

SATCOM for Net-Centric Warfare

# MilsatMagazine

MARCH 2019

## WARFIGHTER COMMS

COMSAT

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Satellite Report

Kratos Defense

Norsat  
International

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AQYR  
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Rebecca M. Cowen-Hirsch, Inmarsat  
Ken Peterman, Viasat  
Paul Scardino, Speedcast  
Giles Peeters, Track24 Defence  
Koen Willems, Newtec

### This issue's authors

Carl D'Alessandro

Brad Bolstad

Dr. Mark Dale

Krystal Dredge

Dan Gager

Dr. Rowan Gilmore

Drew Klein

Mark Knapp

Anatoli Levine

Ken Peterman

Ryan Schradin

Dr. Ian Timmins

Aaron Titus

Barry Vince

David Walton

Mike Wasson

Andrew Werner

## DISPATCHES

### SPAWAR contracts with Comtech EF Data Corporation for satellite modems

Raytheon (NYSE: RTN) won a \$406 million Indefinite Delivery/Indefinite Quantity contract award from the U.S. Army for ARC-231A radio systems.



The contract, which will be performed over the next five years, includes upgrades, production and support for up to 5,000 radios.

Because the ARC-231A is software-defined, it can accommodate rapid upgrades without requiring the radio to be removed from its platform.

The latest version of the system recently gained NSA Type 1 certification and delivers secure, classified communications on the battlefield.

"These radios are the backbone of rotary-wing communications," said Barbara Borgonovi, Vice President of Raytheon Integrated Communication Systems. "The ARC-231A enables U.S. forces to maintain the edge in secure communications, whether they're flying in contested or congested environments."

The radios will be installed on a variety of U.S. Army platforms, including the UH-60 Black Hawk, UH-72 Lakota utility helicopter and the AH-64 Apache attack helicopter.

[www.raytheon.com](http://www.raytheon.com)

Rocket launch photo is courtesy of Raytheon.



**Table of Contents**

Dispatches .....	<b>4 to 29</b>
Arctic Comms for Warfighters, by Dan Gager .....	<b>32</b>
DoD's Automated Satellite Roaming, by Dr. Mark Dale.....	<b>36</b>
Empowering the Warfighter, by Ken Peterman.....	<b>42</b>
Versatile and Robust X-Band, by Krystal Dredge and Dr. Ian Timmins ...	<b>44</b>
Increasing the Warfighter's Bandwidth, by Carl D'Alessandro.....	<b>46</b>
Size May Not Matter, by Dr. Rowan Gilmore.....	<b>48</b>
Missile Warning and Defense, by Brad Bolstad .....	<b>52</b>
The Portable Radome, by David Walton .....	<b>54</b>
The TCPED Information Revolution, by Mark Knapp.....	<b>56</b>
The Hunt for Talent, by Barry Vince .....	<b>58</b>
The Government Satellite Report: mPOWER, by Ryan Schradin.....	<b>60</b>
Enhanced Comms for the Warfighter, by Aaron Titus.....	<b>62</b>
COMMAND CENTER: John Serafini, HawkEye 360 .....	<b>66</b>
A Common Ground System, by Andrew Werner.....	<b>70</b>
Are Mission Critical Communications Stuck in 1912?, by Anatoli Levine..	<b>72</b>
SatCom Frontier: A New Chapter In, by Skot Butler... ..	<b>74</b>
The Crucial Need for Mobile Health, by Drew Klein .....	<b>76</b>
Realistic Mission Modeling, by Mike Wasson.....	<b>80</b>

**Advertiser Index**

2Roads Professional Resources.....	<b>9</b>
a.i. solutions.....	<b>5</b>
ACORDE TECHNOLOGIES, S.A. ....	<b>17</b>
Advantech Wireless Technologies .....	<b>27</b>
AvL Technologies .....	<b>19</b>
C-COM Satellite Systems Inc. ....	<b>15</b>
Comtech Command & Control / TCS.....	<b>13</b>
Comtech EF Data .....	<b>21</b>
CPI Satcom Products.....	<b>83</b>
EM Solutions, Inc. (EMS) .....	<b>25</b>
Experior Labs.....	<b>2</b>
Gilat Satellite Networks, Ltd.....	<b>23</b>
HISDESAT .....	<b>39</b>
iDirect Government.....	<b>29</b>
Intelsat General Corporation .....	<b>1</b>
MITEC VSAT / Alga Microwave .....	<b>6</b>
MOOG, Inc. (Space & Defense Group) .....	<b>7</b>
NAB - Nat'l Assoc. of Broadcasters.....	<b>51</b>
Newtec CY.....	<b>3</b>
Radeus Labs, Inc.....	<b>11</b>
RUAG Space .....	<b>35</b>
Satnews Digital Editions.....	<b>69</b>
SMi Group — MilSpace 2019.....	<b>65</b>
Spacebridge.....	<b>84</b>
Space Foundation.....	<b>82</b>
SSPI — Hall of Fame Dinner (DC) .....	<b>41</b>
W.B. Walton Enterprises, Inc. ....	<b>37</b>

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

## AFRL selects AIS for Cybersecurity contract

**Assured Information Security (AIS) in Rome, New York, has been awarded a \$48.4 million contract for full spectrum cyber capabilities.**

The objective of this effort is to provide the U.S. Air Force with tools and technologies to aid in cyber warfare. This contract provides for research, development and transition of cyber technologies to enable rapid cyber operations and will result in the accelerated delivery of innovative cyber solutions to the warfighter.

*"The full spectrum cyber capabilities effort is an exciting opportunity for AIS and we are very pleased to have been awarded this contract,"* said **Salvatore Paladino**, Program Manager at AIS for the Agile Cyber Solutions (ACS) Group,



whose team will be completing the work. *"This work will have a measurable and powerful impact on cyber mission assurance by assisting the U.S. Air Force in maintaining cyber superiority."*

This award is the result of a competitive acquisition and two offers were received.

Work will be completed by AIS through March, 2024. **Air Force Research Laboratory (AFRL)**, also in Rome, is the contracting authority for the award.

*"There is no doubt the Air Force made the right choice by selecting AIS for this important work in cyber security, which will enhance both our national defense and the regional economy,"* said U.S. Senator **Charles Schumer**.

*"Together, the local workforces at AIS and Rome Lab will blend their expertise to deliver real results in developing our nation's cybersecurity infrastructure. I will continue to do all I can to bring more federal work — and more jobs — to the Mohawk Valley through partnerships like these."*

*"The Mohawk Valley plays a critical role in developing our country's cybersecurity infrastructure,"* said Congressman **Anthony Brindisi**. *"Choosing AIS to do this important work will boost our local economy and ensure the Air Force has the tools and resources it needs to keep our country safe and secure. I will continue working to help bring more of these types of opportunities to Upstate New York."*

[www.ainfosec.com](http://www.ainfosec.com)

## Kratos reaps C5ISR award



**Kratos Defense & Security Solutions, Inc. (NASDAQ:KTOS), has recently received approximately \$7.7 million in Command, Control, Communication, Computing, Combat and Intelligence Surveillance and Reconnaissance (C5ISR) system program awards.**

Kratos is a leading provider of systems, products and solutions that support the U.S. Department of Defense (DoD), its allies and other customers' C5ISR programs and platforms.

Work under these contract awards will be performed in secure Kratos manufacturing facilities.

Due to competitive, customer related and other considerations, no additional information will be provided related to these recent contract awards.

**Eric DeMarco**, President and CEO of Kratos, said, *"Kratos' demonstrated ability to rapidly develop, demonstrate and field technology leading products*

*and systems at an affordable cost is a competitive differential for our Company, and we are proud to support our customers in their National Security Mission."*

[www.kratosdefense.com/](http://www.kratosdefense.com/)

# DISPATCHES

## Space Foundation names the recipient of the Admiral James O. Ellis, Jr., scholarship



In 2017, the Space Foundation announced a new annual scholarship honoring its former board chairman — the Admiral James O. Ellis, Jr., New Generation National Security Scholarship was created to provide a young professional member of the United States Armed

Forces full participation in the Space Foundation’s annual Space Symposium and benefit from its mentoring, networking and professional development opportunities.

For 2019, (S)Sgt. Patrick Harper, USAF, is the recipient of this prestigious scholarship.

He will receive full registration for the **35th Space Symposium**, to be held April 8-11, 2019, at **The Broadmoor** in Colorado Springs, Colorado.

In addition to the main program, he will participate in the Symposium’s **New Generation Space Leaders** program, the Symposium’s **Space Classified** program and will be seated at the Space Foundation Board of Directors table at dining functions during the Symposium.

(S)Sgt. Harper was nominated by his leadership at Fort Gordon, Georgia. He is fluent in Arabic and was recently selected for a promotion, taking over the responsibility

of 24/7 mission coverage and providing critical information to Combatant Commanders.

Harper is pursuing his undergraduate degree in planetary geology, he volunteers with the local Astronomy Club of Augusta and is an active member of the international Space Generation Advisory Council for young professionals.

[www.spacefoundation.org/](http://www.spacefoundation.org/)

[www.spacesymposium.org/](http://www.spacesymposium.org/)

## VORAGO Technologies takes the heat for DoD and USAF

**VORAGO Technologies’ can handle the heat — even with the extreme heat that is generated in space, such as radiation and intense temperatures that affect systems.**

Because of this capability, the company has been awarded an **AFWERX Small Business Innovation Research (SBIR)** Phase II grant from the U.S. Department of Defense and the U.S. Air Force.

The project that is now underway uses VORAGO’s disruptive radiation-hardening technology and is an extension of the successful phase I effort to provide a state-of-the-art,

rad-hard microcontroller that is qualified to meet U.S. Air Force requirements.

The new microcontroller is supported by a broad range of development tools to simplify code development and optimize code reuse.

This architecture can be used for many years by the U.S. Air Force in various platforms with significant software reuse, which shortens development time and reduces development costs.

**Bernd Lienhard**, CEO of VORAGO Technologies, said that the company is delighted that the U.S. Air Force recognizes and supports VORAGO’s unique capability in developing

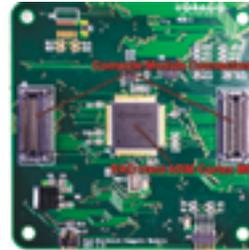


PHOTO OF COMPUTER MODULE PCB PROTOTYPE



PHOTO OF MOTHERBOARD ASIC PCB PROTOTYPE

According to Lienhard, VORAGO’s **HARDSIL®** technology and their ability to optimize size, weight and power consumption will allow the U.S. Air Force to develop optimized and robust next-generation electronics systems.

[www.voragotech.com](http://www.voragotech.com)

innovative technology for high-reliability applications.

# DISPATCHES

## Aerospace provides urgent info to assist with U.S. Defense and Space development



Jamie Morin, VP and executive director of CSPS, stated that, this year, the company witnessed numerous government mandates to treat space programs uniquely and with more resources.

Aerospace hopes that this report provides a solid understanding of why acquisition changes need to be made to achieve the critical goal of accelerating our space capabilities.

The CSPS report analyzes the effects of past acquisition reform initiatives that were implemented during six acquisition regimes.

Every regime reflected various legislative and regulatory changes, as well as structural changes and initiatives attempted during its time.

Each succeeded on their own terms by improving systems and outcomes without having sole responsibility for any specific programs.

[aerospace.org/sites/default/files/2019-02/Lewis-Hastings\\_AcqReform\\_01302019.pdf](https://aerospace.org/sites/default/files/2019-02/Lewis-Hastings_AcqReform_01302019.pdf)

**Making important decisions on any level can achieve best results with more information rather than less. And with that concept, imagine the amount of information required for determining what is best for U.S. defense and space interests and dealing with developing new space systems.**

A report — *Acquisition Reform Regimes on Their Own Terms: Context, Mechanisms, Effects, and Space Program Impact* — is now available from **The Aerospace Corporation's Center for Space Policy and Strategy (CSPS)** to assist decision makers urgently developing new space systems' acquisition plans to help protect U.S. interests.

This insight provides decades of defense and space acquisition reforms and best practices.

Rosalind Lewis, principal director of Aerospace's *Acquisition Analysis and Planning Subdivision* and co-author of the CSPS report, stated that understanding why changes were made in previous defense and space acquisition programs is key to guiding new discussions to field rapid capability and flexibility for acquiring new space systems.

Significant recent developments affecting space acquisition include a call in the *Fiscal Year 2018 National Defense Authorization Act (NDAA)* to identify a "sole authority" for organizing, training and equipping future space operations.

President Trump called for the establishment of a new military branch, the **Space Force**.

The FY19 NDAA asked the *Department of Defense (DoD)* for a report on how to acquire space systems.

This led to a DoD proposal for a new **Space Development Agency** to ensure that a Space Force would have the personnel, assets and capabilities to support our nation's military interests in space.

Finally, on December 18 of last year, President Trump ordered the creation of the **U.S. Space Command** to employ space capabilities and lead space operations.



# DISPATCHES

## SPAWAR contracts with Comtech EF Data Corporation for satellite modems

**Comtech Telecommunications Corp. (Nasdaq: CMTL) — during the firm’s Q2 of fiscal 2019 — has revealed that the firm’s Tempe, Arizona-based subsidiary, Comtech EF Data Corp., which is part of Comtech’s Commercial Solutions segment, received a delivery order in support of the recently awarded contract from the U.S. Naval Warfare Systems Command (SPAWAR).**

This latest delivery order, against the \$59.0 million indefinite delivery/indefinite quantity (“IDIQ”) contract, is for \$1.8 million.

The delivery order specified Comtech EF Data’s SLM-5650B Satellite Modems and firmware upgrades. The SLM-5650B Satellite Modem is Comtech EF Data’s latest generation modem product targeted for critical government and military applications.

The SLM-5650B leverages the heritage and feature set of the SLM-5650A modem. The SLM-5650B supports backwards compatibility/ interoperability for existing SLM-5650A networks, while providing enhanced performance and an expanded feature set.

The commercially available modems will support satellite communications and interoperability across the U.S. Navy’s platforms and shore sites.

“It is a privilege to have the opportunity to support the U.S. Navy’s satellite communications requirements with our latest generation solutions,” said Fred Kornberg, President and Chief Executive Officer of Comtech Telecommunications Corp.

[www.comtechtel.com/](http://www.comtechtel.com/)

## The GA-ASI developed Block 50 GCS controls MQ-9 Reaper

**The U.S. Air Force’s new Block 50 Ground Control Station (GCS) — developed by General Atomics Aeronautical Systems, Inc. (GA-ASI) — for the first time controlled an MQ-9 Reaper on January 8 from the GA-ASI Gray Butte Flight Operations Facility near Palmdale, California.**

The Block 50 GCS cockpit for Remotely Piloted Aircraft (RPA) is designed with improved capabilities through an optimized Human Machine Interface (HMI) that significantly enhances aircrew situational awareness and allows for single seat operations

It integrates multi-level security feeds with onboard sensors to display a comprehensive picture of the battlespace and incorporates improved information assurance capabilities that protect against cybersecurity risks.

“This is an exciting milestone for the Block 50,” said David R. Alexander, President, GA-ASI. “With the Block 50, we’re developing a GCS that will reduce manpower requirements and support future missions in complex operating environments.”

The design of the Block 50 provides separation of flight critical components to increase flight safety posture, enable rapid testing and integration of new mission capabilities.

Features of the new Block 50 GCS include:

- *An intuitive glass cockpit design that reduces operator workload and increases effectiveness of mission execution through electronic checklists and integrated mission data information displays*
- *Demonstrated Single Seat operations*
- *An increase in modularity and interface definition to aid in overcoming Diminishing Manufacturing Sources (DMS)*
- *One-deep line-replaceable unit (LRU) access to reduce maintenance down time and increase operational availability (Ao)*
- *A new Multi-Level Secure (MLS) Integrated Communication System (ICS) for improved situational awareness, leveraging an upgraded network infrastructure for sharing information throughout a globally connected GCS and Squadron Operating Center (SOC) network*

[www.ga-asi.com/](http://www.ga-asi.com/)





# DISPATCHES

## Cobham and Inmarsat launch their helicopter SATCOM solution



**Cobham Aerospace Communications and Inmarsat have launched their SB-Helo X-Stream™ helicopter SATCOM solution for Cobham AVIATOR SP systems — the new system will improve communications through rotor blades by reducing packet loss by as much as 40 percent.**

Few solutions exist in the market to transmit data such as video imagery to a satellite network in the same way as is possible from fixed wing aircraft. This is due to the interference caused by the rotors, which leads to intermittent, jittery data streams and distorted video at the receiving station.

After extensive testing, Inmarsat and Cobham have developed a protocol in network Quality of Service (QoS) selection, as an enhancement of the **Swiftbroadband X-Stream™** service.

This is one of Inmarsat's streaming services that offers guaranteed, on-demand, high-streaming data rates over its L-band network.

