation of 66 satellites provides multiple layers of resilience and redundancy. The large number of fast-moving satellites (each with 48 overlapping spot beams) minimizes the possibility of missed connections.

The interconnected cross-linked satellites "talk" with other nearby satellites in front, behind, and in, adjacent orbits. This dynamic process is similar to that of a cellular network. It ensures smooth, automatic hand-off from one satellite to the next.

Global two-way messaging satellite-class services, such as iSatData Pro, provide high Earth orbit communications for tracking and monitoring both mobile and fixed assets. The orbits of these satellites are geosynchronous; they precisely match the Earth's rotation.

Tracking Solutions

In mining, as with most industries, shipments need to be tracked throughout the supply chain: This is where GPS comes into the equation. Tracking allows mine operators (and other stakeholders) to realize global end-to-end visibility with solutions that enable assets to be tracked and monitored over the entire supply-chain; from mine-to-manufacturing.

The New Normal

Creating and deploying an IoT solution for the mining industry involves various interdisciplinary capabilities. Blending them into a robust, efficient solution will normally be done by an experienced systems integrator that can demonstrate the requisite core competencies.

Meeting the demanding, complex OT and IT requirements of a unified end-to-end solution is a daunting task that can only be realized via adoption of an ecosystem that integrates devices, assets, people, and workflows into a cohesive value chain.

As heavy equipment and mining evolves from a product-centric to a service-centric industry, the intelligence, connectivity, and optimization IoT brings will have a deep and transformational effect on the sector.

The ability to effectively scale growth and satisfy the needs of workers, suppliers, customers and society at large, is fast becoming the new normal.

www.korewireless.com

KORE Connect is now available in Europe. KORE Connect provides a bundled, turnkey solution comprised of secure, managed 4G LTE cellular wireless connectivity, cellular-enabled routers and/or gateways, KORE's best-in-class connectivity management platform, and 24/7 customer support.

KORE Connect is the flagship product in the KORE Power Solutions suite, a set of offerings that simplify the complex and empower businesses to avoid the common pitfalls associated with IoT implementations. KORE's bundled offerings combine a strong foundation of reliable, secure, and scalable IoT connectivity with equipment, applications, and professional services to provide businesses with end-to-end, fully-managed IoT solutions.

KORE Connect supports seamless, continuous operations while enhancing customer support and service delivery for both primary and back-up networking needs:

***Primary connectivity**: Delivers a secure wireless alternative for small offices and highly transient organizations; use case examples include food trucks, kiosks, and pop-up stores.*

***Back-up networking**: Provides immediate failover networking options when the primary connection is disrupted; ideal for businesses such as financial institutions, retail stores and healthcare clinics.*

"The launch of KORE Connect in Europe further bolsters our wide array of global, purpose-built IoT offerings," said Elizabeth Elkins, Executive Vice President of Product at KORE. "With KORE Connect, European businesses can now take advantage of new revenue opportunities, eliminate business continuity risks caused by outages and increase revenue gain, productivity and customer satisfaction."

SATNEWS PUBLISHERS

DIGITAL EDITIONS

SatMagazine • MilsatMagazine • SatNews.com

» *Free subscription and access*

Timely news and editorial «

» *Complete archives*

Join at: *satnews.com/reg*

Focus: Kratos

The looming HTS gateway crunch

Will the promise of HTS in space be met by a shockwave of rising costs on the ground?

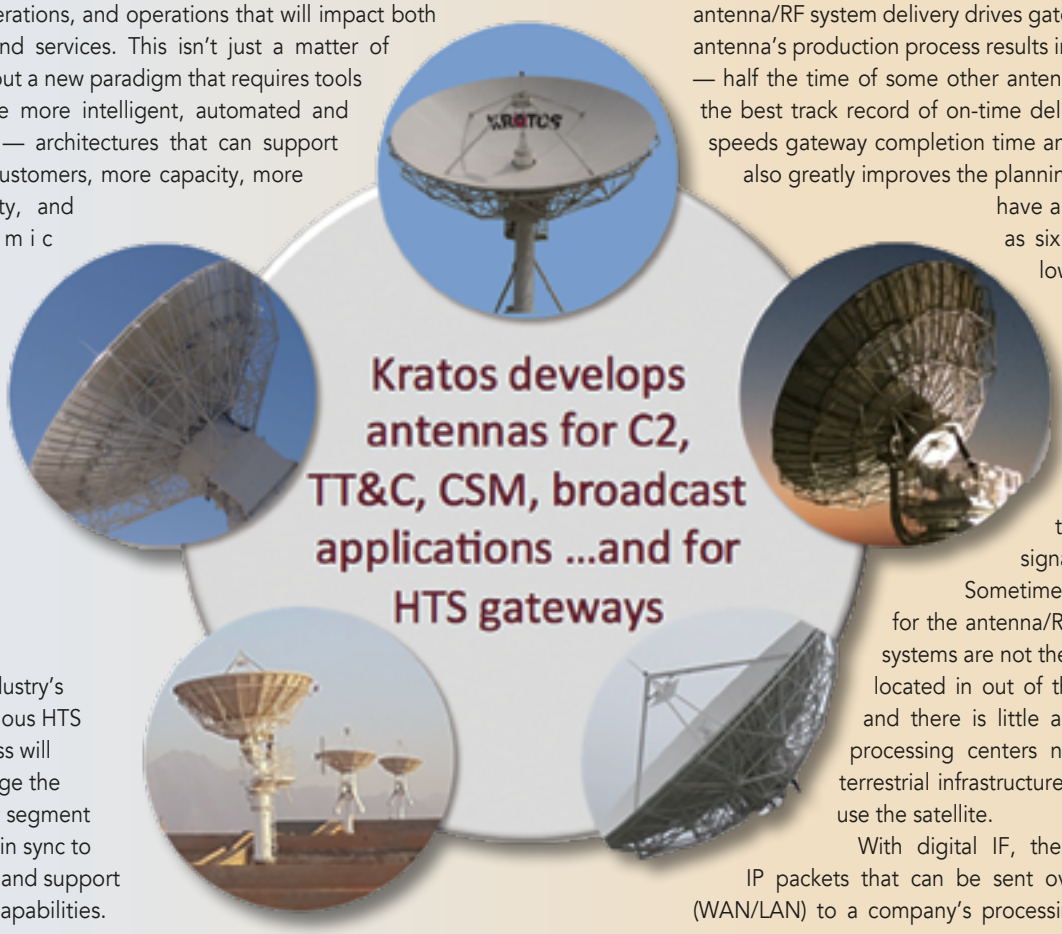
Industry trends, such as HTS and large LEO fleets, are driving changes to gateway design, management and optimization. What makes HTS so attractive is its high level of frequency re-use and spot beams that enable a gigabyte or more of frequency to be re-purposed by 50 plus times.

Euroconsult estimates that approximately 130 HTS satellites will be launched in the next eight years. Each HTS satellite requires roughly one gateway for each time the frequency is reused in both polarizations. As a result, thousands of new gateways will be required to support all this new bandwidth.

The upside is that HTS is massively increasing the amount of capacity and driving down the price per bit, all of which will enable new services to support new applications and drive industry growth. The satellite industry will be able to enter new markets and services from which they were previously economically excluded. As the HTS satellites continue to evolve and improve, they will require new ground architectures and technologies to support the next generation of HTS that will allow for "on-the-fly" changes in beams, frequencies per beam, and power to put HTS capacity when it's needed for their customers.

New Paradigms in Ground Systems' Architectures

HTS satellites have, by design, a more complex infrastructure, but the real challenge is that HTS payloads are steadily adding flexibility into the payload design, through capacity reuse and dynamic allocation of resources. This will require new paradigms in ground system architectures, location considerations, and operations that will impact both sales and services. This isn't just a matter of scale, but a new paradigm that requires tools that are more intelligent, automated and robust — architectures that can support more customers, more capacity, more flexibility, and dynamic usage.



The industry's continuous HTS progress will challenge the ground segment to stay in sync to deliver and support these capabilities.

This continued improvement of HTS payloads will put significant operational, financial and quality of service strains on operators and will force a fundamental re-architecture of their ground systems to optimize the operations of their HTS satellites. The innovation that has enabled HTS in space must be met with a new wave of innovation to optimize ground system performance and economics of the entire service chain. For example, a conventional gateway costs roughly $1 million to $4 million, depending on the system requirements. Therefore, lighting up a single HTS could require up to 10 gateways in the first few years of operation resulting in a $10-$40 million investment. Such economics are forcing changes to gateway design, management, and optimization to remain competitive.

The Architectural Challenge

How do you maximize the value of your gateway and ground infrastructure investment? Let's review some of the key gateway design decisions beginning with antenna/RF system selection. The antenna/RF system normally is one of the most costly ground station subsystems. There are a number of approaches that can be taken to optimize between costs and performance. One of the key trade-offs is the balance of antenna and amplifier. While a smaller antenna will reduce antenna cost, it usually requires larger amplifiers, which could negate the cost-savings realized by reducing antenna size and limit the over-all performance of the system.