This allows data from rotary wing aircraft to be transmitted to the Inmarsat satellite network, via dedicated modulation schemes. The increased resilience of the data pipeline passing through the rotors means that the transmission of high intensity data, like video, will see an improvement in throughput of around 37 percent.

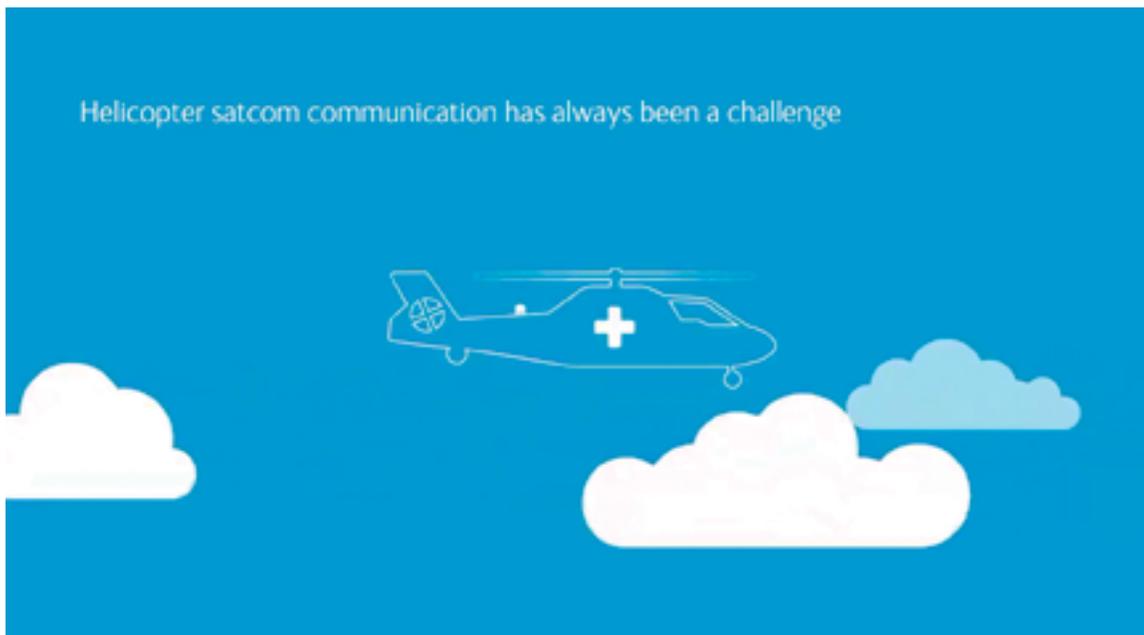
The free of charge software update will allow a helicopter operating from a remote location to transmit a significantly improved video or data stream.

This capability is crucial for organizations operating rotary wing aircraft in specialized roles such as search and rescue, medical evacuation and military forces.

*Todd McDonell*, President of Global Government at Inmarsat, said the company is happy to announce the availability of the SB-Helo X-Stream, an enhancement of the Inmarsat X-Stream service that meets the needs of this growing sector of the government market in an efficient and cost-effective way.

McDonnell continued that having worked with Cobham in the development of this new protocol, Inmarsat is pleased with the results the company has seen from the trials and foresee that this cost-effective solution will be greatly sought after in the growing government helo market.

*Willem Kasselmann*, VP Sales, Marketing and Support at Cobham Aerospace Communications, added that the launch of this new system represents a breakthrough for Cobham, solving a long-standing problem in helicopter SATCOM communications. The partnership between Cobham Aerospace Communications and Inmarsat is an important one for us and we look forward to building on this announcement and expanding and improving other related services over the coming months.



[www.cobham.com/](http://www.cobham.com/)  
[www.inmarsat.com/  
service-collection/  
swiftbroadband/](http://www.inmarsat.com/service-collection/swiftbroadband/)

A Cobham product video is available at [www.youtube.com/watch?v=tqCG0kiGFL0&feature=youtu.be](http://www.youtube.com/watch?v=tqCG0kiGFL0&feature=youtu.be)

# DISPATCHES

## ***Maiden flight of Kratos' new UAV a success***



**Kratos Defense & Security Solutions, Inc. (NASDAQ:KTOS) has completed the maiden flight of the company's XQ-58A Valkyrie unmanned air vehicle (UAV).**

This milestone flight occurred on March 5, 2019, at the Yuma Proving Grounds in Arizona — the U.S. Air Force Research Laboratory (AFRL) partnered on the development of the XQ-58A Valkyrie.

The XQ-58A demonstrator is a low-cost UAV.

During this first flight, the vehicle completed all test objectives during a 76 minute mission.

The Valkyrie is a runway independent UAV capable of long-range flights at high-subsonic speeds.

The joint effort falls within the AFRL's *Low Cost Attritable Aircraft Technology* (LCAAT) portfolio, which has the objective to break the escalating cost trajectory of tactically relevant aircraft.

**[www.kratosdefense.com](http://www.kratosdefense.com)**

**[www.wpafb.af.mil/afri/](http://www.wpafb.af.mil/afri/)**

# DISPATCHES

## The build is on for Northrop Grumman's Omega rocket



*Omega will be Northrop Grumman's first heavy-lift rocket, adding to the company's current lineup of small- and medium-class vehicles. This artistic rendition is courtesy of the company.*

**In a small Mississippi town, a group of scientists and engineers recently gathered to discuss their next project: building large aerospace composite structures for Northrop Grumman's new Omega rocket, which is being designed to launch the U.S. Air Force's most critical spacecraft for U.S. national security missions.**

The kick-off meeting took place in Iuka, Mississippi, home to Northrop Grumman's large-scale composite rocket structure manufacturing facility where the company is building components up to 18 feet in diameter for the rocket. These include the nose cone, connecting sections between the rocket stages and other large composite structures for Omega.

The Iuka facility has a rich 20-year history of manufacturing composite rocket structures for Northrop Grumman's Antares and Pegasus rockets, as well as United Launch Alliance's Delta IV and Atlas V vehicles. Iuka employees have manufactured more than 630 structures, including 432 that have successfully flown to space. The

remaining structures are scheduled for upcoming Atlas V, Delta IV and Antares launches.

Composite structures are extremely important in rockets and are the unsung heroes to the space industry. This innovative technology provides components that are strong enough to withstand the Max-Q dynamic forces during a launch as the vehicle fights against the physics of gravity and aerodynamic loads that happen as the rocket is leaving the Earth's atmosphere, all while weighing considerably less than their metal counterparts.

When launching a rocket, the total weight of the launch vehicle significantly impacts how much the rocket can carry into space. The lighter the rocket, the more performance capability it has to carry critical payloads into space.

Northrop Grumman is building Omega in partnership with the U.S. Air Force through a shared cost program that enables the government to gain the best value in a new rocket. The team building Omega includes rocket scientists, engineers and technicians who,

on average, develop a new rocket every year.

With more than 770 launches in the company's profile — including space and satellite launches, targets, interceptors, hypersonic and suborbital rockets — this team is a proven resource for the Department of Defense (DoD).

Outside of the work being performed in Iuka, this all-American rocket is being produced completely on American soil. The program is based out of Northrop Grumman's Chandler, Arizona, facility, where the company manufactures the rocket's

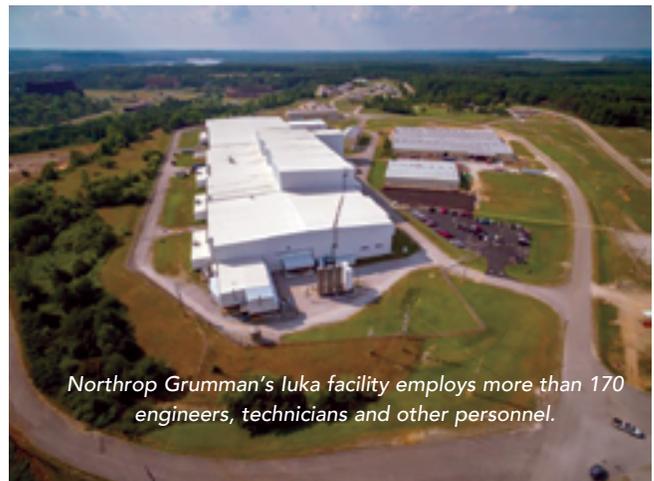
thermal protection, flight systems and avionics. Northrop Grumman builds the first and second stage motors in Promontory, Utah, and the strap on boosters in Magna, Utah.

The cryostage manufacturing is taking place in Michoud, Louisiana, and Aerojet Rocketdyne's West Palm, Florida, facility supplies the upper-stage RL-10 engine. Omega's launch operations will take place from Kennedy Space Center in Florida, and Vandenberg Air Force Base in California.

The Omega team is currently preparing for a ground test of the first stage motor this spring, followed by a ground test of the second stage in the fall. The rocket's first mission remains on track for launch in 2021.

Rick Straka, VP, aerospace structures, Northrop Grumman, said using the company's expert team and innovative, flight-proven technology, the Iuka facility has more than 20 years of experience manufacturing large launch vehicle structures. The company is excited to build on that heritage with the addition of Omega composite structures to the firm's product line here in Mississippi. He added that for many, designing and building complex rockets is a once-in-a-career activity. For the company's team and customers, it is what the firm does all the time.

[www.ngc.com](http://www.ngc.com)



*Northrop Grumman's Iuka facility employs more than 170 engineers, technicians and other personnel.*

# DISPATCHES

## DARPA revamps SBIR/STTR programs

**Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) are the principal set-aside programs for small business participation in federal research and development funding, yet the requirements for administering and managing these programs have not changed significantly in decades.**

To keep pace with discovery in science and technology worldwide, DARPA now intends to release SBIR/STTR opportunities on an out-of-cycle basis, separate from the three pre-determined announcements traditionally issued directly through the Department of Defense (DoD). The change is expected to reduce the overall time from opportunity announcement to contract award.

Prior to the change, the timeline for SBIR/STTR funding opportunities was managed independently of DARPA's primary technology programs, which resulted in small businesses being isolated from the benefits associated with integration into established program communities.

Under the terms of the pilot program, however, DARPA will institute timesaving measures to speed program integration, such as Direct to Phase II authority, which allows the agency to bypass Phase I research requirements once performers provide satisfactory documentation of feasibility, and/or proof of scientific merit, technical merit, and commercialization potential.

DARPA will also seek to identify SBIR/STTR Phase II awardees with a compelling go-to-market strategy

for participation in a newly created commercialization accelerator. The DARPA accelerator will provide additional funding to employ one entrepreneur-in-residence or business development lead who will offer the awardee direct support for activities including, but not limited to, customer engagement planning, market analysis and mapping, competitive analysis, techno-economic analysis, IP securement strategy development, and financial plan creation.

*"It's essential to change our acquisition practices to mirror the commercial marketplace if we hope to attract revolutionary companies that normally avoid working with the federal government,"* said Dr. **Steven Walker**, director of DARPA. *"This move will provide DARPA the flexibility to operate at a much*

*faster pace than traditional SBIR/STTR contracting cycles have historically allowed."*

Congress established the *Small Business Innovation Research* (SBIR) Program in 1982 to provide opportunities for small businesses to participate in federal government-sponsored research and development. Since that time, DARPA has leveraged SBIR awards to promote and sustain small business innovation as well as foster the development and transition of critical national security capabilities.

**[www.darpa.mil/work-with-us/for-small-businesses](http://www.darpa.mil/work-with-us/for-small-businesses)**

# DISPATCHES

## Viasat improves global connectivity for military aircraft

**Until recently, the U.S. Department of Defense lacked the ability to adapt and adjust to new mission demands requiring broadband satellite communications (SATCOM) while in-flight.**

With information and service capabilities changing frequently during the course of a conflict, it's critical warfighters and military leaders have the ability to securely communicate, access HD video streams and transmit vast amounts of data while in transit.

Viasat answered the defense market's need for flexible, robust, and resilient *Beyond Line of Sight* (BLOS) communications.

On a cold November 2018 afternoon at Viasat's Fort Bragg, North Carolina, office, the company's second-generation **KuKarray (KuKa2)** terminal became the first of its kind SATCOM terminal to successfully demonstrate something unique: the ability to access and operate over multiple, commercial SATCOM services on a variety of geostationary (GEO) and medium Earth orbit (MEO) satellite networks.

The KuKa2 terminal also demonstrated operations on two separate steerable beam SATCOM networks, one operating in MIL-Ka and the other in Non-Geostationary Ka-band. Data rates of 90 Mbps to the terminal and 40 Mbps from the terminal were achieved on both networks.

In the demo room — filled with military warfighters and government representatives — members of Viasat's **Government Systems** leadership team demonstrated the KuKa2 terminal is the only solution currently capable of providing wide-body aircraft, including the C-17 platform, with the near ubiquitous, secure, resilient and high-speed broadband SATCOM services military personnel need for en route mission planning; in-flight communications; senior leader and VIP communications; airborne command and control (C2); and



*Military aircraft like the C-17 Globemaster benefit from Viasat's KuKarray terminal, which allows nearly ubiquitous connectivity across different satellite networks.*

cloud-based data transfers across multiple satellite networks.

In discussions with U.S. Combatant Commanders, they've asked for assured, resilient and protected BLOS communications that preserve the U.S. C2 advantage and deliver improved performance, added resiliency, and solutions that will optimize existing assets to adapt to emerging threats. By delivering access to multiple satellite networks, Viasat's KuKa2 terminal meets the requests of the company's government customers today and also provides the capabilities needed to prepare for the missions of tomorrow.

The KuKa2 terminal builds on the performance of Viasat's first-generation KuKarray terminal, which has proven to be enormously successful across commercial and government markets.

*"We hear from a number of senior leaders across branches of the military that high-performance in-flight broadband connectivity is now critical for operations that require warfighters to adjust to situations in near real-time in order to make accurate decisions in a timely and decisive manner,"* said

*Ken Peterman, Viasat's president of Government Systems. "The KuKa2 terminal exemplifies our ability to deliver global in-flight technology solutions that will provide access to a range of advanced capabilities required for critical missions, such as real-time HD video feeds and active cyber defense applications."*

Specific to government users, Viasat's KuKa2 terminal is capable of providing worldwide broadband satellite access through Viasat's **Hybrid Adaptive Network (HAN)** architecture concept.

Viasat's HAN allows users to operate across commercial and government purpose-built SATCOM networks, creating an end-to-end, networked solution that mitigates congestion, intentional and unintentional interference and cyber threats through the implementation of multi-layered resiliency in highly contested environments.

*Matt LeTourneau, business area director of Viasat's communications, command and control global broadband solutions added, "By providing wide-body aircraft, including the C-17 military transport platform, with the ability to access near-ubiquitous, resilient and secure*

*in-flight connectivity across GEO and MEO satellite networks, our KuKa2 terminal will significantly enhance mission capabilities, save lives and provide the means necessary to maintain the tactical edge required to succeed across today's data-driven battlespace.*

*"While others in the industry may claim to deliver similar capabilities, Viasat's KuKa2 terminal is the only mobility product of its kind on the market today that has been fielded and operationally proven to meet the global in-flight broadband connectivity demands of U.S. government customers,"* LeTourneau said.

The KuKa2 terminal has completed the Federal Aviation Administration D0-160G certification process as well as the extremely rigorous **U.S. Air Force Materiel Command C-17 Modified Airworthiness Certification Criteria** and is also designed to meet the **U.S. Army Forces Strategic Command Wideband Global SATCOM Mil-Ka** and other satellite vendor certification requirements to provide access to future high-capacity satellites.

[www.viasat.com](http://www.viasat.com)



# DISPATCHES

## National Security Space Launch program established by USAF

**The U.S. Air Force Space and Missile Systems Center's (SMC) Launch Enterprise Systems Directorate Evolved Expendable Launch Vehicle program name has been officially changed to the National Security Space Launch (NSSL) program.**

The 2019 National Defense Authorization Act (NDAA) directed the name change from EELV to NSSL effective March 1, to reflect consideration of both reusable and expendable launch vehicles future solicitations.

In 1994, the NDAA directed the Department of Defense (DoD) to develop a modernization plan for space launch capabilities. In response, the Air Force initiated the Space Launch Modernization Plan, also known as the Moorman Study, that identified options and cost for the future of space launch.

On August 5, 1994, President Clinton signed a National Space Transportation Policy as a partial response to assigning responsibility for expendable launch vehicles to the DoD.

The final result was SMC's EELV program to develop a family of launch vehicles for medium to heavy payloads. The NSSL program is designed to continue to procure affordable National Security Space launch services, maintain assured access to space and ensure mission success with viable domestic launch service providers.

The program is driven to provide launch flexibility that meets warfighter needs while leveraging the robust U.S. commercial launch industry, which has grown significantly during the past five to seven years.