Kratos, long a respected developer of antenna systems for TT&C, Command and Control (C2) and broadcast applications, among others, is introducing antennas especially designed for HTS gateways. As the antenna/RF system delivery drives gateway schedules, Kratos HTS gateway antenna's production process results in as little as six month delivery cycles — half the time of some other antenna manufacturers and with arguably the best track record of on-time deliveries in the industry. This not only speeds gateway completion time and positively affects carrying costs, it also greatly improves the planning process. Knowing you can reliably have a gateway solution delivery in as little as six months gives greater visibility and lowers the risk in planning of new sites.

Site Diversity

Satellite ground systems have always required that their signal processing (modems) be located relatively close to the antenna/RF system. This is because the Intermediate Frequency (IF) signal degrades the further it travels. Sometimes, however, the optimum locations for the antenna/RF systems and the signal processing systems are not the same. Antenna/RF systems are best located in out of the way places, where land is cheap and there is little around to cause interference. Signal processing centers need to be connected to a robust terrestrial infrastructure to enable customers to more easily use the satellite.

With digital IF, the amplified signal is captured into IP packets that can be sent over a Wide or Local Area Network (WAN/LAN) to a company's processing equipment. The move to digital

technology allows one to re-architect the ground system concept. Whereas the processing equipment had to be relatively close to the antenna that is no longer the case. Digital IF breaks the collocation requirement, allowing the antenna/RF systems and the signal processing centers to be optimally located for their requirements, while only requiring a standard IP network connection between the sites.

The digital IF technology is an enabling technology that makes new architectures and applications possible, such as:

- *Site diversity for disaster recovery, resilience, and even rain fade that occurs so fast that there are no data losses when switching, and over any distance between the sites.*
- *Downlink signal combining that takes a site diversity solution and makes it a performance enhancement solution or closes a link with a disadvantaged user terminal.*
- *Hub extension to bring services to new regions using your existing network infrastructure, but allowing your existing hub to connect to a remote antenna in a new region.*
- *Service extension to enable customers that are not in the coverage of an HTS satellite to use/ access the lower cost, high performance bandwidth.*

SpectralNet®, from Kratos, is such a technology, eliminating distance constraints formally associated with RF over fiber. By digitizing and packetizng RF signals and sending them over IP (while preserving signal integrity) operators can optimize, automate and expand services.

Virtualization

Ground System architectures must reduce emphasis on hardware and migrate to more software oriented solutions and the application of Virtualization Technology. There is an overall trend toward virtualization in all industries, including the satellite industry, and while not a new technology by today's standards, it is new to the ground system industry. Virtualization enables consolidation of processing equipment into fewer, yet higher density computer platforms and allows ground processing software to run within a minimal hardware foot print.

The migration to virtual ground architectures and the virtualization of hardware products into firmware and software applications simplifies operations, enables automation, and lowers operations and sustainment costs. As this transformation occurs, ground operators will benefit from greater system interoperability, an increased ability to scale their operations to meet requirements and greater location flexibility to control costs and enhance performance.

How to Manage Across Multiple Gateways

As monitoring capabilities will be needed to track the numerous spot beams and their associated services, the management and situational analysis of hundreds, if not thousands of spot and traditional beams becomes more critical — and complex. Management of the sensor network, out of necessity, will become increasingly automated.

When you consider mobile services, where signals will move across the beam as well as from beam to beam, the management of the signals and services becomes even more difficult and will require more intelligent and automated systems to ensure that the required quality of service is being delivered.

To address this issue, Kratos offers complete RF monitoring solutions including products specifically tailored for local gateway signal monitoring, VSAT interference and even VSAT network Geolocation (where you can Geolocate every terminal in the network). While many modem manufacturers are moving to 125, 250, and even 500 MHz wide signals, Kratos, in anticipation of 500 MHz modems, is developing a 500 MHz version of Monics® to effectively monitor and analyze ever wider BW signals.

Further, Monics Enterprise Manager provides operators with an enterprise view across gateways via a map-based representation of satellites, beam contours and monitoring sites, specifically designed with the help of some key satellite operators, to quickly identify, characterize and rectify problems when they occur. This will enable operations teams to better manage the significantly greater bandwidth and flexible operations of HTS satellites without having to increase manpower.

Just as importantly, Kratos' Compass® suite of network management offerings provides a full line of capabilities from basic equipment management to full service quality management of each customer service in the entire network.

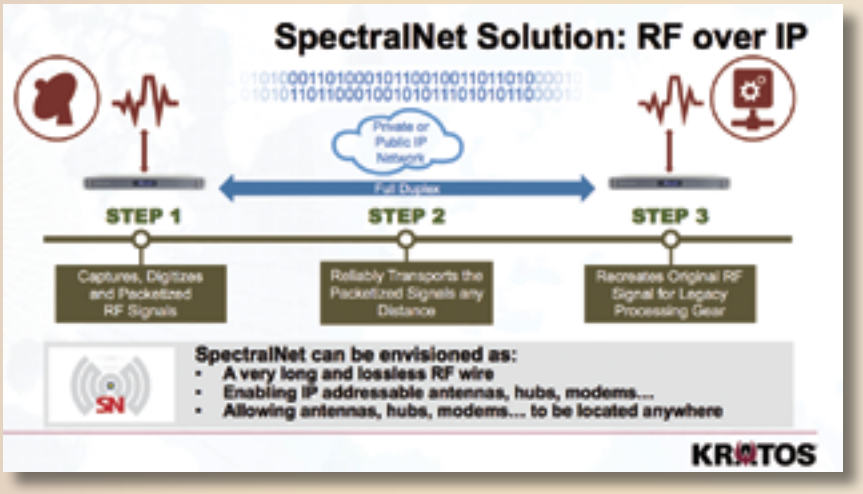
Service Quality Management (SQM)

With the significant growth in bandwidth and lower costs will come a major expansion of services and systems an operator will need to manage. The challenge of managing more gateways, networks, and ground equipment in general, for customers paying less money per service, will require new efficiencies. The imperative is to move from stove-piped manual processes to a consolidated, end-to-end management system that enables and provides more automation and intelligence. This will enable the operator to do far more and do it faster and better when it comes to managing each customer's network to their SLA requirement.

Kratos' SpectralNet® SQM end-to-end service management system has been rearchitected to enable faster response times, consolidation of operations and visibility into customer impacting conditions to maximize revenue and reduce costs. Compass SQM is fully integrated with Kratos' Skyminer cross-platform big data archive and data analytics solution whose advance correlation and predictive analytics provide meaningful value from the system data.

The drop in bandwidth pricing will open up new markets and the industry for growth, but it will take the adoption of new ground system technology to drive the satellite industry to successfully enter these new markets and deliver on the promise of HTS satellites.

www.kratoscomms.com



Focus: Terrasat

With great power...

By Bob Hansen, V.P., Global Sales & Marketing, Terrasat

Comes great responsibility — that's the story many are familiar with in the comic book world of superheroes.

In the maritime communications world, that statement should read, "*With greater power comes greater challenges.*"

The maritime communications environment has changed dramatically over the past decade. Shipping companies need to promote extreme efficiency on board all of their assets at sea — and they are turning to satellite in order to make this happen. Satellite connectivity allows companies to extend their land-based offices to their vessels and to allow constant communication with all of their ships no matter where in the world they happen to be located.

This is the era of the 'office at sea' — and it offers a vast array of benefits to shipping company investors who have been hit by bad economic conditions. Gaining access to a flow of information from their vessels enables them to manage their whole business in a much more efficient manner.

Satellite-based connectivity enables operators to collect data on fuel usage, to monitor the engines, to access weather data, to be able to send data to and from HQ, to access email, voice and other communications services and they want to keep their crew happy. To maintain connectivity, data-centric services are becoming increasingly important. High Throughput Satellites (HTS) allow access to the Cloud, Big Data analytics, automated services, video streaming applications, crew welfare services, and to the popular Bring Your Own Device (BYOD) on board.

These increasing data requirements onboard all types of vessels have pushed service providers to "amp" up the data rates and re-evaluate the network architectures from the ground (or deck) up. This means looking at substantially capable HTS and different modem technologies, such as DVB-S2X, Mx-DMA, and dSCPC.

Today, a new generation of satellites is enabling access to extremely powerful and abundant capacity through most of the major shipping and transit areas around the globe. The new modem technologies facilitate efficient satellite transmission in the order of 10's to 100's of Mbps. Yet, as one major satellite hardware manufacturer executive recently said, "*In many cases, the throughputs [HTS] cannot be increased because the very expensive stabilized antenna was outfitted with a Block Upconverter (BUC) that was sized for the near-term requirement only and thus becomes a bottleneck for the entire ship.*"

There are other reasons in addition to cost to keep the RF power to a minimum. Often, it's a result of limitations in weight or power consumption. However, newer technologies in RF power are re-shaping the thought process when designing stabilized platforms and as a result, some of the leading service providers, now regularly outfit new maritime terminals with "over the requirement" RF power.

Keep Your Cool

Maritime terminals bring a unique challenge to the satellite industry. They are composed of moving parts and operating in a "hostile" environment. Therefore, the terminals are almost always enclosed in a radome. Radomes are great at providing protection from the elements.

However, they also create another problem for powered equipment — heat. To combat this challenge, many radomes are outfitted with air conditioning if they operate in warmer climates. This solution often results in higher operating costs.

Large radomes also limit the amount of deck space available. Traditionally, attempts to increase RF power meant increasing BUC size, weight and heat output. However, the introduction and more widespread use of Gallium Nitride (GaN) based BUC products have allowed for the increased power without all the added issues.

There's a lot going on under the typical radome.

To illustrate this, let's look at the Terrasat traditional Gallium Arsenide (GaAs) BUC product vs their GaN based product:

BUC	Output Power (W)	Weight	Power Consumption
60W Ku iBUC R (GaAs)	60W P1 dB/48W Plin	33 lbs	850 VA
80W Ku iBUC 2 (GaN)	80W PSat/63W Plin	13 lbs	480 VA

The table above demonstrates that at similar output powers, the GaN based products are much more efficient and "radome friendly" in terms of weight and power consumption. Another advantage is that GaN based products consume power commensurate with the output at any given time. GaAs BUCs power consumption is either off or at 100 percent. There is no linear progression.

The Correct GaN for the Job

While GaN based products are not appropriate for all applications, such as many multi-carrier operations, the majority of maritime vessels are single carrier uplinks and perfectly suited to the technology. However, customers must be very careful when evaluating GaN BUCs from different manufacturers.

The real output power for GaN BUCs is described as Plin power. This is different from the common power rating for GaAs BUCs, usually denoted as P1dB power. Because GaN technology isn't as linear (power in = power out) as GaAs technology, Plin is the maximum linear power as defined by MIL STD 188-164B. However, Most BUCs are advertised by their PSAT or P1dB power. The PSAT/Plin discrepancy can lead to a lot of confusion for the "uneducated" end customer. The table below illustrates the difference between BUC manufacturers in the amount of "real" output power (Plin) that is available in various 80W PSAT BUCs on the market.

80W PSAT Ku	Terrasat	Competitor A	Competitor B
PSAT dBm	49	49	49
Plin dBm	48	46	45
Equivalent W	63	40	32

As you can see, the real output power varies greatly between BUC manufacturers with the same PSAT rating on GaN based BUCs.

Importance of Intelligence

Maritime terminals are, by their nature, remote terminals. Service to the terminal is often available during a service window while in port. Whether you are using GaN or GaAs based technology, the intelligence integrated into the BUC device is increasingly important in today's networks.

Most large network service providers have adopted sophisticated network management platforms that not only monitor device status and alarms (red, greens and yellows), but they also provide statistics on

network uptime, data usage, traffic handling, and applications. Network operators use this information to remotely troubleshoot potential and real-time problems.

Without advanced intelligence in the BUC, a problem could result in failure, and the operator would then have no visibility into the entire site. Operators are then left guessing how to restore operations and usually send a technician to the site blind while carrying a lot of spare equipment. With the increasingly demanding Service Level Agreements (SLAs) that most providers have signed, this situation is untenable.

Terrasat has proactively tackled this issue not only in the design of its IBUC2 range but in the IBUC product line. Every IBUC model has both a microprocessor and sensors placed throughout the unit to monitor functions both internal and external to the IBUC.

Terrasat also provides remote access via SNMP, HTTP, or serial interfaces that provides monitor and control capability of about 70 different functions, facilitating an in-depth view of terminal functions from a Network Operations Center (NOC).

A few of the key Monitor & Control (M&C) parameters found in the alarm functions:

- *Input level low/high from the modem*
- *Output level low/high*
- *Temperature*
- *Modem 10 MHz reference detector*

In the event of an alarm, the NOC operator can drill down to determine exact levels of these and several other important functions that can impact performance. If issues develop at a terminal, the operator can locally or remotely explore the upgraded event log that now stores 1,000 sensor readings.

Each time-stamped entry contains status readings for power input, power output, 10 MHz reference, power supply conditions and more. Using this information, the operator can detect trends or track events to quickly isolate the cause of the issue – whether internal to the IBUC or from an external source. Fast trouble-shooting equates to fast service restoration.

Demands placed upon maritime network service providers today are greater than ever before. Network design engineers spend most of their time analyzing the various baseband and satellite capacity solutions available, leaving the BUC decision as an outcome of link budgets and pricing considerations. With new technology available, it is now advisable and economical to design in extra RF power for growth and more integrated intelligence for M&C and data analysis.

Terrasat's forward-thinking and proactive approach allows its customers to take more control with an M&C system that provides in-depth information so that technical issues do not become problems and to ensure that the power is in place for future growth.

terrasatinc.com/

SATELLITE INNOVATION SYMPOSIUM

THE SILICON VALLEY SATELLITE BUSINESS SHOW

October 8th - 11th, 2018

NETWORK WITH INNOVATORS

STAY AHEAD OF THE MARKET

SATINNOVATION.COM

The **2018 Satellite Innovation Symposium** aims to pinpoint key imminent market changes that will become obvious in years to come. While infrastructure and capital status have dominated for decades, key innovations will continue to cause major disruptions to the established marketplace. ***What innovations will define the satellite communications industry going forward?***

The full itinerary of sessions, breakfast, lunch, refreshments and a cocktail reception are included with admission to the event. Optional workshops and a wine tasting tour with invited speakers and other satellite professionals are also available the day prior to the event.

JOIN A DYNAMIC GROUP OF EXECUTIVES FROM ORGANIZATIONS ADDRESSING EXCITING INNOVATIONS AND THE MARKET FORCES THAT WILL FRAME THEIR DEVELOPMENT

MSUA Interview with...

Todd Hill, Panasonic Avionics Corporation

By Catherine Melquist, President, MSUA

With permission, *SatMagazine* presents a Mobile Satellite Users Association (MSUA) interview that was conducted by Catherine Melquist, the President of the organization, of Mr. Todd Hill, the Senior Director of Global Satellite Planning at Panasonic Avionics Corporation.

Catherine Melquist (CM)

Thank you Todd for taking time to share your views on the satellite mobility market for this week's edition of Mobility News. How about setting the stage by talking about your background and the role you play at Panasonic Avionics.

Todd Hill (TH)

I have been at Panasonic Avionics for 16 years and over the last 10+ years I have been focused on Connectivity. I have been lucky enough to be part of the initial team to define and develop our connectivity product. I am involved in planning, designing, procuring and deploying our global mobility network for our customers. Panasonic continues to grow our connectivity business. We currently serve several markets including aero, maritime and energy.

CM

With the increasing demand for mobile broadband, what challenges do you face when planning capacity? How do you believe these challenges will likely evolve in the next 1 – 3 years as the market continues to grow?

TH

Providing enough capacity at the right economic rates continues to be our challenge. People have very high expectations from their day-to-day lives on the ground and don't always appreciate how difficult and expensive it is to provide Wi-Fi in the middle of the ocean. We continue to work to increase capacity and reduce the cost. Over the last decade there have been huge improvements in this area with the mainstream deployment of HTS. The rapid change in satellite technology will continue for the next decade bringing huge increases in available capacity along with substantial reduction in cost.

CM

In addition to increased access to broadband connectivity, what are the driving needs of today's aeronautical customers? How do they differ by customer segment?

TH

There are lots of airline but only a couple of airplane manufacturers, so each airline uses the cabin experience to differentiate their product. A well-managed connectivity product is key to provide a tailored product for each customer. We believe that passenger internet access, TV and mobile phone services are just one part of the value proposition for airlines.

With a connected aircraft, airlines will have situational awareness of every system that they want to monitor. Connectivity will also help them become more efficient in how they repair or maintain their aircraft with the real-time analytics they can offload during a flight. After all, every dollar an airline can save in its operations goes right to their bottom line. Connectivity also opens up new ways to ensure customer satisfaction with on-demand content, live customer care and personalization services. It's really a dynamic and positive change to air travel.

CM

With the launch of new LEO systems, do you envision aeronautical satellite system owners wanting interoperability between GEO/MEO/LEO constellations?

MSUA
Mobile Satellite Users Association

13 MARCH 2018

MSUA

MOBILITY SATELLITE INNOVATION AWARDS

For more information about the Mobile Satellite Users Association and how to join, please visit **www.msua.org**

LIMITED TIME OFFER - MSUA is offering complimentary tickets to the 2018 Mobility Innovation Awards Luncheon to companies that join MSUA from now until February 28, 2018. Two tickets ($150 value) will be given to each new corporate member and one ($75 value) for each new small business member.

MSUA's 2018 Satellite Mobility Awards Contest

Awards will be given to the top technical or service delivery innovations introduced to the market in 2017. Categories include:

- Top Aeronautical Satellite Mobility Innovation
- Top Maritime Satellite Mobility Innovation
- Top Government Satellite Mobility Innovation
- Top Land Satellite Mobility Innovation
- Top M2M/IOT Satellite Mobility Innovation
- Company to Watch

To enter, send a one-page description of your innovation together with data and customer testimonials evidencing the impact it's made on the mobility market to marketing@msua.org no later than February 16, 2018.
You must be an MSUA member to apply!

MSUA's 2018 Satellite Mobility Innovation Awards Luncheon

Tuesday, March 13, 2018.
Keynote Speaker: David Howgill, Founder and President of Huckworthy LLC - a consulting firm specializing in market development for companies with emerging technologies
Topic: Satellite Mobility and the 5G Opportunity
Time: 12:00 p.m. – 1:30 p.m.
Cost: $75 Members | $85 Non-Members
Register for the luncheon when you register for the SATELLITE 2018 conference and use code MSUA4SAT18 for 20% off the cost of your conference fees.