Colonel Robert P. Bongiovi, director of the Space and Missile Systems Center's Launch Enterprise Systems Directorate, is joined by 2nd Lt. Lauren Peterson, youngest officer in the directorate, to mark the creation of the Evolved Expendable Launch Vehicle Program Heritage Center during a ribbon cutting ceremony.

Observing from left to right are retired Air Force Col. Richard W. McKinney (1st EELV Program Director), retired Maj. Gen. Susan K. Mashiko (3rd EELV Program Director, partially obscured), retired Col. Gary N. Henry (7th EELV Program Director) and Dr. Claire Leon (9th EELV Program Director). The EELV program has been replaced by the National Security Space Launch Program, after a name changing ceremony held March 1 at Los Angeles Air Force Base in El Segundo, California.

Photo is courtesy of the U.S. Air Force — Van De Ha.



Col. Robert P. Bongiovi, director of the Space and Missile Systems Center's Launch Enterprise Systems Directorate, is joined by past Evolved Expendable Launch Vehicle program managers and directors after unveiling the new logo of the National Security Space Launch program. The NSSL program replaces the EELV program after a name changing ceremony held March 1 at Los Angeles Air Force Base in El Segundo, California to honor the past, celebrate the present and embrace the future.

Photo is courtesy of the U.S. Air Force photo — Van De Ha.

Colonel Bongiovi said that as the NSSL program embarks on a new chapter making launch services more agile and effective for the warfighter, it honors more than 25 years of EELV history — the program boasts a remarkable legacy of the successful launches of 75 National Security Space missions, placing more than \$50 billion of space warfighting assets on orbit.

He added that as NSSL commences, it is focused steadfastly on the future as this is one of the most critical times in the national security space history. The program is committed to 100 percent mission success and providing the most innovative, flexible, and affordable services to meet National Security Space mission needs and maintain U.S. dominance in space.

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

SMC's portfolio includes the global positioning systems, military satellite communications, defense meteorological satellites, space launch and range systems, satellite control networks, space based infrared systems, space situational awareness capabilities, and space superiority.

# DISPATCHES

## ***DISA preparing warfighters for future, multi-domain conflicts***

**As stated by U.S. Navy Vice Admiral Nancy A. Norton, the director of the Defense Information Systems Agency (DISA), the agency needs to “set the globe.”**

“Setting the globe” means anticipating warfighters’ future needs and approaching the agency’s combat support mission with global mindset instead of a theater-specific strategy. This planning method aligns with the joint force readiness requirements laid out in the 2018 National Defense Strategy (NDS) and the DoD Cyber Strategy, said Norton.

During the past 18 months, DISA’s Operations Center has led an agency-wide effort to examine DISA’s ability to support the warfighter against a near-peer competitor in an all-domain, trans-regional fight, said DISA’s chief of plans, Army Lieutenant Colonel Blair Sawyer. Sawyer said DISA is currently involved in four major planning efforts supporting two combatant commands and said the agency has largely provided analysis and products to support the new globally integrated campaign and contingency planning concept directed by the Chairman of the Joint Chiefs of Staff.

This new planning concept helps integrate the joint force for engagement with long-term strategic competitors, principally China and Russia — as well as other competitors, such as North Korea, Iran, and violent extremist organizations. It also defines proposed tactics to fight and win global conflicts in the future. Developing these plans requires a holistic and integrated review process designed to improve unity of effort and mission assurance, while shifting the focus of planning from theater-specific to a global problem-focused approach, said Sawyer. He then commented that transitioning to this proactive thought process is especially important in today’s environment.

Continuously advancing technologies have signaled a paradigm shift in how battles and future wars are fought and won — the agency must shift with them.

Sawyer noted that DISA primarily builds its customers’ peacetime capabilities for day-to-day command and control. The agency’s mission now is to go to those customers and

ask, ‘What will you need in regard to these capabilities in a wartime environment?’ For example, if a command processes 400,000 emails worth of data each day across the theater in peacetime, then this requirement will drastically increase in a wartime environment.

DISA is linking the business development side of DISA to

the planning side, said Phil La Perla, civilian deputy of the cyber operations directorate., adding that bringing all the planners together in a joint planning group gives everyone a common operational picture and situational awareness for warfighter requirements.

***disa.mil/***

# DISPATCHES

## Ball Aerospace is selected for the second phase of DARPA's Hallmark program

**Ball Aerospace has been selected to continue work on the Space Evaluation and Analysis Capability (SEAC) testbed for the second phase of the Air Force Research Laboratory (AFRL) and Defense Advanced Research Projects Agency's (DARPA) Hallmark program.**

The Hallmark program is advancing technologies that deliver real-time space-domain awareness informing the command and control and protection of space assets.

As part of the Hallmark program's second phase, Ball will collaborate with a set of independent software development teams and conduct three additional evaluation events in which the company will run mock space operations exercises to evaluate software tool performance. During the first phase of the Hallmark program, Ball completed five successful evaluations of the testbed.

Under the Hallmark program, Ball is working to streamline this process, bringing essential mission capabilities into operations faster than ever before. Ball's approach to the SEAC testbed design eliminates the single-contractor integration bottleneck in traditional acquisition models.

This modern software development practice succeeds by enabling external tool developers to rapidly design and test capabilities in an operations-like environment without risking system security or stability.

Steve Smith, VP and GM, Systems Engineering Solutions, Ball Aerospace, said the company's revolutionary open architecture approach brings commercial capabilities and best practices like rapid integration of new services and secure DevOps to the Department of Defense. Ball Aerospace looks forward to continuing the successful demonstration of the firm's enterprise software architecture's capabilities during the second phase of the Hallmark program.

With 30 years of experience developing unique and accurate exploitation algorithms for satellite systems, Ball understands the challenges of integrating new features into operational systems.

Dr. Fotis Barlos, the Program Manager for DARPA's *Strategic Technology Office (STO)*, explained more about the Hallmark Program at the DARPA info site...



Military commanders responsible for situational awareness and command and control of assets in space know all too well the challenge that comes from the vast size of the space domain. The volume of Earth's operational space domain is hundreds of thousands times larger than the Earth's oceans. It contains thousands of objects hurtling at up to 17,000 miles per hour.

The scales and speeds in this extreme environment are difficult enough to grasp conceptually, let alone operationally, as is required for commanders overseeing the nation's increasingly critical space assets. Complete and timely information is vital to a commander's ability to react to events in space that may threaten critical and costly assets.

Current space domain awareness tools and technologies were developed when there were many fewer objects in space. Only a few nations could even place satellites in orbit, and those orbits were easily predictable without advanced software tools. That situation has changed dramatically in the past decade with a developing space industry flooding once lonely orbits with volleys of satellite constellations.

Despite this much more complex and chaotic environment, commanders with responsibility for space domain awareness often rely on outdated tools and processes—and thus incomplete information—as they plan, assess, and execute U.S. military operations in space.

DARPA's Hallmark program seeks to provide a full spectrum of breakthrough real-time space-domain systems and capabilities to help address these technical and strategic challenges. The envisioned system would fuse information from diverse sources, allow potential actions to be simulated and effects determined in advance, and vastly reduce the overall time required to make and execute decisions and observe results.

A state-of-the-art enterprise software architecture would support the ability to model current and future space situational awareness and command and control tools, capabilities, subsystems, and systems, as well as external interfaces to air, cyber, land, maritime, and command and control environments.

An advanced testbed featuring playback and simulation capabilities would significantly facilitate research and development activities, experiments, and exercises to evaluate new technologies for their impact on space command and control capabilities.

The testbed would be used to expedite the creation and assessment of a comprehensive set of new and improved tools and technologies that could be spun off into near-term operational use for the Defense Department's Joint Space Operations Center (JSpOC) and Joint Interagency Combined Space Operations Center (JICSpOC).

[www.ballaerospace.com](http://www.ballaerospace.com)

[www.darpa.mil](http://www.darpa.mil)



Artistic rendition of the Hallmark program. Image is courtesy of DARPA.

Artist's Concept



# DISPATCHES

## On-orbit spacecraft commanded by Kratos using the USAF's EGS framework

**Kratos Defense & Security Solutions, Inc. has commanded an on-orbit spacecraft using the U.S. Air Force's Enterprise Ground Services (EGS) framework.**

This demonstration directly follows on the heels of three successful pathfinder studies announced earlier by Kratos for migrating the *Command and Control System – Consolidated (CCS-C)* ground system to the EGS architecture. CCS-C provides consolidated MILSATCOM tracking, telemetry and command capability for **14th Air Force** and the **50th Space Wing**.

The Kratos demonstration supports the U.S. Air Force's strategic approach to implementing a common, service-based satellite ground infrastructure that will evolve current satellite ground systems into a single platform.

EGS is a critical enabling technology that is focused on a sustainable, resilient space architecture that can respond to emerging threats and protect space-based assets.



Artistic rendition of the Altair Pathfinder satellite. Image is courtesy of Millennium Space Systems.

Kratos EGS software and services commanded an on-orbit spacecraft and demonstrated multiple capabilities supporting the EGS framework.

These included the EGS service paradigm and dynamically allocating satellite ground resources and executing deployment automation with the ability to spin up new satellite command and control instances in less than 10 minutes.

**Technology Readiness Level (TRL)** is a method of estimating technology maturity of critical technology elements of a program during the acquisition process. Evidence of TRL 8 was proven in the following ways:

- **Kratos Commercial Off-The-Shelf (COTS) software natively mapped into the EGS service paradigm.**
- **The deployment automation solution was shown to work on two different vendor technology stacks.**
- **Kratos EGS integration software completely decoupled each EGS service from all other services using the NASA Goddard GMSEC message bus.**
- **Kratos COTS software was utilized to demonstrate the implementation of EGS services including Telemetry and Command Processing, Automation, User Experience, Orchestration and a Range Interface.**

TRL 8 readiness means that the actual system was completed and mission qualified through test and demonstration in an operational environment.

The entire test and demonstration was accomplished working cooperatively with **Millennium Space Systems**, a **Boeing** company, and their on-orbit Pathfinder spacecraft, **Swedish Space Corporation** with their worldwide ground antenna network and the U.S. Air Force's **Space Management Battle Lab (SMBL)** in Colorado Springs, Colorado.

[www.kratosdefense.com](http://www.kratosdefense.com)  
[www.millennium-space.com](http://www.millennium-space.com)  
[www.sscspace.com](http://www.sscspace.com)



The CCS-C provided consolidated MILSATCOM tracking, telemetry and command capability for 14th Air Force / 50th Space Wing launch and early orbit, on-orbit and anomaly resolution operations.

Photo is courtesy of the U.S.A.F.

# DISPATCHES

## Leidos wins their first U.S. Army task order

**Leidos has been awarded their first task order by the U.S. Army under the \$37.4 billion Responsive Strategic Sourcing for Services (RS3) Contract Vehicle.**

The task order is to provide customizable fielding, modernization, and support services solutions for the total package fielding and logistics of new and existing Army computer and communication technology, weapon systems, and equipment. The single award, cost-plus-fixed-fee task order has a one-year base period of performance, four one-year option periods, and a total ceiling value of \$278 million if all options are exercised.

Leidos' technical experts will provide fielding services, customizable equipment configuration, equipment set up,



and unit instruction in support of the Army's Communications Electronics Command, Integrated Logistics Support Center, Field Support Directorate, *Field Modernization Division* (FMD) customers and end-users.

FMD serves global Warfighters by providing high-quality solutions tailored to a military unit's fielding and operational requirements.

The company's experts maintain, set up, and configure each unit's equipment and systems and then deploy mobile fielding teams with

the hardware to the units to perform various tasks associated with a total fielding modernization concept.

Additional areas of support include engineering, *research, development, test and evaluation (RDT&E)*, logistics, acquisition, and strategic planning.

*"We have a strong track record supporting Army missions for decades,"* said *Tom Dove*, operations manager for Leidos Logistics & Mission Support. *"This win allows Leidos to provide lean program management structure and processes, the right-sized team, and the best value solution for the Army to keep their warfighters situationally aware and ready to respond at all times."*

**[www.leidos.com](http://www.leidos.com)**

# DISPATCHES

## iDirect Government's 9-Series product family gains WGS certification

**iDirect Government (iDirectGov) has received Wideband Global SATCOM (WGS) certification for the company's 9-Series Defense portfolio of satellite routers and line cards operating on Evolution 3.4 software.**

The new U.S. Army certification (18-004), along with certification 18-001, confirms that all **Evolution 3.4** hardware and software will operate on the **WGS** constellation with no performance certification restrictions, enabling enhanced military communications.

The certification includes the **900 Satellite Router** board, **9350 Satellite Router**, the **950mp**, **9050 OM**, **Tactical Hub** and **DLC-T** and **DLC-R** line cards.

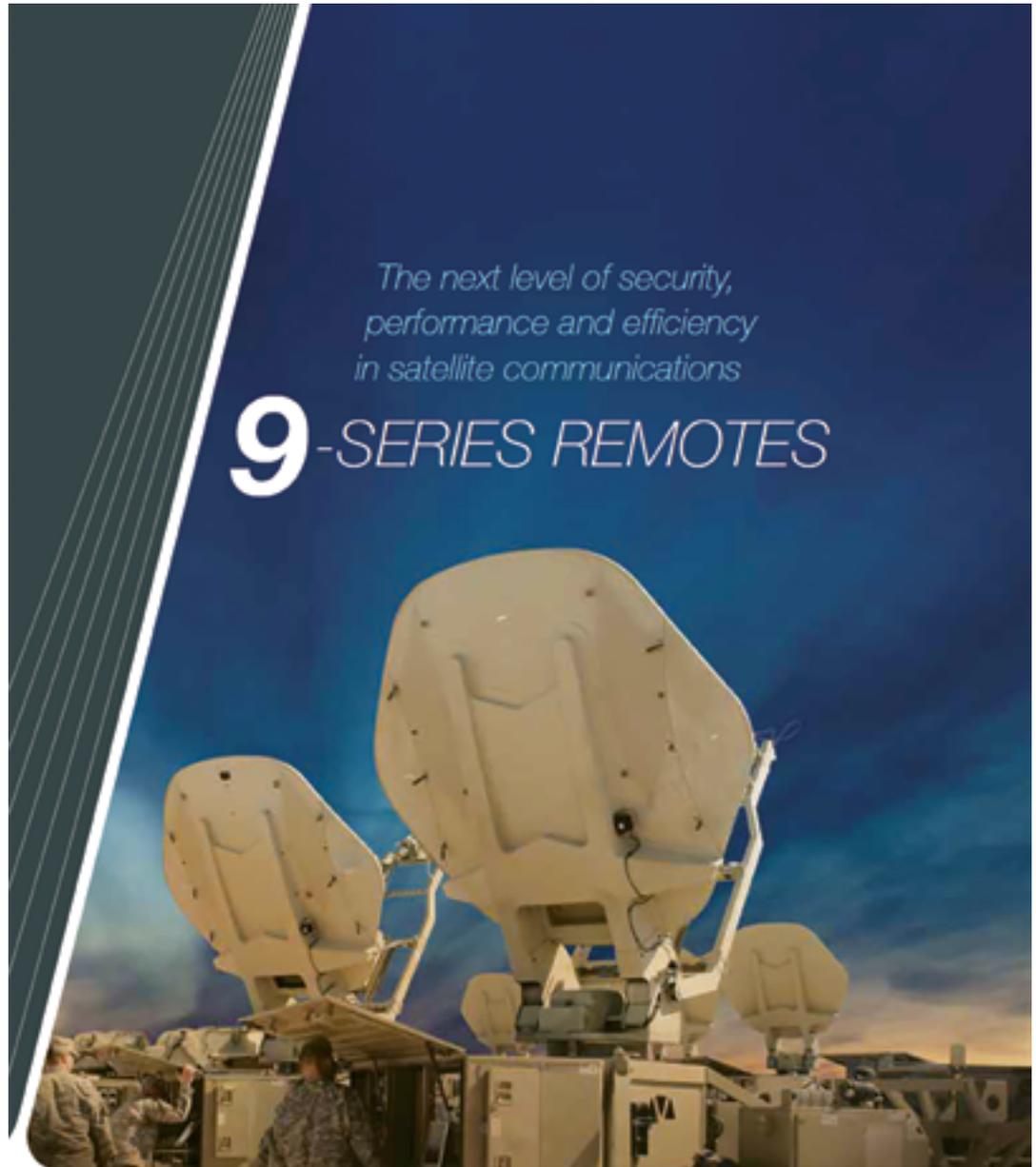
The 9-Series Defense products underwent stringent evaluation and testing as part of the U.S. Army's certification process.

The WGS certification ensures that iDirectGov's 9-Series Defense products work effectively with WGS to support military missions.

The new WGS certification builds upon iDirectGov's existing high-quality certifications that include TL 9000 and ISO 9001:2008 quality certifications.

These recognitions validate its demonstrated ability to provide the highest quality levels of design, development, production, delivery, installation, and maintenance of information and communications technology products including hardware, software and services.

The WGS supports the Department of Defense (DoD) by providing MILSATCOM worldwide at no additional cost to the services and provides Beyond-Line-Of-Sight (BLOS) reach-back and in-theater communications capabilities to the military's operations worldwide.



John Ratigan, President of iDirect Government, said the new WGS certification validates the company's 9-Series Defense line and Evolution 3.4 as the 'go to' communications solutions for military communications requirements worldwide, and the company is committed to play a part in keeping the military connected as they defend the nation.

John continued by stating the WGS certification confirms what customers know — that iDirect Government is dedicated to delivering high-quality military satellite communications solutions to ensure that those deployed in the field have critical clear lines of communication needed for mission success and system reliability.

John concluded by stating that this newest certification highlights the effort of their engineers who have worked to bring the latest technology to the market, earning this recognition.

[www.idirectgov.com](http://www.idirectgov.com)



# DISPATCHES

## Aon releases their 2019 Cybersecurity risk report

**Aon plc (NYSE:AON) has released their 2019 Cyber Security Risk Report which details the greatest cyber security threats and challenges organizations are currently facing, discusses that as companies continue to use technology to speed up the transfer of information, game-changing business opportunities are created, as well as increased cyber risk.**

*"In 2018 we witnessed that a proactive approach to cyber preparation and planning paid off for the companies that invested in it, and in 2019, we anticipate the need for advanced planning will only further accelerate," said J. Hogg, CEO of Cyber Solutions at Aon. "Leaders must work to better insulate their companies and their processes, while simultaneously identifying the ways they can benefit from the opportunities offered through technology and digital transformation."*

Hogg continued, *"Our 2019 report also shows that organizations must recognize the need to share threat intelligence across not only their own network but with others as well. While it may seem counterintuitive when thinking about cyber security, collaboration within and across enterprises and industries can keep private data of companies and individuals alike safer. Working together can result in improved efforts to hunt bad actors, while also raising the bar and making all parties more prepared for the inevitable day when a disruption does happen."*

The *"What's Now and What's Next"* report focuses on eight specific risk areas that companies may face in 2019. The risks illustrate how, as organizations transition to a digital-first approach across all transactions, the attack surface of global business expands rapidly and sometimes in unexpected ways.



In other words, thanks to the rapid enhancements and constant changes in technology, the number of touch points that cyber criminals can access within a business is growing exponentially.

Highlights from the report include:

### 1. Technology

While technology has revolutionized the way organizations today conduct business, broader and wider-spread use of technology also brings vulnerabilities. From publishing to automotive, industries are facing new, evolving services and business models.

These new opportunities however, bring with them a radically different set of risks, which organizations will need to anticipate and manage as they continue the digital transformation process.

### 2. Supply Chain

Two prevailing supply chain trends will heighten cyber risks dramatically in the coming year: one is the rapid expansion of operational data exposed to cyber adversaries, from mobile and edge devices like the Internet of Things (IoT); and the other trend is companies' growing reliance on third-party — and even fourth-party — vendors and service providers. Both trends present attackers with new openings into supply chains, and require board-level, forward-looking risk management in order to sustain reliable and viable business operations.

### 3. IoT

IoT devices are everywhere, and every device in a workplace now presents a potential security risk. Many companies don't securely manage or even inventory all IoT devices that touch their business, which is already

resulting in breaches.

As time goes on, the number of IoT endpoints will increase dramatically, facilitated by the current worldwide rollouts of cellular IoT and the forthcoming transition to 5G. Effective organizational inventory and monitoring process implementation will be critical for companies in the coming year and beyond.

### 4. Business Operations

Connectivity to the Internet improves operational tasks dramatically, but increased connectivity also leads to new security vulnerabilities. The attack surface expands greatly as connectivity increases, making it easier for attackers to move laterally across an entire network.

Further, operational shortcuts or ineffective backup processes can make the impact of an attack on business operations even more significant. Organizations need to be better aware of, and prepared for, the cyber impact of increased connectivity.

### 5. Employees

Employees remain one of the most common causes of breaches. Yet employees likely do not even realize the true threat they pose to an entire organization's cyber security. As technology continues to impact every job function, from the CEO to the entry-level intern, it is imperative for organizations to establish a comprehensive approach to mitigate insider risks, including strong data

governance, communicating cyber security policies throughout the organization, and implementing effective access and data protection controls.

### 6. Mergers & Acquisitions (M&A)

Projections anticipate that M&A deal value will top \$4 trillion in 2018, which would be the highest in four years (*IMAA Institute's M&A Statistics*). The conundrum this poses to companies acquiring other businesses is that while they may have a flawless approach to cyber security enterprise risk, there is no guarantee that their M&A target has the same approach in place. Dealmakers must weave specific cyber security strategies into their larger M&A plans if they want to ensure seamless transitions in the future.

### 7. Regulatory

Increased regulation, laws, rules and standards related to cyber are designed to protect and insulate businesses and their customers. The pace of cyber regulation enforcement increased in 2018, setting the stage for heightened compliance risk in 2019. Regulation and compliance, however, cannot become the sole focus. Firms must balance both new regulations and evolving cyber threats, which will require vigilance on all sides.

### 8. Board of Directors

Cyber security oversight continues to be a point of emphasis for board directors and officers, but recent history has seen an expanding personal risk raising the stakes. Boards must continue to expand their focus and set a strong tone across the company, not only for actions taken after a cyber incident, but also proactive preparation and planning.

To learn more about the risks included in Aon's **2019 Cyber Security Risk Report** as well as to review the solutions offered by the company, please visit **Aon.com**.

# DISPATCHES

## Consortium to build secure network for the French Navy

**The French defence procurement agency DGA (Direction générale de l'armement) has awarded the RIFAN 2.1 contract to an industrial consortium headed by Airbus and also comprising the Naval Group and Rohde & Schwarz — this contract was signed for a maximum duration of eight years and up to a maximum amount of €150 million.**

The contract covers work to maintain and adapt the existing IP network for the French naval forces, RIFAN 2 (Réseau IP de la Force Aéronavale étape 2), to the needs of the Navy during the coming years, to integrate new ships and remedy hardware and software obsolescence.

It will also enable the future front-line frigates of the FDI ('frégates de défense et d'intervention') program and the future replenishment tankers of the BRP ('bâtiment-travailleuse de forces') program to be integrated into the RIFAN 2 network.

The network adaptations will involve both its central architecture and an update of the cybersecurity incident monitoring and detection system. A total of 63 ships are equipped with the RIFAN 2 network, ranging from aircraft carriers and frigates to support ships, patrol craft based overseas and submarines.

The purpose of the program is to equip French naval forces with a truly secure broadband network and is designed for exchanges of data of various classification levels, ranging from 'Unclassified' to 'Secret' between ships at sea and on-shore command centers.

The network transmits data from applications specific to the coordination of carrier group operations and those dedicated to the daily and logistical management of life on board, such as those between information systems of theater chiefs of staff on board a vessel for the duration of an operation.

Whether it's a ship sailing alone or a carrier group, the various vessels are equipped to meet their respective connectivity requirements. The system is capable of combining several communication streams in order to optimize the use of the transmission capacity available at sea, which is, by nature, limited. It uses satellite connections, such as

Comcept or Syracuse, and also radio communication systems allowing all-IP (Internet Protocol) exchanges between ships, with a range of several dozen nautical miles.

RIFAN 2 also provides overall network management and cybersecurity incident monitoring capability. This monitoring can

take place both from an on-shore management and control center and also locally on board the ships, thus providing the crews with a degree of independence so that they can make best use of the network according to the operational situation.

**[www.securecommunications-airbusds.com](http://www.securecommunications-airbusds.com)**

# DISPATCHES

## NOAA rescues 340 people in 2018



A U.S. Coast Guard crew, a vital component of SARSAT, conducts ocean search and rescue training. Photo is courtesy of the U.S. Coast Guard.

The pilot of the rowboat *Alba* had a noble goal — to raise awareness and funds for the Scottish Association for Mental Health — and he was going to row 3,400 nautical miles, from Norfolk, Virginia, to his home in Scotland, to accomplish his goal.

However, on June 15, 2018, when he faced life-threatening danger as his boat began to take on water off Nantucket, Massachusetts, he did the correct thing — he set off his *Emergency Position Indicating Radio Beacon*, called an EPIRB, and a NOAA satellite picked up his distress signal.

First responders soon rescued him, about 39 miles off the coast.

He was among the 340 people rescued within the United States and its surrounding waters with the help of NOAA satellites last year.

Of those rescues, 219 were from the water, 32 were from aviation incidents and 89 were on land, using *personal locator beacons*, or PLBs.

NOAA satellites are part of the global *Search and Rescue Satellite Aided Tracking System*, or **COSPAS-SARSAT**, which uses a network of U.S. and international spacecraft to detect and locate distress signals from emergency beacons aboard aircraft, boats and from handheld PLBs.

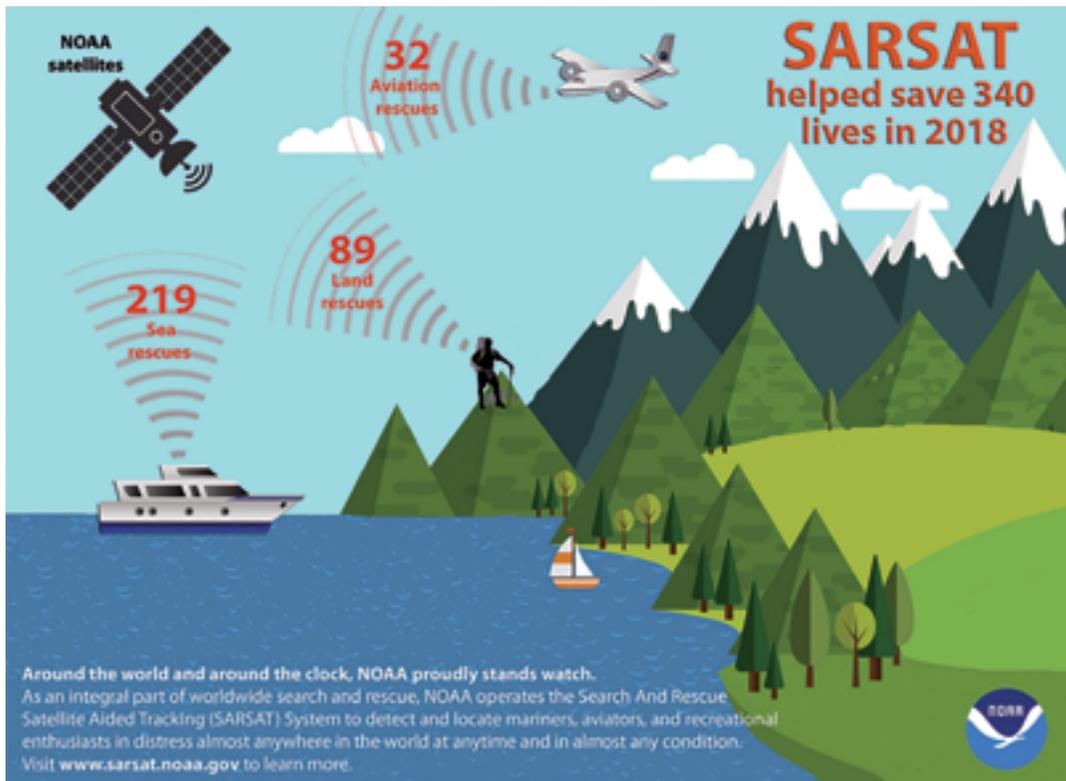
“The same NOAA satellites, critical for our weather forecasts, also play a direct role in saving hundreds of lives each year,” said retired Navy Rear Admiral **Tim Gallaudet**, Ph.D., assistant secretary of commerce for oceans and atmosphere and acting under secretary of commerce for oceans and atmosphere.

When a NOAA satellite pinpoints the location of a distress signal, the information is relayed to the SARSAT Mission Control Center at NOAA’s *Satellite Operations Facility* in Suitland, Maryland. From there, the information is sent quickly to *Rescue Coordination Centers*, operated either by the U.S. Air Force for land rescues, or the U.S. Coast Guard for water rescues.

Since the program’s inception in 1982, COSPAS-SARSAT has been credited with supporting more than 43,000 rescues worldwide, including nearly 8,700 in the United States and the nation’s surrounding waters.

Beacon owners are required to register their devices online with NOAA. The registration information often helps provide better and faster assistance to people in distress, and can guard against false alarms. The beacon may also provide information about the location of the emergency and what type of help may be needed.

[www.sarsat.noaa.gov/](http://www.sarsat.noaa.gov/)



SARSAT rescues for 2018. Infographic is courtesy of NOAA.

# DISPATCHES

AFRL successfully completes CDR for the X-60A hypersonic rocket



The Air Force Research Laboratory (AFRL), Aerospace Systems Directorate, High Speed Systems Division, in partnership with Generation Orbit Launch Services, Inc., is developing the X-60A vehicle.

This is an air-dropped liquid rocket specifically designed for hypersonic flight research.

The X-60A program has now completed the *Critical Design Review* (CDR), a major program milestone that now moves into the fabrication phase.

The initial flight of the vehicle, scheduled in about a year, is based out of *Cecil Spaceport* in Jacksonville, Florida.

A key part of the X-60A program is that the U.S. Federal Aviation Administration-licensed Cecil Spaceport provides a diversification in hypersonic flight testing to traditional *Department of Defense* (DoD) flight test ranges.

Additionally, this is the first *Air Force Small Business Innovative Research* (SBIR) program to receive an experimental "X" designation, in a long line of historical X-planes that includes hypersonic vehicles such as the X-15 and X-51A.

AFRL's motivation for the X-60A program is to increase the

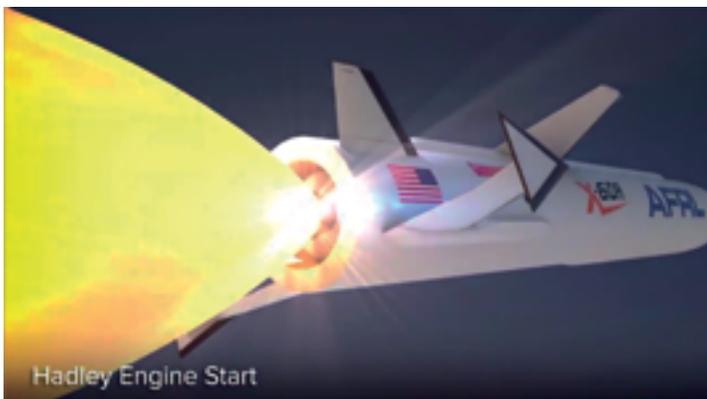
frequency of flight testing while lowering the cost of maturing hypersonic technologies in relevant flight conditions. While hypersonic ground test facilities are vital in technology development, the agency must also test those technologies with actual hypersonic flight conditions.

The X-60A rocket vehicle propulsion system is the **Hadley** liquid rocket engine, which uses liquid oxygen and kerosene propellants.

The system is designed to provide affordable and regular access to high dynamic pressure flight conditions above Mach 5.

[afresearchlab.com](http://afresearchlab.com)

[generationorbit.com](http://generationorbit.com)



Hadley Engine Start

# ARCTIC COMMS FOR WARFIGHTERS

**The connectivity required within a brutal environment and potential future conflict**

By Dan Gager, Vice President of Business Development, COMSAT, Inc.

**With melting ice exposing valuable natural resources and new trade routes, the Arctic has become the next economic frontier and the United States is in a race to strategically position itself to protect its interests in the region.**

The Arctic is rich with valuable oil, gas, metals, minerals, and fishery reserves. The Arctic seabed is estimated to contain approximately 15 percent of the world's remaining oil supply, 30 percent of the world's natural gas deposits, and 20 percent of its liquefied natural gas.

Historically, the frozen tundra made it nearly impossible to mine these valuable resources, but the melting ice along with improved infrastructure technology has made mining a very feasible opportunity. Therefore, the United States is taking proactive steps to increase its military presence in the Arctic region to protect its interests.

As the United States expands its military presence, it is finding that existing connectivity options are limited or inadequate for the harsh and austere Arctic environment.

Fortunately, the newly launched **Iridium NEXT** constellation of satellites will provide a secure and reliable broadband connectivity for military personnel in the region.

**COMSAT**, as the sole provider of Iridium broadband to the **Department of Defense (DoD)**, will bring its full suite of value-added services to the DoD's **Iridium Certus** program. COMSAT intends to deliver enhanced capabilities that meet the DoD's requirements, which will, in turn, drastically improve secure communications in the region.

Expanding the military footprint in the Arctic is not an easy task. Warfighters require specialized training and communications are extremely difficult to maintain. With that said, secure communications are critical to mission success in the Arctic.