TH
Interoperability between GEO and MEO/LEO systems is the way most are heading. The MEO/LEO systems offer polar coverage and reduce latency. With the rapid change in technology there is a nice competition brewing regarding economics between VHTS GEO systems and MEO/LEO constellations.

There does, however, need to be some improvements made to antenna technology, specifically electronically steered phased array antennas, in order for our industry to fully leverage LEO and MEO technologies. We're seeing improvements, but there still needs to be more improvements made to antennas before we can maximize the benefits of these new constellations.

CM
Do the GEO and NGEO systems need to be interoperable or will that be incumbent on the devices that access them?

TH
That is a great question and as the NGSO systems get further into the design cycle and the operators fine turn their business models details will start to emerge. For Aero Mobility a single antenna is the most important aspect to allow a hybrid GEO – NGSO system.

CM
What innovations do see driving future mobility market growth in the aviation market and sectors?

TH
There is rapid change in technology in all aspects – satellite, modem and antenna. These are driving continued cost reductions, which are key to making in flight connectivity accessible to more and more passengers.

CM
Panasonic recently launched its third generation satellite network. What are the competitive advantages your network offers and what role is Newtec playing in service delivery?

TH
This is major jump in technology that improves all aspects of our network. Fundamentally it makes the jump to DVB-S2X, which unlocks the power of HTS and VHTS. We're also looking at our internal operations and making changes to things like traffic shaping, trends on flight lengths or routes, etc., all designed to make sure that passenger have all the bandwidth they need for their favorite services.

CM
Cybersecurity attacks are becoming a major focus for all industries. What unique challenges does aviation face?

TH
Separating what's possible versus what you read in the press is a big factor that we deal with on a daily basis. We have all seen erroneous reports about taking over airplanes through the IFE or connectivity system. In truth, our IFE system software is certified at Level-E per DO-178B, with "No Effect" to aircraft safety for any failure. We do not expect that classification to change. Still we take safety and security very seriously.

Panasonic has set our own rigorous standards, and we also meet applicable airframe specifications and government regulatory requirements. We have extensive internal processes in place to identify potential and emerging vulnerabilities, including the use of third party penetration testing. We assess such vulnerabilities, and provide security patches as necessary.

We fully support aircraft manufacturers to ensure our IFEC systems are aligned with their requirements for isolation from other aircraft systems.

CM
Last year, you took on the role of MSUA Programming Chair spearheading the effort for MSUA to align the association's focus and programming with member priorities. What's your leadership goal for the year's MSUA Programming Committee?

TH
My goal is to help MSUA fully embrace Broadband in Mobility and help the industry understand the additional design aspects required for mobility applications.

CM
So…aside from your professional focus on aeronautical mobility, what's your favorite form of mobility, when you're not working?

TH
I am lucky that I now get to focus on all forms on mobility although Aero was my first love. I still love to fly and enjoy the many adventures we have around the world.

CM
Todd, on behalf of MSUA [*and SatMagazine*], we appreciate your service on our Board of Directors and thank you also for taking time to be the subject of this week's MSUA member interview.

www.msua.org

Satellite mobility is revolutionizing the operations of maritime, aeronautical, enterprise businesses and governments worldwide. The ***Mobile Satellite Users Association*** *is a non-profit association dedicated to promoting satellite mobility innovations and development of the satellite mobility market worldwide. The association fosters the exchange of news, information and ideas among mobility providers and users including those focused on communications, navigation, safety and other evolving new applications. MSUA sponsors the annual Mobility Satellite Innovation Awards celebrating the top market proven mobility advancements and collaborates with conference organizers around the world to shape and facilitate conference programming dedicated to mobility market development*

President of the Mobile Satellite Users Association, Catherine spearheads the group's mission to promote mobility market development and mobility innovation. With more than 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 and disseminates mobility news and information to the wider mobility community through weekly editions of MSUA Mobility News.

SatComm

A part of

CommunicAsia

26 – 28 June 2018
Marina Bay Sands, Singapore

DRIVING DIGITAL TRANSFORMATION

Boasting Asia's largest congregation of satellite companies, SatComm is the gathering place for satellite solution providers and operators, telecom operators, broadcasters, IT professionals from government agencies and many more! Featuring leaders of the industry and a host of associated activities, SatComm is a must-visit event for all involved in satellite communications.

Be updated on the latest event highlights!
Join our mailing list at **www.CommunicAsia.com/join-list** now.

Organised by: UBM

A part of: ConnecTechAsia

Held alongside: BroadcastAsia, NXTAsia

Endorsed: aif Approved International Fair MEGA TRADE FAIR; ufi Approved International Event

Supported by: Singapore Exhibition & Convention Bureau

Held in: Singapore Passion Made Possible

Innovation: AvL Technologies

Amazing flat panel antennas

By Ian Timmins, Ph.D, Principal RF Engineer, and
Krystal Dredge, Director of Marketing, AvL Technologies

AvL Technologies is widely recognized as an industry leader in parabolic antenna technology and, in particular, rugged and robust transportable systems with mechanical positioning that is built to last and insanely reliable.

With more than 25,000 antenna systems deployed worldwide, AvL's products are found in nearly every terrestrial environment and have enabled satellite communications to reach millions of people.

Over the last 10 years, customers have been requesting antennas that are smaller, lighter, more powerful and more versatile, including antennas that operate in multiple bands and antennas that communicate with satellites in GEO, MEO and LEO orbits. While this has been doable for some time with parabolic Earth terminals, it's challenging and incredibly complex to do so with flat panel antennas. But new technologies emerge quickly, and soon — perhaps quite soon — flat panel antennas will be operating in significant numbers and for many different applications.

The most significant driver of demand for flat panel antennas is form factor, form factor, form factor. Flat panel antennas are small, compact, transportable, require little power and most offer high throughput. Newer, now emerging technologies also will enable spectral efficiency and the ability to move from beam to beam for LEO and MEO operation as well as the ability to track two satellites simultaneously. Additionally, advances in software defined radio and radiation pattern reconfiguration will enable communications to multiple satellites with multiple bands and orbits — all with one terminal.

Another driver is few or no moving parts. Though antennas with mechanical steering are sometimes disparaged because of the potential for mechanical issues, many mechanically-steered antennas have operated for decades without a problem. Mechanical steering can be a benefit to parabolic and flat panel antennas as it enables a much broader range of elevation, and thus can enable operations in more far-reaching locations and for a broader range of applications. That said, electronically steered flat panel antennas are in demand and when configured with multiple collaborative panels, can offer near or full hemispherical coverage without any moving parts.

Communications-On-The Move, or COTM, is yet another important driver of flat panel antenna technology. The desire to continuously communicate from a moving aircraft, ship or vehicle has fueled significant investment in technologies that adapt to an environment instead of being limited by it.

Debuting at SATELLITE 2018 will be the new DarkWing Ka-band terminal. DarkWing is a joint effort by L3 Technologies, GCS and AvL Technologies, and the terminal is a small form factor flat panel that can be packed in a standard 17" laptop bag. Photo is courtesy of AvL Technologies.

Flat panel antennas use several different technologies — some emerged in the 1970s and 1980s and some are emerging today. Most flat panel satellite communications antennas are waveguide based with horn or slot array antennas with mechanical steering, printed circuit board (PCB) antennas with mechanical steering, or active electronically steered arrays.

Waveguide Based Array Antennas

A waveguide based array is one of the most conventional implementations of a flat panel antenna. Waveguide is used for the feed network, and also forms the basis of the radiating element. Many times a horn is used as the individual antenna element. A horn antenna is exactly what you think it is — an antenna in the shape of a horn that directs energy through the horn. Thus a horn array antenna is an antenna comprised of many horns with energy being directed to and from a feed network to the back side of the horns. A slot can be used in a similar manner. Because energy projected through these radiating elements cannot easily be redirected in multiple directions, such waveguide based array antennas must have mechanical steering. In some cases, depending on the bandwidth of the element, and the required element spacing, transmit and receive arrays can be integrated or exist as separate entities.

Waveguide based array antennas are often used for high frequency applications including satellite communications and radar. This is due to the low loss nature of waveguide as a transmission line, particularly when compared to PCB based antennas and respective feed networks.

Limitations of such arrays typically include a complex and expensive manufacturing process that ultimately produces a thick overall structure as compared to PCB based alternatives. Bandwidth limitations of the radiating element may also be a consideration, and though slots are typically more compact than horns, they tend to be of lower bandwidth.

Printed Circuit Board Antennas with Mechanical Steering

Printed circuit board (PCB) antenna arrays are very popular in published technical literature whereby an array is created using a radiating element such as a square or round patch antenna.

The feed network may be composed of either a PCB based structure or a waveguide subsystem. PCB antennas can be easily modified with various shapes and sizes to optimize bandwidth or discrete patterns with exceptional diversity due to the ease of making changes in physical attributes of the fundamental structure. As such, a PCB antenna array becomes an excellent alternative to waveguide based arrays because they are much more suited to both high volume and low cost manufacturing.

PCB antennas also form the basis to integrate various components easily into the PCB structure such as phase shifting elements for reconfigurable radiation patterns or adding gain and filtering elements to refine overall antenna performance.