Current radio frequency solutions are patchy and unreliable and data transmissions are limited. With a growing presence in the region, there is a need to communicate with voice, text, images, and video anywhere and at any time.

Iridium Certus users will be able to securely connect warfighters deployed in the region to command and control centers anywhere on the planet because the terminals can maintain broadband connectivity in unpredictable environments on land, at sea and in the air.



The **U.S. Coast Guard (USCG)** also plays an important role in the Arctic and the organization is taking steps to increase its presence and effectiveness.





"Presence equals influence. If we don't have a presence there, our competitors will," USCG's Commandant, Admiral Karl L. Schultz, said at the Wilson Center in Washington DC.

The USCG's activities in the Arctic are reliant on precise and ongoing maritime domain awareness, which is currently restricted by limited surveillance, monitoring, and information system capabilities.

Without a strong domain awareness, USCG resources will face greater threats.

**Unmanned Aerial Systems (UAS)** are being outfitted on the USCG's fleet of cutters and they can be used to identify maritime threats, such as ice, but only if they have reliable and secure communications connectivity.

Iridium Certus can be used to improve domain awareness and communications for the U.S. Military by providing VoIP, IP data for text messaging/asset tracking through the use of the proprietary Iridium NEXT network of 66 cross-linked satellites residing in **Low-Earth Orbit (LEO)**.

COMSAT's Iridium Certus offering is the premiere choice and ideal solution for teams operating in harsh conditions that are restricted by a limited and compromised environment. User terminals connect directly to the Iridium Gateway via inter-satellite links.

COMSAT Iridium Certus users are also supported with a 24x7 NOC and Customer Care, always managed by background checked and security cleared staff in the United States.

Secure military communications, such as Iridium Certus, will also help the United States' economic interests in the region. From drilling to transportation, the economic opportunities are immense.

The United States has already issued exploratory drilling permits in the region, and transportation opportunities are also increasing, but navigating the ice is still dangerous and requires reliable communications and accurate domain awareness.

There are three passages in the Arctic that could be used as possible trade routes, but one of them is controlled by Russia and another one is still considered too constrained by thick ice caps.

The Northwest Passage, though, has become a more economically viable shipping route, creating more direct routes between North America, Europe, and Asia. The Northwest passage could cut thousands of miles from journeys that currently use the Panama or Suez canals.

Control of these routes could create potential conflict and is yet another reason why the region needs a stronger United States military presence.

U.S. forces have been increasing their presence in the Arctic over the last few years and are including special training to prepare for the brutal environment and potential future conflict.

Iridium Certus will provide them with the connectivity required to safely perform intelligence surveillance and reconnaissance. Although the company is cooperating with other Arctic states, U.S. forces must continue to prepare for any eventualities.

Part of the military strategy for the region is to increase military exercises. In March of 2018, more than 1,500 U.S. military personnel gathered in the **Joint Pacific Alaska Range Complex** and **Long-Range Radar System** sites for the largest joint training exercise of 2018, the **Arctic Edge**. The exercise exposed areas where better processes could be implemented to improve operational successes.

Everything is more difficult in the Arctic. Communicating in the harsh conditions could become a life and death situation and radio communications are often tricky when interacting with the ionosphere. Military personnel on patrol using radio frequencies spend most of their time listening to static while they are trying to find a clear signal.

The Iridium network is unaffected by terrestrial conditions and will provide reliable mobile connectivity for military personnel on the move during training exercises and operations.

Telemedicine, casualty evacuation and **search and rescue (SAR)** are also three areas where Iridium Certus connectivity would provide life-saving communications. When conditions deteriorate, telemedicine may be the only way to provide life saving health services in the region; however, a dependable connection is required.

Although the number of SAR cases in the Arctic are relatively low, the increased presence in the region will likely lead to more emergency situations requiring such services.



land, in the air, and at sea. With reliable and secure connections, COMSAT's Iridium Certus offering is the best communications solution for the Arctic region.

[www.comsat.com](http://www.comsat.com)

[www.iridium.com/services/iridium-certus/](http://www.iridium.com/services/iridium-certus/)

Dan is the Vice President of Business development at COMSAT Inc. and he possesses more than 18 years of SATCOM experience. Dan brings a wealth of satellite program management and technical experience to COMSAT from his work as an active duty U.S. Army satellite communications officer, a DoD Civilian and as a network operator.

Before starting at COMSAT, Dan was Executive Vice President at satellite hardware manufacturer NAL Research; Director of Government Business Development at Iridium Satellite; and as a satellite program manager at the Defense Information Systems Agency (DISA) where he served as the Chief of the DoD's Enhanced Mobile Satellite Services Division; Program Manager of the U.S. Government's Future COMSATCOM Services Acquisition (FCSA); Gateway Satellite Systems

Expert GIG Operations; and as DISA's liaison to the CJ6, Multi National Forces, Baghdad Iraq.

On active duty, Dan served as the assistant operations officer, 1st Satellite Control Battalion, and Commander of the Defense Satellite Communications Certification Facility, Schriever Air Force Base in Colorado. Dan currently serves as a Lieutenant Colonel in the DC National Guard where he is a plans and operations officer for National Guard Legislative Affairs.

Dan holds a Bachelor's Degree from Cameron University and is a graduate of the Command and General Staff College. Dan's other affiliations include the Army Signal Regiment, Society of Satellite Professionals International, Armed Forces Communications and Electronic Association, Association of the United States Army, Army Reserve Officers Association, and Phi Delta Theta fraternity.

Distance is a great barrier in receiving SAR services in the Arctic. Swift notification is the difference between life and death, and with real-time data, Iridium Certus is the most reliable communications solution.

Much of the Arctic military and commercial strategies are still being formed — any success in the region will require a stronger military presence and dependable communications that work on





# DOD'S AUTOMATED SATELLITE ROAMING

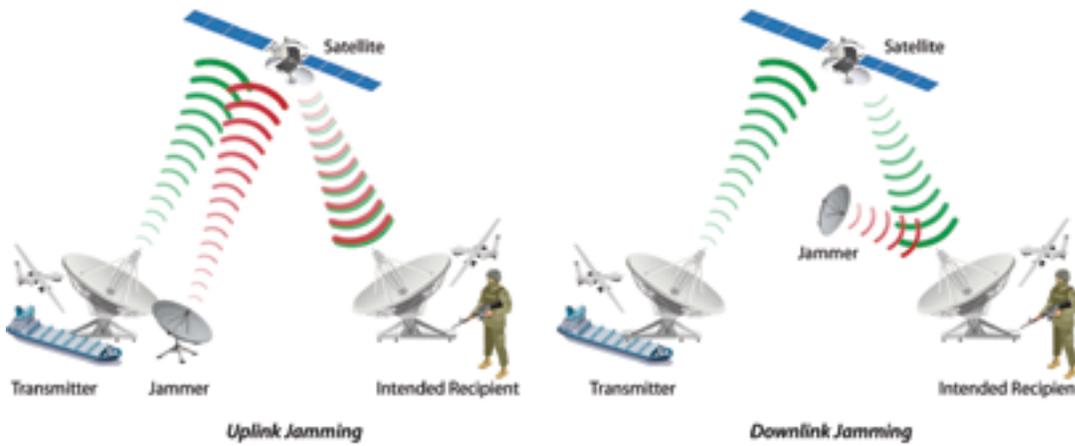
## How the technology protects against denial of satellite services

By Dr. Mark Dale, System Architect, EM&C, Kratos Defense

**Satellite communications (SATCOM) are an essential capability for U.S. military operations and missions. But they also present an attractive target, one that leaders believe adversaries may attempt to deny, degrade, and destroy in the future.**

To counter this, the Department of Defense (DoD) is moving on several fronts to protect and secure its SATCOM infrastructure. This article looks at one notable program making progress, the *Enterprise Management and Control (EM&C)* system. This U.S. Air Force (U.S.A.F.) initiative is developing a newly defined SATCOM architecture that will enable DoD SATCOM users to dynamically access diverse satellites, service providers and gateways in an operationally relevant time frame, typically in minutes.

**Conventional Jamming/Denial of Service to Users**



Today, the vast majority of DoD SATCOM use either the **Wideband Global SATCOM (WGS)** system and/or various commercial satellites that are highly susceptible to interference. However, current SATCOM infrastructure and processes weren't design to allocate SATCOM services on the fly when encountering threats or disruptions. Switching users to alternative services or networks requires bureaucratic and manual processes that are slow and cumbersome, taking days, weeks, or months to procure and set up.

through path diversity, providing unprecedented agility to theater users in working through interference and outages. Equally important, EMC's architecture will allow the DoD to inexpensively update the vast majority of its current wideband SATCOM terminal infrastructure, which includes thousands of existing field terminals. Using EMC software, DoD can leverage this extensive investment without replacing terminal equipment.

EMC's breakthrough roaming capability, akin to the automated switching that occurs (invisibly to users) across multiple cellular networks, protects SATCOM access in the event of interference. EMC works by combining flexibility at the terminal with enterprise components that determine why, when, and how the system should roam and transition. By monitoring the RF environment and impacts to performance, its system logic determines best available SATCOM resources, coordinating and connecting users (on each end) as needed. Benefits include increased resilience to interference, jamming, or environmental affects, far more rapid resource allocation, improved situational awareness, and increased bandwidth utilization efficiencies.

**Enterprise M&C Senses Interference and Reroutes Signal Path**

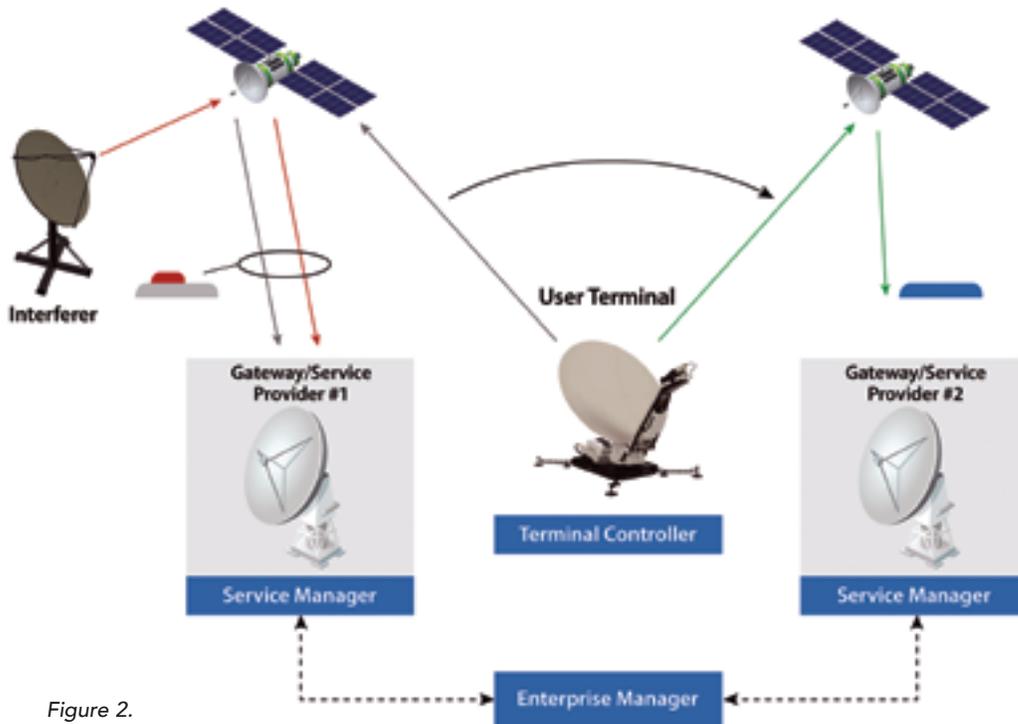


Figure 2.

EMC works by combining flexibility at the terminal with enterprise components that determine why, when, and how the system should roam and transition. By monitoring the RF environment and impacts to performance, its system logic determines best available SATCOM resources, coordinating and connecting users (on each end) as needed. Benefits include increased resilience to interference, jamming, or environmental affects, far more rapid resource allocation, improved situational awareness, and increased bandwidth utilization efficiencies.

Figure 2 to the left illustrates the concept of a User Terminal experiencing interference on its primary network. EM&C functionality enables the terminal to have cognizance of other network options operating on alternate satellites, and automatically switch to the new network to avoid interference.



EM&C components consolidate:

- 1) requirements collection
- 2) planning
- 3) resource allocation
- 4) operational management

**EM&C Status**

The Air Force has continued to define details of the EM&C architecture over the past several years. These efforts have included funding a Pilot Phase 1 study, which solicited feedback from Industry on possible solutions and recommended architectures, followed by a Pilot Phase 2 effort, which funded several companies to demonstrate prototypes of the EM&C architecture.

Successful demonstrations were then carried out in December 2018 and January of 2019, showing the ability to roam among heterogeneous networks, enabling secure SATCOM across multiple operator networks. This used a U.S. government multi-band satellite communication terminal and gateway equipment representative of current (deployed) infrastructure.

An application of these new EM&C capabilities to existing terminal infrastructure is illustrated in *Figure 3* below. Note the Terminal Controller, Service Manager and all elements of the Enterprise Manager (in orange) are new; everything else leverages the current architecture.

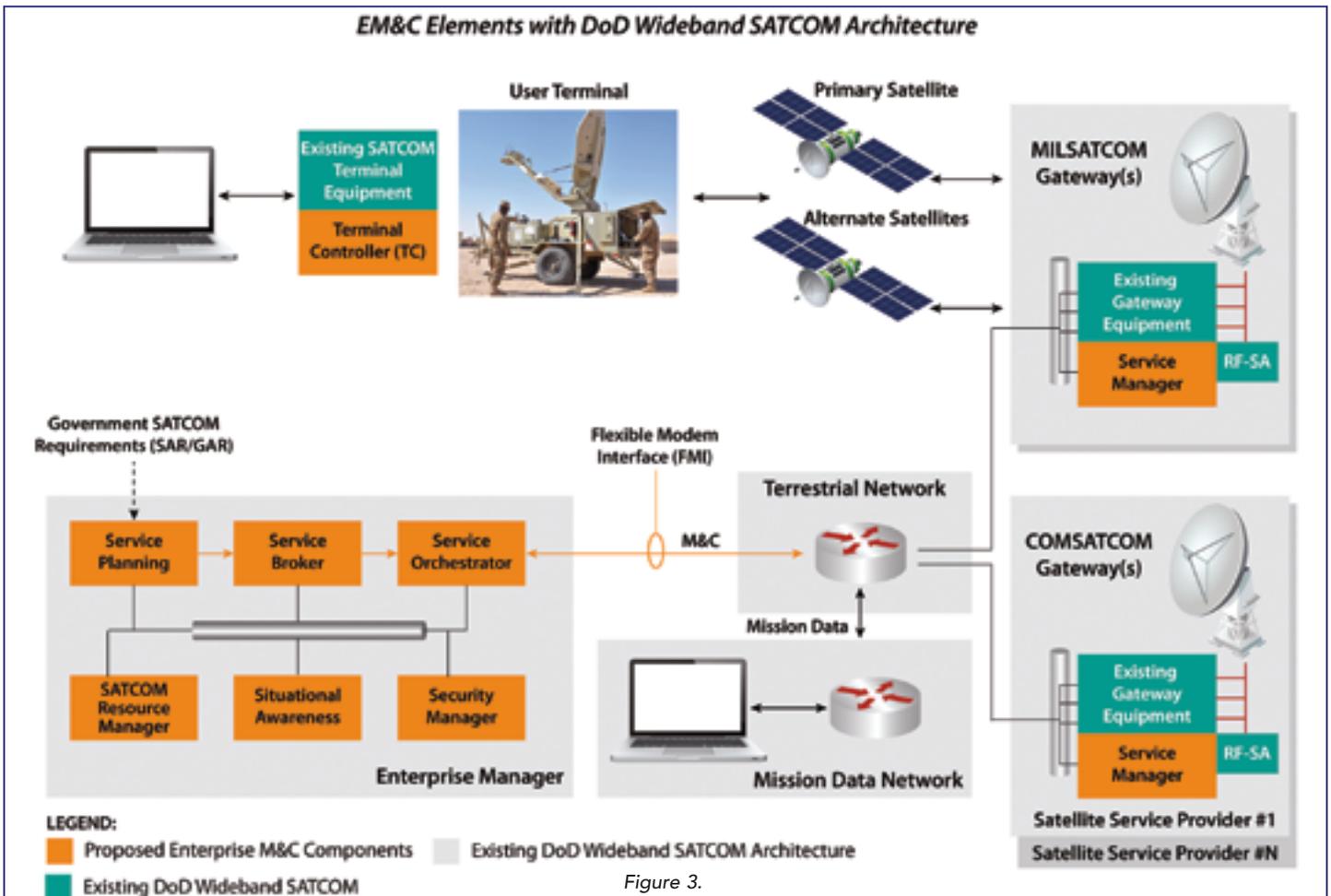


Figure 3.

*The Advanced Concepts Division of the Space and Missile System Center (SMC-MCX) recently provided this perspective on EM&C:*

*“Flexibility to roam between SATCOM services provides warfighters an advantage against potential adversaries working to deny, degrade and destroy capabilities. Enterprise Management and Control maintains the asymmetric advantage of global space-based communications by pre-planning diverse communications paths and facilitating seamless handover. This is the cornerstone to employ SATCOM as a single enterprise through contested, degraded and operationally-limited environments while continuing to deliver the critical effects.”*



In Figure 3, terminals connect to other terminals and/or to satellite Gateways through a variety of satellites. Gateways that are controlled by the DoD, and provide Government-dedicated SATCOM resources are referred to as MILSATCOM Gateways. Those that are controlled by commercial companies and provide Government/commercial shared SATCOM resources are referred to as COMSATCOM Gateways. Terrestrial transport networks connect Gateways to networks supporting the DoD's mission applications (Mission Data Networks).

In Figure 3, EM&C is implemented by the new processing blocks integrated into the existing architecture as a straightforward upgrade/modification (not a wholesale replacement). The key functions of each of these new elements are...

1. **The Terminal Controller** configures and controls the user terminal equipment. It stores the required information even when the terminal is disconnected from the SATCOM network due to a failure or outage. Depending on the terminal model, a Terminal Controller can be integrated as a separate hardware module or as a software-only upgrade without any required modifications to other terminal components.
2. **The Service Manager** configures and controls equipment and resources at each COMSATCOM or MILSATCOM Gateway. Similar to existing terminals, equipment at the Gateways has management interfaces that can be utilized for control and to obtain situational awareness information. This Gateway control function talks to the Enterprise Manager, which has the master plan.
3. **The Enterprise Manager** is the centralized control function that manages the overall network. The Enterprise Manager is the core of the EM&C capabilities, and includes several sub-functions:
  - a. **Service Planning and Service Broker** determines the plan: *Ingests the Government's Satellite Access Request (SAR) and Gateway Access Request (GAR) information (or their next-generation equivalents), and generates Primary, Alternate, Contingency and Emergency (PACE) SATCOM access plans based on available satellites and services. Collects or generates the required configuration information needed by the Terminal Controller and Service Manager.*
  - b. **Service Orchestrator** loads, configures and executes the plan. *Communicates with Terminal Controllers and Service Managers to execute the desired terminal and Gateway configurations necessary to implement the selected options, and collect SA data.*
  - c. **SATCOM Resource Manager**: *Tracks currently utilized and available SATCOM resources and keeps track of historical allocations. Provides trends and forecasts.*
  - d. **Situation Awareness (SA)**: *Collects and displays network status and event history including performance data, health and status of SATCOM links, SATCOM equipment, terrestrial network elements, and security data. Provides centralized view of network status and resource usage.*
  - e. **Security Manager**: *Manages network access, provides cyber tools for network monitoring and other functions that ensure compliance with National Institute of Technology (NIST), Risk Management Framework (RMF) cyber security, and information assurance (IA) guidelines.*
4. **Flexible Modem Interface (FMI)**: The FMI presents a uniform interface between the many varieties of user terminals and the Enterprise Manager, allowing the population of user terminals. The proliferation of this open, government-sponsored FMI standard is key to enabling the vision of satellite and user-terminal interoperability. For existing terminals, the FMI is added as either a software- or lightweight hardware-based interface upgrade to provide the necessary management and communication functions.

Centralized situational awareness provides a global view of network status and available resources. Flexible terminal control enables terminals to use these resources more efficiently and resiliently. Both support the overarching goal of bolstering communication superiority.

The EM&C vision has been well-defined by the U.S. Government. Early risk-reduction efforts by Industry have shown that this vision is realizable, proving that minor modifications to existing government terminals can create the ability to seamlessly cross between commercial and DoD SATCOM resources of various types.

The concept has the potential to address many of the vulnerabilities and inefficiencies currently inherent in wideband SATCOM, and can be an important future tool for the DoD to effectively increase access and resilience for the warfighter operating in hostile RF environments, without replacing or adding new terminals.

[www.kratosdefense.com](http://www.kratosdefense.com)

*Dr. Mark Dale is the System Architect leading the EM&C effort for Kratos Defense, where he helps define next generation satellite communications solutions in support of the U.S. Government.*

*His recent activities for EM&C have included support for the Pilot Phase 1 and 2 efforts sponsored by the Advanced Concepts Division of the Space and Missile Systems Center (SMC-MCX). Together with team members internal and external to Kratos, he has worked to define mechanisms to enable satellite terminals to flexibly access commercial and USG SATCOM capacity and roam between a diverse pool of satellites, teleports, and managed systems.*

*Dr. Dale has been working in the satellite industry for over 20 years, with responsibilities that have spanned systems engineering, product management and business development. He holds a MSEE from the Georgia Institute of Technology, and a Ph.D. from the University of Southern California.*



# EMPOWERING THE WARFIGHTER



## A better way to keep pace with technology

By Ken Peterman, President, Government Systems, Viasat

**Viasat collaborates closely with warfighters who are deployed around the globe to clearly understand the “problem to be solved” in customer terms, such as improved mission effectiveness and warfighter safety.**

Year over year, Viasat’s Government Systems business continues to grow at a remarkable rate. The company’s secret to achieving truly differentiated growth in such a complex and challenging defense market environment is no surprise — Viasat listens, acts proactively and empowers warfighter customers with technology-enabled operational capabilities and then continuously evolve these capabilities over time to ensure they keep pace with the rapidly accelerating technology trajectories in the commercial market.

Perhaps such sounds simple, but it’s really quite an innovative and entrepreneurial approach to defense contracting that recognizes current defense market trends and builds business strategies that leverage them. For example, one defense acquisition trend is the fact that acquisition and fielding timelines are not keeping pace with technology trajectories that evolve a new generation every 18 to 24 months.

A recent **Institute for Defense Analyses** report on *Acquisition Timelines* noted that the expected development cycle for a new technology on average is “8 to 14 years — even if you do everything correctly” and that it takes an average of either years from a stated operational requirement to achieve *Initial Operational Capability* (IOC), while *Full Operational Capability* (FOC) can take decades.

Viasat starts by collaborating closely with warfighters deployed around the globe to clearly understand the “problem to be solved” in customer terms, such as improved mission effectiveness and warfighter safety. New operational capabilities are then developed and deployed that leverage cutting-edge technologies in innovative ways.

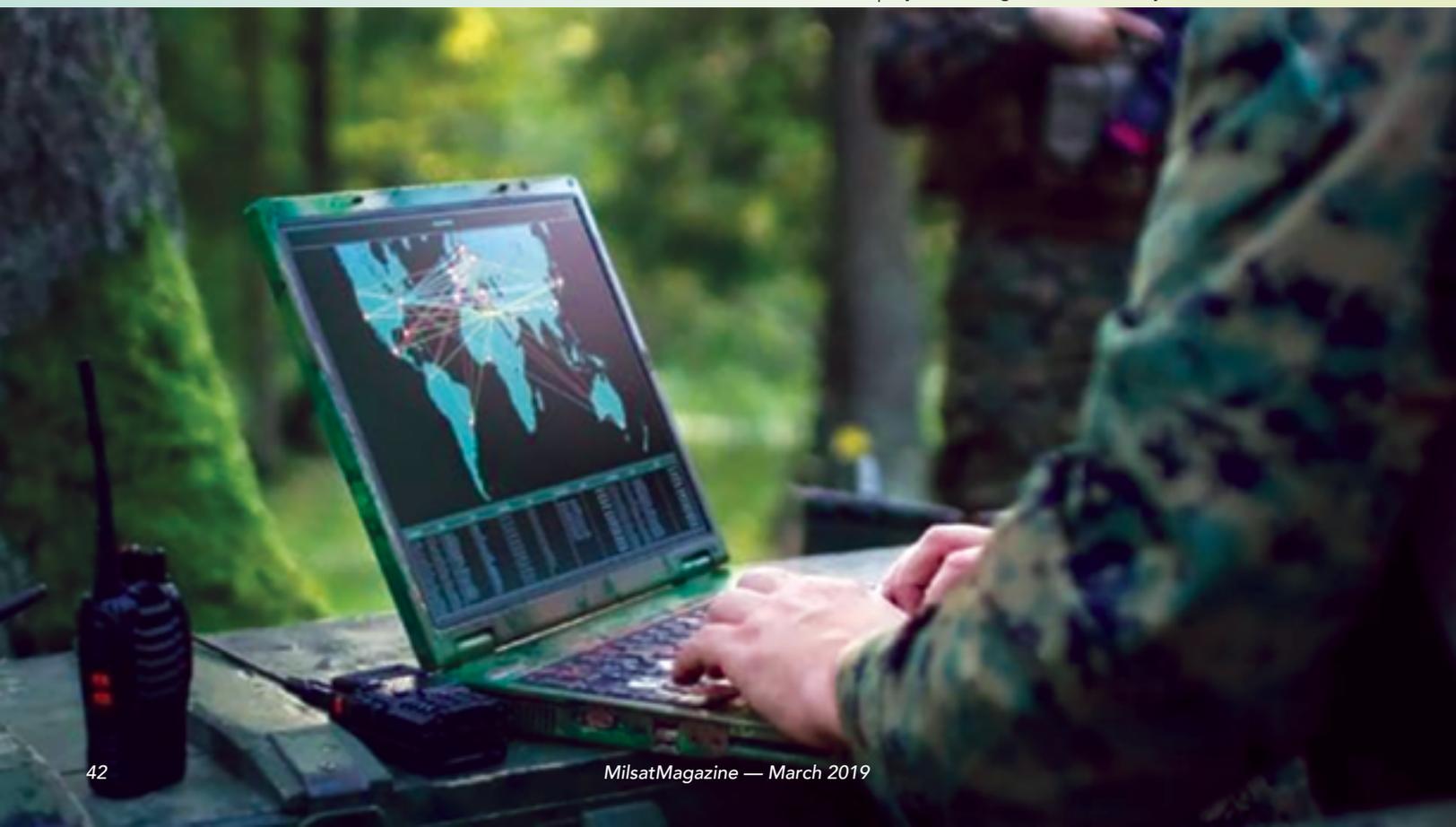
Unconventional **U.S. Department of Defense (DoD)** procurement processes are often used to develop and deliver these turnkey operational capabilities that address the real-world problems warfighters face on the ground, in the air, and at sea. In short, the company helps warfighters find a better way to perform critical missions and their needs are answered quickly and effectively.

Ofentimes, innovative business models — such as “SATCOM-as-a-Service” — are employed

that bundle traditional satellite communications (SATCOM) services with valuable companion capabilities like automated network management, terminal prioritization and active cyber defense. This is important, as the warfighter is enabled to acquire an integrated SATCOM service that assures capacity, performance and quality of service in benign — as well as contested — environments.

It’s an axiom of business that listening to customers is the best way to truly understand what they really need. Clarity on the customer “problem to be solved” allows forward-thinking businesses to deliver focused and innovative capabilities that empower the end-user with genuine solutions to their hardest problems.

While the company’s year-over-year revenue growth is gratifying and rewarding, what Viasat is most proud of is being part of a team that’s rapidly innovating, pushing traditional boundaries and delivering constantly improving operational capabilities and cutting edge technology solutions to our customers in uniform. Additionally, today’s mobile phones often offer more advanced technology than some of the communications equipment soldiers have in the field. Viasat is trying to change that fact with a faster way of turning needs into reality.





In the world of defense, acquisition policy has become bogged down with a myriad of bureaucratic processes — what used to be called “red tape.” Such bureaucracy tends to fragment operational capabilities into programmatic and technology silos that deliver the interdependent components of operational capabilities in an unsynchronized manner, resulting in lengthy delays from a warfighter perspective.

The frequent result is that it takes far too many years to deliver a much-needed operational capability — eventually solving yesterday’s problem instead of today’s issue and creating critical capability gaps that put our warfighters at an unfortunate disadvantage.

Evidence of this is the fact that the typical DoD development program takes many years to reach IOC/FOC — even if everything is done correctly. These long timelines and the lack of synchronization among mutually dependent capabilities are genuinely alarming.

Meanwhile, private sector commercial technology trajectories are advancing at unprecedented rates. The stark contrast between DoD development timelines and commercial timelines means the warfighter is left at a technology disadvantage. The defense acquisition process is simply not keeping up and, as a result, the warfighter suffers.

Today’s national security threats are largely being enabled by some of these same rapid technology advancements, which are transforming threat envelopes and accelerating threat vectors at an increasingly alarming pace. Leaders within the DoD recognize that this challenge must be met by exploiting these same commercial technology trajectories to quicken the DoD innovation cycle.

Taking advantage of commercial technologies and private-sector investment will enable the DoD to maintain technology superiority by deploying advanced operational capabilities across the battlespace.

At Viasat, the senior leaders agree and are rallying to meet this challenge. The company collaborates with DoD and allied partners around the globe to leverage proven agile development techniques to bring the latest technology solutions to the warfighter in efficient ways.

That means focusing on building greater intimacy with the customer, the end-users of battlespace technology, such that their most challenging problems are understood and solved. Through a thorough understanding of a customer’s most urgent needs, cutting-edge technologies can be proactively applied to create innovative solutions that provide warfighters with new and truly remarkable operational capabilities.

The company continuously evolves these capabilities over time to ensure the warfighter is never left behind on today’s technology-driven battlespace.

### Case Study: A Better Radio

An example is Viasat’s work on the **AN/PRC-161 Handheld Link 16** radio. In just 17 months, the company took the concept for this radio from the back of a napkin to successful operational assessment of a revolutionary operational capability.



Today, the AN/PRC-161 radio is being used in the field to drastically improve close air support — significantly improving situational awareness, reducing the chance of friendly-fire incidents, accelerating targeting timelines, and improving mission effectiveness.

This is only one example of Viasat’s ability to rapidly transform innovative ideas and cutting-edge technologies into warfighter solutions in months, rather than years. While the company has completed this rapid development in the tactical data links market segment with the AN/PRC-161 Handheld Link 16 radio, as well as the **KOR-24A Small Tactical Terminal (STT)**, this has also been accomplished in the satellite communications market segment with Viasat’s **Global Mobile Antenna (GMA) 5560-101 KuKarray** multi-mode,

multi-band antenna as well as the **AN/TSC-241 Multi-Mission Satcom Terminal (MMT)**. This same agile development process in the cybersecurity and information assurance market segment resulted in the world’s first 100 GB encryption products.

The company’s passion is developing technologies that address customers’ most difficult problems and rapidly creating new and innovative operational capabilities that address their quickly evolving mission needs.

The firm’s position as an industry leader is based on groundbreaking technology developed by teams of engineers that are empowered to push beyond traditional limits to find a better way to solve challenges — that includes anti-jam, high-capacity satellite communications; tactical mobile networking and Link 16 data links; information assurance and cybersecurity solutions; ground/air situational awareness; and intelligence, surveillance and reconnaissance services.

Incumbent upon the industry is to give America’s warfighters the best tools and technology available to keep them safe. That means providing them with ubiquitous, assured broadband connectivity and cloud-based battlespace situational awareness to help provide access to cognitive decision aids and artificial intelligence. This also means enabling them to employ machine learning to carry out new missions, even in the most difficult of environments.

Today, the Viasat team is working with customers to deliver these new lifesaving capabilities such as A.I., machine learning and assured, secure cloud connectivity to today’s warfighter, and the company is looking forward to pushing the boundaries to enable “what’s next” future connectivity solutions.

[www.viasat.com](http://www.viasat.com)

*Ken joined Viasat in April 2013 as Vice President, Government Systems. In June 2014, he was appointed Senior Vice President, Government Systems, and in May 2017, he became the President, Government Systems.*

*Ken has more than 30 years of experience in general management, systems engineering, strategic planning, portfolio management, and business leadership in the aerospace and defense industries. From July 2012 to April 2013, Ken served as President and Chief Executive Officer of SpyGlass Group, a company he co-founded which provides executive strategic advisory services to the aerospace and defense industries. From 2011 to July 2012, Ken served as President of Exelis Communications and Force Protection Systems, and from 2007 to 2011, he served as President of ITT Communications Systems and he also served as Vice President and General Manager of Rockwell Collins Government System’s Integrated C3 Systems and the Displays and Awareness Systems.*

# VERSATILE AND ROBUST X-BAND

## Impressive performance for MILSATCOM

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



**X-band is designated by the International Telecommunications Union (ITU) as satellite communications spectrum in the frequency range of 7.25 GHz to 7.75 GHz for space to Earth (receive) and 7.9 GHz to 8.4GHz for Earth to space (transmit).**

X-band is used for commercial and military applications because this portion of the RF spectrum provides overall performance advantages that other bands do not, including minimal rain disruption (rain fade), resilience to interference, delivery of data rates approaching that of other less resilient RF spectra, ability to operate with relatively small, remote SATCOM terminals, and acceptance by most developed nations as a spectrum that is reserved for government (and military) use.