PCB antenna arrays are easily scalable in terms of physical size, and can be manufactured to meet size, weight and power (SWaP) specifications, or manufactured to operate at a specified performance requirement. Like their passive waveguide based counterparts, printed antenna arrays can be either interleaved where transmit and receive functions share a common aperture, or exist as discrete array structures.

PCB antenna arrays with fixed beams can use mechanical positioning systems in the same manner that has been used with parabolic reflectors. One significant difference in the system architecture is that the feed network of a printed antenna array is typically located behind the radiating elements,

SPACE TECH CONFERENCE

May 22 – 24, 2018 // Pasadena, CA

The ground-breaking and exciting Space Tech Conference returns to Pasadena with a new agenda format, packing three days of powerful insights, thought leadership and future trends into a comprehensive program not to be missed!

Hear from:

Virgin Orbit · SpaceX · Blue Origin · ULA America's Ride to Space · Orbital ATK · Aerojet Rocketdyne · Airbus · NASA · Jet Propulsion Laboratory California Institute of Technology · Raytheon · Boeing · NanoRacks · Intelsat · SNC Sierra Nevada Corporation · Rocket Lab

Conference highlights include the Satellite Systems Day sessions:

- Keynote Panel: Big Ambition, Short Timeframe – Providing Solutions to Answer Insatiable Market Demand
- The Big Squeeze: Technological Challenges and Requirements for Large Technology in Small(er) Satellites
- Propelling Propulsion System Accuracy with Innovations and Insights
- How To Do Business With… Raytheon

EARLY BIRD AVAILABLE

Book by March 9, 2018 to save up to $200!*

www.spacetechexpo.com

*CONFERENCE DISCOUNTS: Exhibitors, government, military, academic representatives and group bookings are eligible for discounted rates off full rate passes.

whereas for a parabolic reflector it is placed in front of the overall assembly, making the overall form factor similar in operation, but somewhat more discrete due to the elimination of the RF feed network installed on a boom.

This form factor of a PCB antenna array (without the need for a feed boom) makes it an excellent choice of system architecture for a manpack solution. For example, a printed antenna array can be very small with hundreds of elements designed for receive only, or both transmit and receive functionality and not require a boom assembly for operation. This helps make the manpack antenna small and light to carry, and easy to deploy and manually point using features such as adjustable-height fold-out legs to optimally position the antenna for full horizon-to-horizon coverage.

For an aircraft, a PCB array antenna can be fabricated in a manner that is exceptionally well suited to the aircraft's structural form factor, and this is true for both smaller and larger sized arrays. A conformal shape would allow for a really low profile aerodynamic radome to be placed over the antenna such that the overall assembly does not create excessive drag during flight. That said, a fixed beam conformal antenna typically is not meant to be steered mechanically and thus will have limited look angles. A better solution for an aircraft is a short and wide flat panel with conventional mechanical positioning so that the flat panel antenna can be tilted to send or receive a signal from a satellite at or near the horizon.

A PCB antenna has the advantage of being easier and more cost effective to manufacture than waveguide based counterparts. It also can be made conformal for certain applications.

The distinct disadvantage of PCB antennas is that PCB based systems tend to be lossy when compared to the air-filled waveguide components of a conventional parabolic reflector and feed system. The losses may be less significant when utilizing PCB based flat panel technology for LEO and MEO applications, whereby freespace loss effect is reduced due to the closer distance of the terminal to satellites in low or medium Earth orbit.

Active Electronically Steered Array Antennas

Active Electronically Steered Antennas (AESAs) are array antennas with each element having an independent solid state transmit and/or receive module. As such, each element can independently point to or track a satellite for transmit or receive, or collaboratively with other elements to create larger beams and increase gain. With one AESA, an operator can use the antenna's control system to direct elements to point to multiple satellites simultaneously. And as all RF energy is directed with electronics, these antennas typically have no moving parts.

AESAs offer some very distinct advantages when compared to conventional parabolic reflectors. First, with few or no moving parts, AESAs do not experience the wear and tear that normally would be induced on those components that may dictate the functional life of the antenna. This is particularly important for LEO and MEO applications, as parabolic reflectors require constant movement as satellites are tracked as they move from horizon to horizon. This may even require multiple parabolic antennas, depending on how quickly the positioning system can repoint once a satellite passes out of view.

Another key AESA advantage is the ability to repoint almost instantaneously when compared to the slew rate of a parabolic reflector, which is key for tracking multiple satellites in LEO and MEO orbits. Additionally, the LEO or MEO distance reduction, as compared to GEO, makes losses in PCB materials less problematic, with high data rates still possible.

For GEO applications, however, AESAs do not offer much of an advantage. Traditional parabolic antennas with mechanical positioning systems typically operate with limited movement to maintain peak after the initial pointing is complete. As such, mechanically positioned antenna systems experience very little wear and tear and are optimal for GEO applications, so AESA technologies are not necessary.

A significant challenge for AESAs is the characteristic roll-off or reduced gain that occurs as the beam is pointed 60 degrees or more away from boresight. Because AESAs experience reduced gain as this low look angle pointing occurs, it necessitates multiple AESAs to form a complete field of view. For example, on a ship, multiple antennas would be required encircling and on top of the mast to provide complete coverage from any direction. It is possible that the collective of these antennas can be combined to produce an overall more robust data link to a single or even multiple satellites simultaneously.

Another much-anticipated application for AESAs is operation on a moving vehicle. If the vehicle is moving in a relatively stable direction in an open area — east to west across the state of Kansas for example — an AESA should work really, really well. But a vehicle driving in an area with limited visibility to the southern sky, such as an area with steep terrain, will experience significant signal outages. In this environment, a combination of mechanical steering and or multiple antennas would enable better overall signal management.

The PCB-based manufacturing process for AESAs makes this technology well suited to high volume manufacturing. But the PCB materials for Ku- and Ka-band are currently still expensive when compared to conventional PCB materials.

Other Electronically Steered Antennas

Another promising new technology incorporates the use of metamaterials. This solution uses tunable elements which scatter radio frequency energy when the elements are activated to generate a holographic beam. The beam is directed by the elements that are activated, which enables continual beam direction or immediate change in direction as required to maintain a satellite signal. As with other flat panel technologies, the range of steering is limited with one antenna, so the need for one or several antennas operating collaboratively will be determined by the application.

In conclusion, the demand for flat panel antennas is being driven by form factor, few or no moving parts, and communications on the move applications. And the new flat panel antennas coming to market now or very, very soon are fueled by amazing new technologies to meet these demands. Though parabolic and other mechanically steered antenna systems are robust and well-suited to many applications, the versatility of flat panel antennas will create new markets and new applications that have yet to be imagined.

Ian Timmins, Ph.D., is the Principal RF Engineer at AvL Technologies. Prior to joining AvL, Ian was VP of Engineering for Optical Cable Corporation's Enterprise and Harsh Environment lines of business. He also previously held technical roles with Dell Computer Corporation, Cisco Systems and COM DEV Space Group. Ian holds a Ph.D. in Electrical Engineering and is an adjunct professor with Western Carolina University.

Krystal Dredge is the Director of Marketing for AvL Technologies. Krystal has 15+ years of product marketing experience in satellite and wireless communications, and most recently worked at Honeywell and EMS Defense & Space Systems in Atlanta prior to joining AvL in 2012. She holds a BSJ degree in Journalism from the University of Kansas and an MBA from Wichita State University.

Co-Hosted By:

SSPI

Smithsonian
National Air and Space Museum

DATAPATH

The SSPI Hall of Fame Celebration

March 13, 2018, 7:00pm - 10:00pm
Smithsonian's National Air and Space Museum
Washington, DC



Honoring the induction of: **Gwynne Shotwell**, President and COO of SpaceX; **Terry Hart**, former astronaut, Loral Skynet CEO; and **Otto Hoernig Jr.**, founder of Spacelink International and smallsat pioneer.

This Celebration is an invitation-only reception. SSPI sponsors, their invited guests and Lifetime Members are entitled to attend. Contact SSPI for more information at HoF_Celebration@sspi.org

Insight: Taming the Angry Sun

A Future Scenario?

By Graham Mackintosh, Industry Consultant in Applied A.I. for Space Science

On the morning of June 25, 2034, Sunspot NOAA-750 appeared to be unremarkable, sitting amongst the patchwork of other active regions on the Sun.

That all changed at 10:00 a.m. UTC, when it suddenly erupted into the most intense solar flare ever observed — an X37 class storm that was many times more powerful than the previous record holder in 2003[1]. Automated solar observatories set off NOAA alarms, triggering preparations for the dangerous proton storm and geomagnetic events that were expected in the hours and days ahead. (*See Figure 1 below.*)

Unfortunately, this flare had a rare characteristic with consequences that would soon turn deadly. Like the solar event in January 2005[2], there was a coincidental alignment of the solar flare's position and the Sun's spiraled magnetic field lines, which meant that this powerful flare had a perfect magnetic pipeline leading straight to Earth. A massive proton storm, accelerated to near-light speed with energies in excess of 100 MeV, followed this magnetic channel to impact the Earth a mere 11 minutes after the flare's initial observation.