Communicating in X-band is robust also has some technical challenges. X-band transmit signals require active filtering and receive signals are vulnerable to unintended active and *passive intermodulation (PIM)* products, which cause signal degradation and distortion (see discussion below).

In addition, the unusually narrow separation between receive and transmit sub-bands makes X-band inherently vulnerable to the generation of unintended *intermodulation products (IMPs)* that can lead to interference and disruption.

### Propagation Impacts

X-Band is below Ku-Band (12 to 18 GHz) and Ka-Band (26.5 to 40 GHz), so the wavelengths are larger and less susceptible to rain fade and other propagation issues. X-band is able to burn through environmental challenges and enables high link availability, which can be up to 99.9 percent.

### Adjacent Satellite Interference

*Adjacent satellite interference*, or ASI, is a common issue with Ku- and C-band (4 to 8 GHz) communications due to the proximity of Ku- and C-band satellites orbiting in the Clark belt at 2 degrees apart.

Due to this orbital nearness, an inexperienced terminal operator can easily cause interference with poor pointing, poor polarization alignment or signal amplification with a small terminal, as small terminals have wider transmit signals.

X-band satellites are typically placed no less than 4 degrees apart, which lessens the risk of ASI due to pointing or polarization alignment errors. Additionally, X-band signals are filtered,

which also lessens the risk of ASI, and terminals require less signal amplification because the X-band spectrum does not require additional help to burn signals through rain and other environmental challenges.

### Terminal Size

The size of a terminal — namely, the size of the parabolic reflector — is determined by the data requirement as gain increases as the square of the ratio of wavelength to reflector size. This means gain and data rates increase with reflector size — relative to frequency.

In the U.S., the *Federal Communications Commission (FCC)* requires C-band terminals to be 2.4 meters or larger, and in Asia and South America, terminals must be at least 1.8 meters to ensure appropriately sized transmit signals.

X-band terminals can be quite small as compared to C-band terminals, yet possess impressive gain. For example, the X-band transmit gain for an **AvL 1.2 meter Model 1050** flyaway antenna is

38.1 dBi,

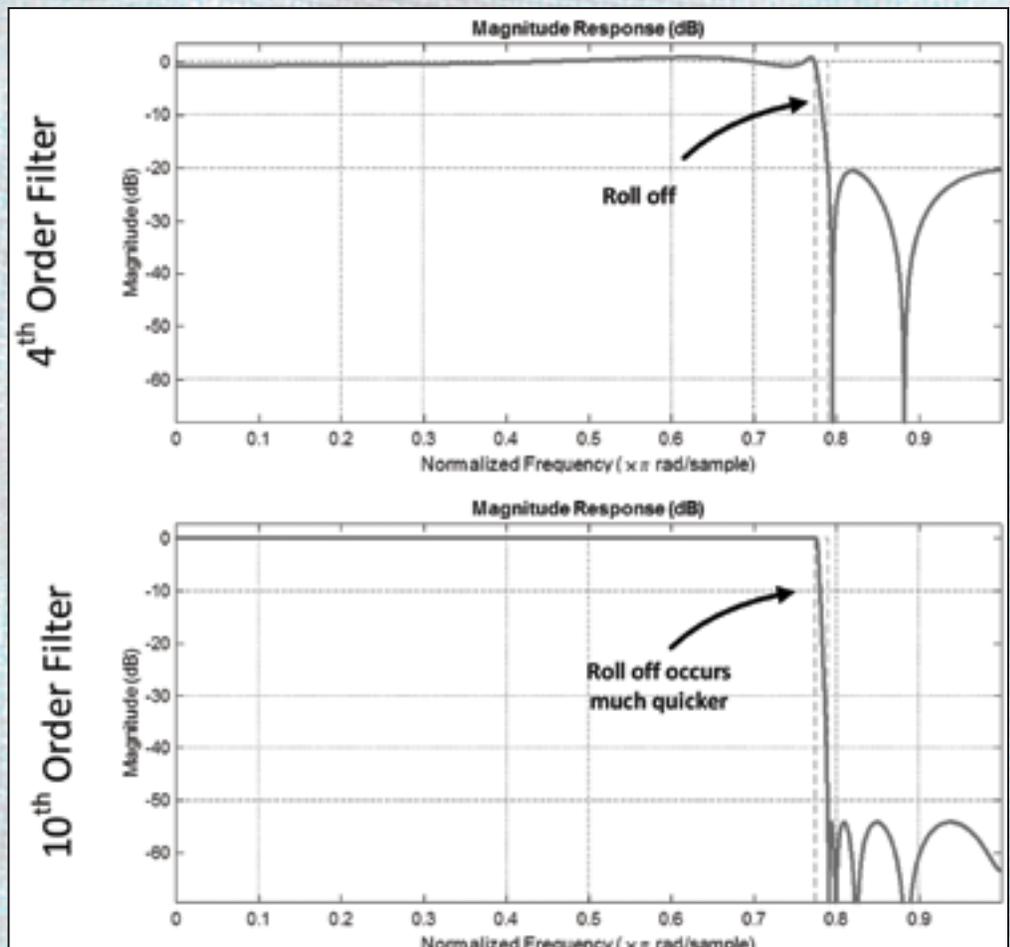
whereas the gain for an AvL 1.6 meter **Model 1220** antenna is 40.5 dBi and the gain for an AvL 2.0 meter **Model 2020** antenna is 42.8 dBi.

### Transmit Signal Filtering

As X-band receive (7.25 to 7.75 GHz) is only separated by 150 MHz from X-band transmit (7.9 to 8.4GHz), X-band communications require the use of filters to separate the signals and keep them from becoming intermingled and generating unintended IMPs.

By comparison, Ku-band receive (11.7 to 12.7 GHz) is separated by 1.3 GHz from Ku-band transmit (14 to 14.5 GHz), meaning Ku-band is far less susceptible to generating unintended IMPs.

As an X-band filter's performance over changing frequency goes from pass band to stopband, the rate at which the insertion loss changes from minimal attenuation to heavy attenuation is known as the "roll off." Because the frequency



As illustrated, the roll off increases as the order of the filter is increased.



separation between transmit and receive occurs relatively quickly at X-band, it is important to pay more attention to the level of isolation in comparison to Ku-band.

Typically speaking, higher order filters are used to increase the rate of roll off. The tradeoff is that the higher the order of the filter, typically the filter must become physically larger.

### Passive and Active Intermodulation

There are two types of IMPs: *active* and *passive*.

Active IMPs are generated through an active component, such as the transmit amplifier — the problematic IMPs can be filtered and rejected within the amplifier using established filter design techniques.

Passive IMPs (PIMs) are typically the most troublesome, as they can they appear as the sum or the difference of the two original signal frequencies. They also may add in a manner where either or both of the original frequencies are multiplied by an integer.

Typically, however, as the order of these integers increases, the amplitude of the product decreases. Nonetheless, as the number of channels increases, the number of possible intermodulation products increases quite rapidly, ultimately making systems with an increased number of channels more susceptible to passive intermodulation.

### PIM Generation

The foundation of PIM effects is the use of two distinct frequencies in the antenna, whereby a non-linear passive component is excited by both frequencies simultaneously.

When the intermodulation interference products are generated by the nonlinear materials in the passive components, they appear as the sum or the difference of the two original signal frequencies.

intermodulation products increases rapidly, ultimately making systems with an increased number of channels more susceptible to passive intermodulation.

Material selection for PIM mitigation is critical. Metals to avoid on antenna components include ferromagnetic metals such as ferrites, nickels and steels, including some types of stainless steel.

These materials exhibit hysteresis when exposed electromagnetic phenomenon, resulting in PIM products. Metals that oxidize quickly or produce significant amounts of rust also should be avoided.

PIM detection and measurement can be challenging. PIM products are typically low level compared to signals intended for data transmission. However, due to the fact that transmitters share many of the same transmission lines as the receiver (as parts of the antenna and feed system), even low level PIM products can cause significant problems.

PIM is a reality of RF systems that directly threatens operational readiness for military communications, as soldiers rely heavily on a constant flow of information. Though this effect can be subtle, soldiers in theater are often in harsh environments — hot and sandy or damp and salty — that can create or hasten PIM-inducing issues on an antenna. As such, many U.S. military communications programs specify that antennas must be designed and produced as “Low PIM” in an attempt to mitigate the issue altogether.

### Spread Spectrum

Spread spectrum techniques are often used with X-band military communications to enable greater resistance to jamming and signal interception.

Spreading bandwidth within a frequency also greatly increases satellite bandwidth requirements (higher user cost) but reduces the likelihood of ASI, thereby enabling the more efficient use of the bandwidth.

They also may add Spreading the spectrum enables a channel to in a manner where be broken (or spread) across multiple pieces either, or both, across the full band. If, for example, a signal is of the original spread across six channels instead of two, and frequencies are one channel is jammed, the remaining five will multiplied by an maintain the communications link. This ability to integer as well. communicate with a lower risk of jamming and Typically, however, intercept is a high priority for the U.S. DoD. as the order of these integers

### Impressive Performance

increases, the Communicating in X-band is versatile and robust amplitude of the and this is why it’s in demand for commercial and product decreases. military communications.

Nonetheless, as Additionally, technical challenges aside, X-band the number of enables impressive performance advantages channels increases, that other bands do not offer and they include the number minimal rain disruption (rain fade), resilience to of possible interference, delivery of data rates approaching that of other less resilient RF spectra, and the ability to operate with relatively small, remote SATCOM terminals.

[www.avltech.com](http://www.avltech.com)

*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.*

*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.*

*AvL Technologies is an engineering centric OEM specializing in transportable satellite antennas and positioner systems. With experience in designing X-band components and mitigating passive intermodulation, AvL offers a wide variety of X-band SATCOM products for both commercial and government applications.*

# INCREASING THE WARFIGHTER'S BANDWIDTH



## The innovative use of the WGS' Global Broadcast Service

By Carl D'Alessandro, President and CEO, Windmill Int'l, President of the company's wholly-owned subsidiary, AQYR Technologies

**Though new technologies and services have the potential to provide more SATCOM bandwidth to the warfighter, deployed users continue to struggle with congested networks.**

While the use of hybrid networks under the control of flexible and secure network management will mitigate this issue, innovative applications of the Global Broadcast System can address it today without significant additional expense.

### GBS System Overview

The **Global Broadcast Service (GBS)** is part of the **Wideband Global SATCOM (WGS)** satellite communications system, allowing authorized users to access high speed data downloads for crucial operations. It is a one-way service (receive only) that provides advantages to users as a supplement to standard two-way systems.

GBS was first deployed in 2001 to support **Operation Enduring Freedom** using UHF Follow-On satellites and currently operates over the WGS constellation, of which there are currently nine satellites in **Geosynchronous Orbit (GEO)**, with the 10th satellite scheduled to launch in March of 2019.

The latest WGS satellites offers 4.875 GHz of instantaneous switchable bandwidth, which provides capacity ranging from 2.1 Gbps to

more than 3.6 Gbps to tactical users, depending on the mix of ground terminals, data rates and modulation schemes employed.

WGS provides 19 independent coverage areas that can be used throughout each satellite's field of view to serve warfighters between 65 degrees North and South latitude. Users are serviced via eight steerable / shapeable X-band beams formed by separate transmit and receive phased arrays; 10 steerable Ka-band beams served by independently steerable, diplexed (*the transmission of two simultaneous messages over one wire in the same direction*), gimbaled dish antennas, including three with selectable polarization; and one X-band Earth coverage beam.

GBS' one-way, wideband service is capable of near real-time classified and unclassified data and video transmission to support critical missions and is based on commercial satellite broadcast technology such as is used by **Direct-To-Home (DTH)** satellite TV providers.

This readily available, commercial technology was relatively inexpensive, easily integrated into existing systems and processes and allowed for terminals that are usable by smaller and more mobile units.

GBS uses two **Satellite Broadcast Managers (SBM)**, co-located with **Defense Information Systems Agency (DISA)** computing centers, to

broadcast IP-based, real-time video and large data files to garrisoned and deployed forces using net-centric prioritized delivery.

SBMs are the primary broadcast content sites. Under the overall management of the **GBS Operations Center**, the SBMs transmit data through the **Department of Defense (DoD)** teleport infrastructure (fixed or theater-based) that allows reception to multiple simultaneous receivers. This saves considerable bandwidth resources and allows ground terminal (or "Receive Suite") operators to quickly download mission data.

GBS provides service to 2,000+ "Receive Suites" deployed world-wide at U.S. Army, Marine, Navy, Air Force ground sites, shipboard and subsurface platforms and at **NORTHCOM**-sponsored homeland defense organizations worldwide.

Any DoD customer with a need for data can request access to the Global Broadcast Service.

For ground users, the three terminals that allow access are the **AN/TSR-11**, **AN/PRS-11**, and **AN/PRS-12**. The TSR-11 is a large "transportable" terminal, while the PRS-11 and PRS-12 (*pictured on the next page*) are suitcase or rucksack portable. A user can access either the classified or unclassified side of the broadcast, depending on





their mission needs, and can request access to feeds and/or request specific mission data online through the SBM portal.

subscribes to a channel and sets the tuner to that channel for reception of the information being transmitted. In this case, however, the user is receiving classified (or unclassified) data essential to fulfill the mission or support the force.

With the congestion on military networks and the delay (and expense) of integrating commercial satellite resources, it is vital to find a way to offload some of the mission data to an available, less expensive alternative.

The GBS' typical broadcasts of FMV, digital maps, biometric data or satellite imagery represent only a portion of the system's capability; also allowed are high speed downloads of data transfers.

This type of communication between a command and their deployed units, or between multiple deployed units, requires large amounts of bandwidth that may not be available using traditional means.

With a single transmission on the GBS, this data can be broadcast simultaneously to all units that are authorized to receive the transmission, saving considerable time and bandwidth costs.

Even large file transmission can be received far faster than using the standard two-way transmission. The potential ability to offload significant amounts of data from two-way systems to a system capable of a 45 MBs stream is a true "force multiplier."

Transfers for data, such as software updates, security patches or other large files, could occur in a timely, low cost fashion using an existing, supported infrastructure. Although a one-way system can never replace a bi-directional communications link, it can assist in reducing the strain on already congested networks and do so with a minimal electromagnetic signature.

The DoD is currently considering numerous programs to modernize the network to make it more expeditionary, resilient, and effective.

The GBS provides a cost-effective way of supporting those goals without significant incremental expenditures.

As the DoD moves into a new era of hybrid SATCOM networks, the innovative use of GBS should be considered as a key element of a holistic solution.