With no time to execute safe-mode shut downs, hundreds of satellites quickly became electrically charged and were rendered inoperative. Moreover, within hours, the increased solar irradiance caused perturbations and density changes in the upper atmosphere, resulting in rapid orbit degradations for thousands of orbiting objects. More than 50 military and Earth science satellites burned up before operators could regain control and execute corrective burns.

Also of grave concern was the cloud of orbital debris, carefully tracked for collision avoidance, whose pattern was suddenly altered on a global scale. All bets were off while computer models struggled to simultaneously reassess the trajectory of thousands of objects whose orbits were modified by the swelling atmosphere. Thankfully, no collisions occurred, although there were reports of an unusual "energy event" near the secretive U.S. Space Force Station, apparently indicating that the military crew had been forced to use some sort of proximity defense mechanism.

Through another stroke of good luck, there were no commercial or NASA cis-lunar flights in progress at the time of the flare, with one Virgin Deep Space shuttle having just returned to Earth. The NASA Deep Space Gateway (*please see Figure 2, above*), orbiting the Moon every 90 minutes, was also temporarily protected on the dark side of the Moon at the moment of the flare, and NASA alerted the crew of six using the lunar communications relay. The astronauts scrambled into the safety of the shielded center hub just in time, as they emerged into the sunlight and the full force of the proton storm that was, by then, well underway.

On the lunar surface, the Shackleton Crater Outpost was safe within the permanent shade of the crater rim, although the communications relays positioned above the rim quickly became inoperative. Two astronauts were outside of the outpost, installing a fifth solar panel in the perpetual sunlight of the crater's southern edge. With communications cut off, they received no warming and continued to work for a full 30 minutes in direct sunlight while high energy protons hammered their bodies.

Figure 1. A solar flare, image courtesy of NASA.

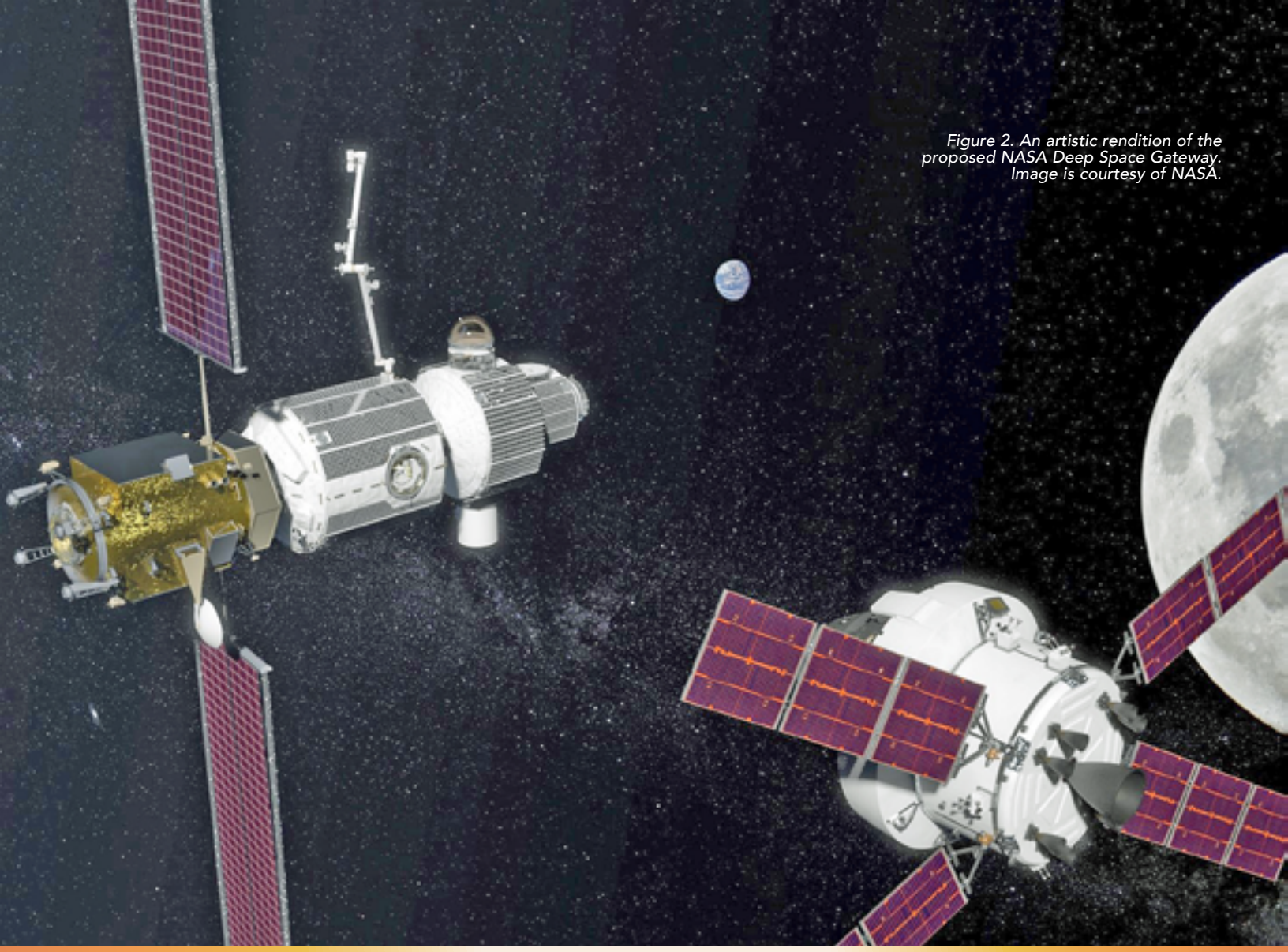


Figure 2. An artistic rendition of the proposed NASA Deep Space Gateway. Image is courtesy of NASA.

NASA flight surgeons estimated the two men had received a potentially lethal radiation dose of over 450 rem and were in dire need of immediate evacuation back to Earth. NASA was faced with a terrible decision: they could evacuate the dying men immediately, but this would risk exposing the spacecraft and the other healthy crew members to the flare's inbound coronal mass ejection (CME), which was expected to arrive within 48 hours. In the end, NASA decided to wait out the CME before evacuating — a delay that ultimately cost the two astronauts their lives.

Meanwhile, back on Earth, the wave of hard x-rays from NOAA-750 had impacted the Earth's ionosphere with no warning at all, followed by even more ionization from the powerful proton storm that arrived just minutes later. Ionospheric radio communications were completely blacked out and many radar systems beyond 40 degrees in latitude were rendered useless. Most critically, the ionospheric irregularities caused GPS signal delays and distortions so massive that even the high precision dual frequency GPS systems could not compensate. The world's GPS systems essentially shut down.

In the air, the loss of GPS positioning was compounded by communications problems that disrupted the aircraft peer-to-peer separation network that had replaced the old centralized air traffic control centers. Suddenly, with almost no warning, thousands of aircraft were flying blind. For the most part, aircraft in flight did what they were meant to do: long haul drones activated their intense emergency strobes and shifted into tight holding patterns, while manned aircraft alerted their flight crews to take manual control. Despite these best efforts, in the foggy skies over Amsterdam, just 15 nautical miles from Schiphol airport, an inbound commercial flight collided with an unmanned air freighter with the loss of all 260 passengers and crew.

Back on the ground, millions of autonomous vehicles also responded to the complete loss of GPS positioning, and used their lidar systems to navigate to a safe stop. However, with every vehicle doing this simultaneously, the result was complete urban gridlock on a global scale. Emergency response vehicles, including police, ambulances and firetrucks, were unable to move for over 15 hours, resulting thousands of deaths and widespread civil unrest in cities around the world.

Fortunately, for reasons that heliophysicists are still trying to understand, the coronal mass ejection from NOAA-750 was far less severe than was predicted based on the intensity of the initial flare. Thankfully, the much feared "trillion dollar storm"[3], with global power outages, did not materialize. Despite this lucky break, tens of thousands of deaths were attributed to the flare, while damage totaled over $690 billion, and there was also a sobering realization that things could have been much, much worse.

Back to the Future

This scenario is not just futuristic speculation; we have already experienced, studied and documented all of these dangers from extreme "space weather",

Figure 3. Artistic rendition of a GPS satellite. Image is courtesy of NASA.

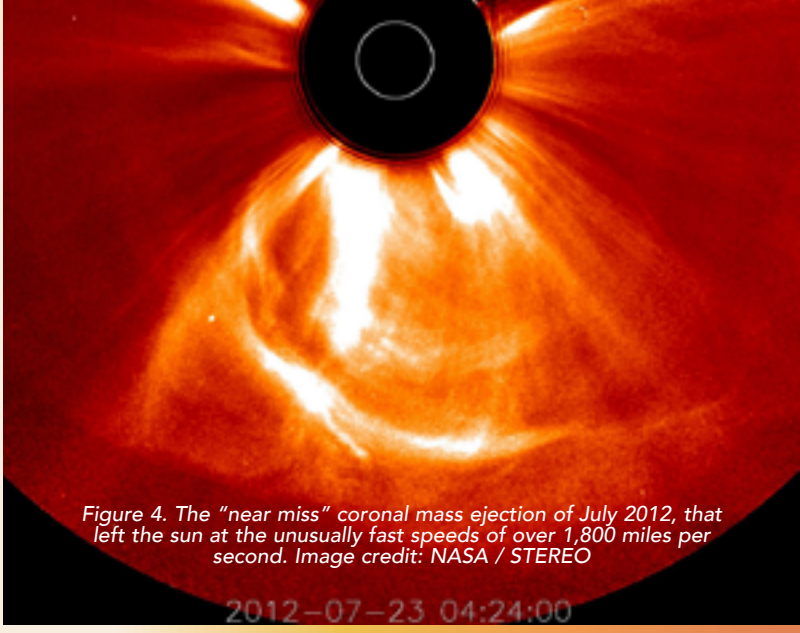


Figure 4. The "near miss" coronal mass ejection of July 2012, that left the sun at the unusually fast speeds of over 1,800 miles per second. Image credit: NASA / STEREO

and scientists have even begun to agree on the probabilities of a Carrington-class storm hitting Earth within the next ten years: about 12 percent[4].

"*Carrington-class*" refers to the massive solar storm that struck the Earth in 1859, which was studied by English astronomer Richard Carrington. The resulting distortions and fluctuations of the Earth's magnetosphere were so intense that telegraph wires caught fire due to the large electric currents produced by the Faraday Effects of the geomagnetic storm. If the Carrington Event happened today, the result would be a global human catastrophe, thanks to our ever increasing reliance on satellites, delicate electronics, power grids, autonomous navigation, and information-packed radio communications.

In fact, a Carrington-sized solar eruption narrowly missed the Earth in July 2012. A mere seven days determined the difference between a benign solar storm directed out into the solar system and one directed Earthward, with devastating consequences[3 5].

Even milder solar events have resulted in potentially dangerous situations on Earth and in space. For example, in November 2015, a relatively modest solar storm disabled the air traffic control systems in Sweden causing authorities to close off Swedish airspace for more than an hour[6], while 25 years earlier, in March 1989, a solar storm took out a Hydro Québec generating station, leaving six million people without power for nine hours[7].

There have also been multiple instances of degraded GPS navigation, such as the December 2005 solar flare that produced an immediate X-ray surge that disrupted satellite-to-ground communications and GPS navigation signals for more than ten minutes.

The military has long understood and studied these dangers. In May of 1967, a solar storm disrupted US military ionospheric communications over the polar cap. Given the jittery context of the Cold War, the U.S. Military interpreted this to be intentional radio jamming by the Soviet Union, and they shifted to high alert. Thankfully, the nascent Air Force space weather team was able to connect the disruption with an energetic solar event and deescalate the tense situation. More recently, in March 2002, during military operations in Afghanistan, a solar flare induced changes to the ionosphere that severely impacted military communications, and the resulting confusion led to a friendly-fire incident that left seven Americans dead[8].

This is the context behind the ominously titled study that was prepared for the US Department of Joint Military Operations: "***The Sun as a Non-State Actor: The Implications on Military Operations and Theater Security of a Catastrophic Space Weather Event***"[9]. The report concludes that "a repeat of the historic Carrington Event of 1859 would devastate entire fleets of spacecraft and wipe out entire electrical grids", and goes on to explain how world-renowned physicist Dr. Michio Kaku describes the worst-case scenario: "*We're talking about wiping out all satellite communications, all weather satellites, spy satellites, internet, GPS and blackening out most cities.*"

Another problem for satellites in lower orbits is the change in atmospheric drag that solar flares can induce. The increased irradiance from flares causes low density layers of the upper atmosphere to rise so that spacecraft experience a stronger drag force. Even during routine periods of solar maxima, satellites may have to be maneuvered every two to three weeks to maintain their orbit[10], but unpredictable solar events can produce rapid and very large increases in drag on satellites and alter their trajectory. For example, following the March 1989 solar storm, over 1,000 objects were "lost" due to sudden changes in their orbits, and it took the North American Aerospace Defense Command (NORAD) over a week to reacquire them and once again track their orbits with precision[11].

As NASA moves ahead under the direction of the newly signed Space Policy Directive[12], astronauts will soon leave the safety of Low Earth Orbit (LEO) for the first time in 45 years and return to the Moon and Mars soon thereafter. Once again, history provides us with a warning for the future: the solar storm of August 1972 thankfully occurred right in between the two manned missions of Apollo 16 and 17. Had the launch schedules been slightly different, Apollo astronauts could have been on the Moon at the time of the flare and suffered from radiation poisoning[13].

More recently, in October 2003, a solar flare and subsequent coronal mass ejection forced the crew on board the International Space Station (ISS) to take shelter from the increased radiation (***see Figure 6 on the next page***); meanwhile, far below the ISS, this same event caused diversions in polar region flight paths, degraded GPS performance, caused a Japanese satellite failure, and induced power outages in Europe and Africa[8].

The U.S. government is aware of our increasing vulnerability to solar storms, as evidenced by recent government documents such as the ***2017 National Space Weather Strategy, the National Space Weather Action Plan***[14] and the ***2016 Presidential Executive Order for Coordinating Efforts to Prepare the Nation for Space Weather Events***[15]. Among other things, these directives demand that NOAA, NASA, and other institutions, take immediate action to better protect our vital technical infrastructure

Figure 5. Permanent power grid transformer damage photo from 1989 solar storm. Photo credit: NASA

from the next super storm, and — most critically — improve our ability to predict solar events to give us more time to prepare.

Some promising new research, centered on emerging the capabilities of artificial intelligence (AI), may help with the second part of that mandate: to predict and prepare.

Artificial Intelligence to the Rescue

A computer system is considered to demonstrate some level of artificial intelligence if it mimics cognitive functions that we would typically associate with biological intelligence, especially that of the human mind. Examples include strategy formulation in game play, complex image recognition, "learning," and creative problem solving.

Deep Learning is a specific type of AI development that has received a great deal of attention due to its recent success in enabling computers to learn from vast amounts of data and subsequently make "intelligent" predictions, observations and decisions about that subject matter, even when the computer is shown new data that it has not seen before. Deep Learning systems accomplish this by using the mathematical concept of an artificial neural network, which loosely simulates information processing and adaptation patterns in a biological nervous system. This is a departure from the traditional approach to "teaching" a computer by manually writing a computer program that systematically encodes some aspect of human expertise.

The excitement is well placed, as there is growing evidence that something remarkable is taking shape within the intersection of high performance computing, massive data sets, and neural net algorithms. Problems which have been traditionally tackled with pensive coding, such as image classification and visual pattern recognition, have been overwhelmingly superseded with far more effective neural nets that often outperform the humans that trained them (***See Figure 7 on the next page***).

This sea change is particularly relevant to NASA due to the petabytes of scientific data already within its archives, and because of the high affinity of new AI technologies to many space science problems that are top priorities to NASA, including space weather and heliophysics research.

Recognizing the potential value of AI to the space program, the NASA Frontier Development Lab (FDL) was launched in 2016 to become an applied artificial intelligence research accelerator that would combine the AI capabilities of NASA, academia, and private sector companies in support of NASA's science priorities and mission goals. The program has been growing steadily, both in the scope of its AI investigations, as well as the range of commercial partners that are contributing with computing infrastructure and AI implementation experts.

Figure 6. Apollo 16 astronauts on the Moon just before the August 1972 solar flare. Photo is courtesy of NASA.

The FDL 2018 research portfolio includes various AI projects grouped into seven major disciplines, including orbital debris and space weather. The FDL space weather teams will build from the progress made by researchers during the previous FDL 2017 cycle, in which scientists used AI Deep Learning tools, such as Google's Tensorflow, to look for new ways to improve our ability to predict imminent solar events.

One of these teams focused on teaching Deep Learning neural nets to predict solar storms by analyzing high resolution images of the Sun[16]. The NASA Solar Dynamics Observatory (SDO) was a particularly useful source of training data for this work (***See Figure 8 above***). This satellite has been observing the Sun since 2010, and has been constantly streaming huge volumes of solar observation data back to Earth, including an uninterrupted sequence of HD-quality images of the Sun, taken every 12 seconds, year after year.

The team also integrated information from other satellites, such as the GOES X-Ray observatory, to teach their neural network the difference in appearance between a "quiet Sun" and images of the Sun when flares were prevalent. The goal of the team was to produce an AI system that could estimate how strong a flare could be given the current state of the Sun.

Their work has produced several exciting indications of progress, such as the manner in which their neural network quickly learned to "pay attention" to active regions on the Sun. These are areas of intense and complex magnetic activity that can sometimes give rise to sunspots, and, more importantly, trigger solar eruptions such as solar flares and coronal mass ejections. As more data is fed into the AI system, the hope is that it will further refine its abilities – perhaps looking for a particular set of features within an active region, or specific combinations of active regions that together signal a potential solar flare may soon erupt.

The FDL team went on to generalize their AI framework to release an open source tool they call FlareNet[16], which allows other heliophysicists to more easily build large collections of data to train new AI systems to predict other forms of solar phenomena. Using FlareNet, researchers are now able retrieve and combine archived data from two different SDO instruments: the Helioseismic and Magnetic Imager (which produces full-disk images of the Sun's surface magnetic field) and the Atmospheric Imaging Assembly (which captures high definition images of the Sun more than eight channels spanning the UV and EUV spectrum). This can provide a much richer data set to train FlareNet, hopefully allowing it to tune into subtle hints of trouble before a solar storm erupts.

Meanwhile, a second FDL Space Weather team showed how an AI system, using Deep Learning technology, could predict variations of the Earth's geomagnetic fields based on measurements of "solar wind"[17]. Solar wind is a stream of charged particles released from the upper atmosphere of the Sun, so establishing a predictive link to geomagnetic disturbances would be a big step forward, since these shifts in the Earth's magnetic field can cause power grid failures and other infrastructure problems.

When they trained the AI system, it correctly deduced for itself that solar wind speed and proton density were important factors in making accurate predictions. In a particularly interesting twist, the AI system also determined that North-South component of the Earth's geomagnetic field at low latitude monitoring stations — such as Guam, Hawaii, and Puerto Rico - are also important to predicting the intensity of a geomagnetic storm. The team realized that their AI program had tuned into a phenomena called "ring currents"; these are electric currents carried by charged particles trapped in the Earth's magnetosphere and they have a significant effect on the electrodynamics of geomagnetic storms. The AI system was correctly learning about the complex physics of the Earth's magnetic field. Perhaps, with more

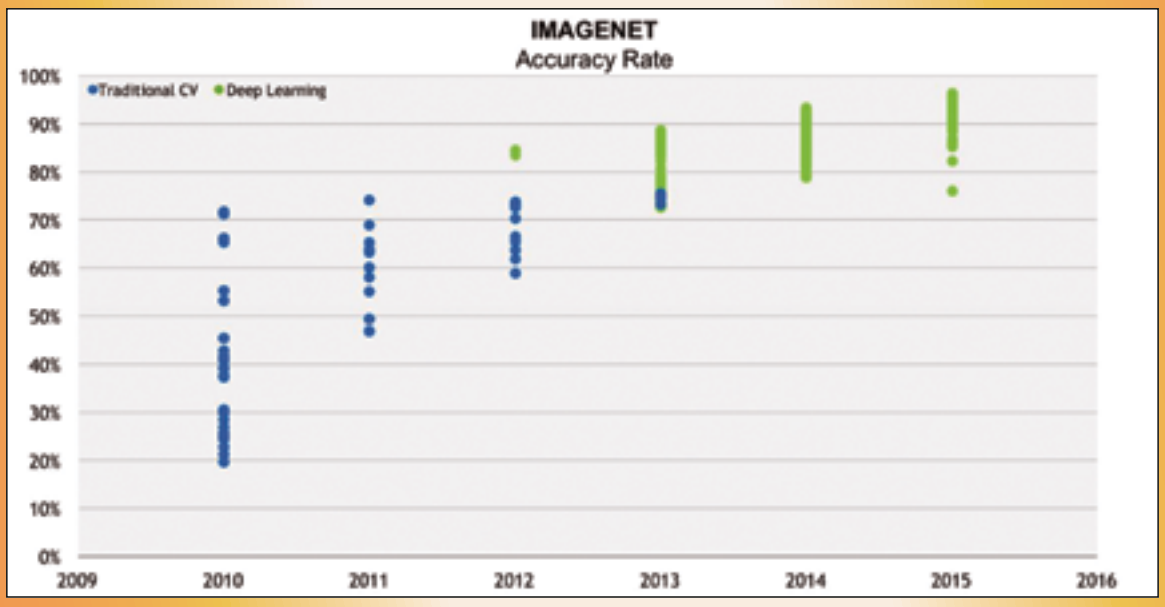


Figure 7. Progressive accuracy of the ImageNet competition results, showing that, since 2012, deep learning solutions have dominated the 10 million image classification task and now exceed human abilities. Chart is courtesy of NVIDIA Corp.

data and more training, this neural net might find new predictive factors that the scientists cannot explain, leading to new research and discoveries. At that point, it may be difficult to determine who is teaching who.

The space weather researchers have joined the FDL program because they believe that the application of artificial intelligence to heliophysics is a critical step in the taming the Sun and protecting the systems we all depend on. However, above and beyond the practicalities of making our technical infrastructure more resilient to solar events, there is our restless and relentless desire to understand the universe around us, to push out, explore, and learn what is beyond the horizon. The silicon chip was one of the key technologies that has allowed us to probe our solar system and have astronauts visit the Moon. Now, half a century later, artificial intelligence will help us to take the next step, to again explore beyond our home planet, not just to visit, but to stay.

References

[1] "SOHO Hotshots", Solar and Heliopheric Observatory, NASA, 3 Nov. 2003, sohowww.nascom.nasa.gov/hotshots/2003_11_04/

[2] "A New Kind of Solar Storm", NASA Science Beta, NASA, 10 Jun. 2005, science.nasa.gov/science-news/science-at-nasa/2005/10jun_newstorm

[3] "Near Miss: The Solar Superstorm of July 2012", NASA Science Beta, NASA, 23 Jul. 2014, science.nasa.gov/science-news/science-at-nasa/2014/23jul_superstorm

[4] Riley, P. (2012), On the probability of occurrence of extreme space weather events, Space Weather, 10, S02012, doi:10.1029/2011SW000734.

[5] Baker, D. N., X. Li, A. Pulkkinen, C. M. Ngwira, M. L. Mays, A. B. Galvin, and K. D. C. Simunac (2013), "A major solar eruptive event in July 2012: Defining extreme space weather scenarios", Space Weather, 11, 585–591, doi:10.1002/swe.20097.

[6] "Solar storm knocks out flight control systems in Sweden", Phys.org News Service, 4 Nov. 2015, phys.org/news/2015-11-sweden-solar-flare-flight.html

[7] "A Super Solar Flare", NASA Science Beta, NASA, 6 May 2006, science.nasa.gov/science-news/science-at-nasa/2008/06may_carringtonflare/

[8] "The trillion-dollar (solar) storm", The Space Review, SpaceNews, 30 Oct. 2017, www.thespacereview.com/article/3358/1

[9] Major Brian W. Kabat, "The Sun as a Non-State Actor: The Implications on Military Operations and Theater Security of a Catastrophic Space Weather Event", 03-05-2010, UNCLASSIFIED, Joint Military Operations Department.

[10] "Satellite Drag", Space Weather Prediction Center, NOAA, www.swpc.noaa.gov/impacts/satellite-drag

[11] H. C. Koons and J. F. Fennell, "Space weather effects on communications satellites," in URSI Radio Science Bulletin, vol. 2006, no. 316, pp. 27-41, March 2006.

[12] "New Space Policy Directive Calls for Human Expansion Across Solar System", NASA Press Release, NASA, 11 Dec. 2017, www.nasa.gov/press-release/new-space-policy-directive-calls-for-human-expansion-across-solar-system

[13] "Sickening Solar Flares", NASA Science Beta, NASA, 27 Jan. 2005, science.nasa.gov/science-news/science-at-nasa/2005/27jan_solarflares

[14] "National Space Weather Strategy And Action Plan Released", Space Weather Prediction Center, NOAA, 9 Mar. 2017, www.swpc.noaa.gov/news/national-space-weather-strategy-and-action-plan-released

[15] "Executive Order -- Coordinating Efforts to Prepare the Nation for Space Weather Events", The White House Office of the Press Secretary, The White House, 13 Oct. 2016, obamawhitehouse.archives.gov/the-press-office/2016/10/13/executive-order-coordinating-efforts-prepare-nation-space-weather-events

[16] Sean McGregor, Dattaraj Dhuri, Anamaria Berea, Andrés Muñoz-Jaramillo, "FlareNet: A Deep Learning Framework for Solar Phenomena Prediction", Workshop on Deep Learning for Physical Sciences (DLPS 2017), NIPS 2017

[17] Mark C. M. Cheung, et al. Modeling Geomagnetic Variations using a Machine Learning Framework, in AGU 2017 Conference Proceedings. SM23A-2591, agu.confex.com/agu/fm17/meetingapp.cgi/Paper/281227

Graham Macintosh is an industry consultant in Applied A.I. for Space Science.

AWARD WINNING SATELLITE TECHNOLOGY THAT OPTIMIZES PERFORMANCE

INNOVATIVE SOLUTIONS FOR REAL-WORLD CHALLENGES

Advantech Wireless | SMARTER SOLUTIONS, GLOBAL REACH.

Second Generation ASAT II™ Multiservice VSAT System

Industry Leading SATCOM GaN based SSPAs/BUCs

SMARTER SOLUTIONS, GLOBAL REACH.

Advantech Wireless delivers intelligent broadband communications solutions that achieve excellence, maximize performance and minimize operational costs, all with uncompromising quality. Ultimately, we help people stay connected and informed by designing and manufacturing the most advanced terrestrial and satellite communication technologies on the planet.

INDUSTRIES

Commercial
Critical Infrastructure & Government
Military

SOLUTIONS

Broadcast
Mobile Wireless Communications & Satellite Backhaul
Government & Military
Disaster Recovery & Emergency Management
Homeland Security
Maritime & Cruise Ships
Oil & Gas
Direct-to-Home Satellite Television & Internet
Enterprise & Corporate

www.AdvantechWireless.com

Russian Satellite Communications Company

Visit RSCC at Satellite Show 2018
March 12-15
Walter E. Washington Convention Center
Washington, D.C.
Stand 933

Nab Show
April 9 - 12
Las Vegas Convention Center
Stand SU12014

SATELLITE TECHNOLOGIES FOR NEW VICTORIES

www.rscc.ru