**aqyrtech.com**

*Mr. D'Alessandro is President and Chief Executive Officer of Windmill International Inc. and the President of its wholly owned subsidiary, AQYR Technologies, Inc. He is involved in all aspects of managing Windmill's operations and workforce, leading efforts to set the firm's business goals and growth strategy, build value for employee owners, and provide superior, cost-effective solutions to clients.*

*Mr. D'Alessandro became Windmill's CEO on March 5, 2018. Prior to Windmill, he spent 31 years at Harris Corporation (NYSE: HRS), where he held several senior leadership roles including VP, Global Business Development and President of Harris' Critical Networks segment. At Critical Networks, Mr. D'Alessandro built a unified leadership team, integrated legacy businesses and processes, and managed a >6,000-person global employee base. During his tenure, Critical Networks achieved record award fee performance and secured several contract re-competes and extensions worth >\$2B.*

*Mr. D'Alessandro is an alumnus of Manhattan College where he received his Bachelor of Engineering in Electrical Engineering. He is also a graduate of The Executive Program at the University of Virginia's Darden School of Business and the Harris Leadership Directions program at Darden.*

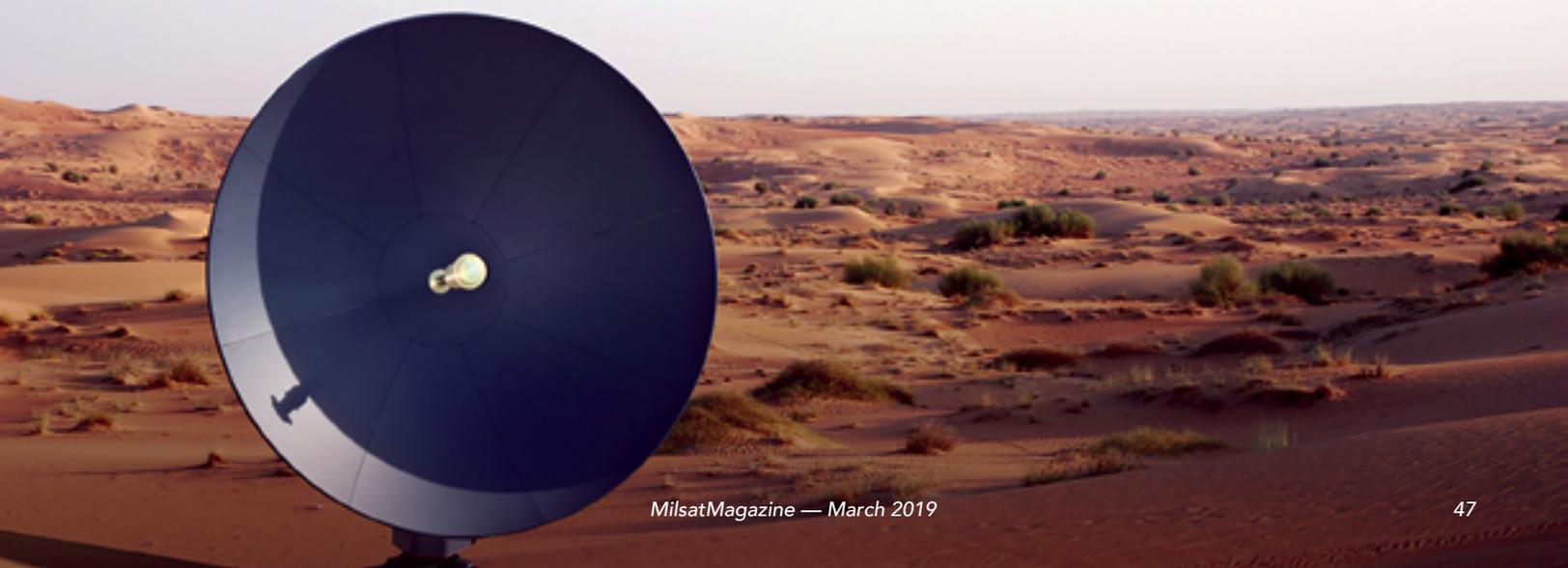
**GBS as a Force Multiplier**

There are many misconceptions concerning GBS' utility that have limited its use as a bandwidth augmentation capability.

The GBS provides critical download capabilities for receiving information such as ISR data, weather data and mission data; it is not just for "viewing CNN or the Super Bowl."

One capability that is slowly gaining traction is to provide high speed data downloads in conjunction with a deployed unit's organic, two-way, SATCOM systems.

While typical two-way systems are constrained due to bandwidth limitations and download speeds, GBS systems can provide consistent, high-speed download of secure and non-secure data. Think of GBS as a military version of a DTH service — such as DirecTV or Dish Network — where one



# SIZE MAY NOT MATTER

## Why bigger may not be better... for antennas

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



**Does size really matter? Perhaps satellite communications mirrors life in many ways. Bigger is more powerful. A bigger antenna means higher performance. Size, then, does matter?**

Nowhere is this observed more than on huge cruise ships that sport massive radomes to secure their enormous parabolic dishes that feed streams of data to the hordes that inhabit them. Or on trailers hauled behind large trucks, in order for armies on the move to be able to assemble the largest possible antenna to provide them with as much data as their troops can consume.

Unfortunately, behind the marketing hype, the science tells us that bigger is not necessarily better. Bigger antennas only work better if they can be accurately pointed to the satellite. At higher frequencies and with bigger antennas, this challenge becomes increasingly difficult and errors much more costly — so costly, in fact, that smaller may actually be less expensive, more convenient and... better.

### The Fundamentals of Antenna Size

Why do we want a big antenna?

First, for the most common case when the link is not overly impacted by uplink noise, interference or modem capability, the satellite link equation that ultimately determines the achievable throughput capability can be simplified to a very simple equation:

$$P_R \text{ (dBW)} = \text{EIRP} + G_R - L_o \text{ (in dB)}$$

which expresses the received power  $P_R$  as the sum of the transmitted "Equivalent Isotropically Radiated Power"  $\text{EIRP} = G_T P_T$ , receiver antenna gain  $G_R$ , and the free space loss or spreading loss  $L_o$  that models the impact of distance on the signal (all in dB). We want to maximize the received power  $P_R$  in order to obtain the maximum signal to noise ratio at the receiver and thereby maximize the data rate that can be received. Clearly, to maximize  $P_R$ , we must maximize the antenna gain  $G$  at both the receiver and transmitter.

Second, consider a transmitter antenna (the treatment of the receiver antenna is identical). The antenna gain compares the power focused in a particular direction against the power of an isotropic radiator which radiates power equally in all directions.

In the following analysis, we will look at the performance of a standard parabolic reflector because most large antennas use such dishes anyway, but bear in mind that even a flat panel antenna behaves in a similar way.

It can be shown that an isotropic antenna (which by definition has unity gain) has an effective aperture of  $\lambda^2/4\pi$  where  $\lambda$  is the wavelength of the radiated signal. Since an antenna with gain  $G$  focuses  $G$  times more power into the same area, we can define the effective aperture of that antenna as

$$A_e = (\lambda^2/4\pi) * 10^{G/10} \text{ m}^2$$

or, alternatively,

$$G = 10 \log[(4\pi/\lambda^2) * A_e] \text{ dB}$$

This shows that, clearly, size matters. A larger antenna has a larger effective aperture and higher gain. A 2.4 meter diameter antenna will have a gain 5.8 times higher (7.5 dB) than a 1 meter antenna. Everything else being equal, its receive signal-to-noise ratio should also be 7.5 dB higher, and for a geostationary satellite the 'clean' link capacity (data rate) in most cases will then have a data rate that is between 1½ to 2½ times higher as well.

By the way, this equation shows the gain also increases as the square of the frequency (inversely with wavelength  $\lambda$ ). In fact, the same size antenna transmitting in C-band at 6 GHz will have a gain 25 times higher (14dB) when transmitting in Ka-band at 30 GHz.

### Why Bigger May Not Be Better

Marketing might want to stop there, but for better or worse, the science tells us more.

Do not forget that the antenna gain just calculated and typically quoted is the maximum antenna gain measured on boresight. Off boresight, it drops rapidly — particularly with large antennas. The total angle around boresight at which the antenna power drops by ½ (3 dB) is known as the 3-dB beamwidth. Assuming symmetry, we will deal with the angle to one-side of boresight, or the 3-dB "half" beamwidth.

Consider a conventional parabolic antenna with an aperture of  $D$  (m) operating at a frequency of  $F$  (GHz).

The 3dB "half" beamwidth angle  $\alpha$  (measured from boresight to the 3dB point, i.e., half the conventional 3dB beamwidth) for such a dish is given by:

$$3\text{dB "half" beamwidth } \alpha = \pm 11/(F * D) \text{ (deg)}$$

Now the antenna gain as a function of small angles off-boresight with respect to the maximum gain  $G_R$  on boresight is given by:

$$G(\phi) = G_R + 20 \log(\cos(45\phi/\alpha)) \text{ in dB}$$

where  $\phi$  is the offset angle. This is because an antenna power pattern looks like a cosine squared curve about its peak on boresight.

As an example, consider the EM Solutions maritime **Cobra** terminal, which has an aperture of about 1 meter in diameter.

The angle to the 3dB point is therefore (at the nominal tracking frequency of 20.7GHz)

$$3\text{dB angle } \alpha = 11/20.7 = 0.5\text{deg}$$

The Cobra terminal uses monopulse technology to acquire and accurately track the satellite signal. It senses the satellite beacon, extracts the TE21 mode in the antenna, and uses the deep null of this signal on boresight to generate a vector to determine in which direction the antenna should point to always remain on boresight, in spite of any motion.

Typically, its TE21 monopulse tracking system will achieve an accuracy (including initial offset errors) of 50 millidegrees (0.05 deg) at 20 GHz. The drop in level of gain due to this error is therefore given by:

$$G(\phi)/G_R = 20 \log(\cos(45 \times 0.05/0.5)) \sim -0.03\text{dB}$$

This is negligible.

For the Tx beam at 30 GHz, the beamwidth is narrower with  $\alpha$  around 0.35deg. The drop in power due to pointing inaccuracy is therefore higher at around 0.06 dB for the same tracking error, but this is still insignificant.

The change with gain across the beamwidth can be visualized as a function of off-boresight angle in the red curve of **Figure 1**, where the 3-dB gain points are indicated by **markers 1 and 2**.

Now consider a larger antenna of 2.4 meters. At 30 GHz, its nominal gain on boresight is 56 dB, more than 7 dB higher than the gain of the 1 meter antenna, whose gain is 49 dB.

However, the value of  $\alpha$  is now much smaller at around 0.15 degrees at 30 GHz. The beamwidth of the latter is shown by markers 3 and 4 on the green curve in Figure 1 below.

If the tracking error were still 0.05 degrees, then the drop in Rx power would be ~ 0.14 dB and for Tx about 0.3 dB. These are small but now detectable in the case of the Tx beam.

However, if the tracking/pointing error was larger, say 0.25 degrees, then the Rx signal would be around 4 dB lower and the Tx signal more than 11 dB below the maximum values. This can be seen in Figure 1, where the gain from the larger antenna falls very rapidly because of its narrower beamwidth, to such an extent that its effective gain becomes significantly lower than that of the smaller antenna.

This illustrates how pointing errors can severely compromise the performance of terminals with narrow 3dB beam-widths (i.e., large antennas operating at higher frequencies). A 2.4 meter antenna mis-pointed by only 0.25 degree will perform only marginally better on receive, and significantly worse on transmit, than an accurately pointed 1 meter antenna.

Ever wonder why most data sheets for terminals do not specify the pointing accuracy? Many systems will struggle to achieve better than 0.3 degree pointing error, assuming such can even be measured.

### How a 1 Meter Terminal Outperforms a 2.4 Meter Terminal

To prove the science, tests were performed on a military Ka-band transponder by a defense customer in late September of 2018 with multiple terminal types.

EM Solutions' 1 meter Cobra terminal (Figure 2) was shown to achieve a communications data rate of 105 Mbps and to outperform competitor terminals of both 2 meter and 2.4 meter antenna diameters.

The trials, on a spoke-and-hub network set up between capital cities in Australia and New Zealand, were to test the performance of a new military Ka-band transponder on a commercial satellite. A variety of terminals were used at the (stationary) spoke endpoints, including EM Solutions 1 meter on-the-move Cobra terminal and auto-acquire, on-the-pause 2 meter and 2.4 meter terminals from other companies.

A maximum data rate of 104 Mbps was achieved in both directions between the Cobra terminal in Brisbane and the remote network hub, surpassing the performance of terminals twice its size. That data rate was ultimately limited by the modem rather than the terminal.



Figure 2. EM Solutions 1 meter X-/Ka-band maritime Cobra terminal

These tests reveal that customers need to be careful in selecting technology aside from marketing hype. The Cobra's outperformance was due to its superior monopulse pointing technology, which provides the most accurate tracking on boresight, whether stationary or on-the-move.

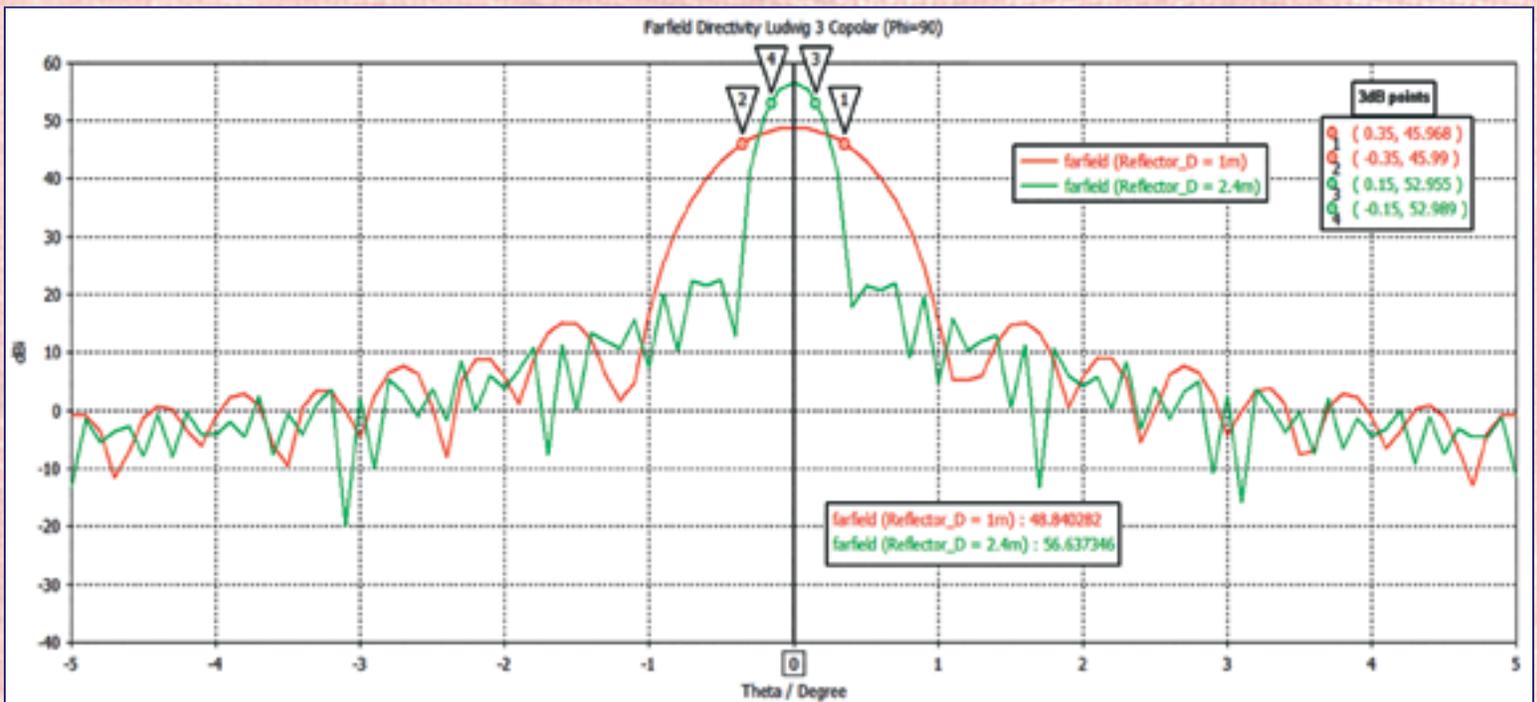


Figure 1. Transmit antenna gain patterns for a 1 meter (red) and 2.4 meter (green) parabolic antenna about boresight, with the 3-dB points at 30 GHz, indicated by markers.

A small pointing error on a large antenna, particularly operating in Ka-band, can completely eliminate the benefit of the larger aperture. The mis-pointing error needs to be only 0.21 degrees (in military Ka-band) for a larger 2.4 meter antenna at transmit frequencies to perform no better than EM Solutions 1 meter terminal, which guarantees excellent pointing accuracy.

Poor pointing ability of actuator-controlled on-the-pause antennas or of step track on-the-move antennas is no match for the pointing and tracking ability of the monopulse technology used by EM Solutions in all its terminals.

This technology typically achieves pointing errors of less than 50 millidegrees, whether stationary or while on-the-move. That maximizes both uptime and throughput in a much smaller package than larger terminals whose marketing would lead you to believe otherwise.

### **The Importance of Tracking and Pointing**

Whether stationary, on-the-pause, or on-the-move, the science is the same: the pointing error must be as small as possible to realize the benefits of size. Too much pointing error (0.21 degrees for a 2.4 meter antenna transmitting at Ka-band) will forgo all benefits over a 1 meter antenna if the smaller antenna is more accurately pointed.

How does the EM Solutions terminal achieve a pointing error less than 50 millidegrees, while the specification of most other terminals is probably 0.3 degrees?

Only 'monopulse' technology is able to maintain lock on the satellite without deliberately introducing an intentional mis-pointing error off boresight to search for the exact beam maximum, even after the satellite has been 'acquired'.

Monopulse technology is a closed-loop system that measures the relative signal level in a higher order mode generated inside the antenna feed whenever the signal is not precisely incident along the antenna boresight.

EM Solutions uses the TE21 mode as this provides tracking information for both linear and circular polarized signals. The system uses that mode's sharp null along boresight to derive a highly accurate corrective pointing vector to force the antenna back in line, without the need to introduce any deliberate pointing loss to determine whether the antenna is aligned for maximum receiver power, as happens with conical or step scan systems.

As a monopulse system directly measures the TE21 signal which is proportional to the deviation off-axis, such a technology also has the benefit of being able to accurately monitor and report the instantaneous pointing error to the user.

Other systems using conical scan or step-track search patterns that deliberately mispoint the system to find the maximum signal level are less accurate for several reasons.

First, they often rely on the modem to indicate the signal level and signal maximum, rather than use an integrated receiver that directly measures the beacon. Using the modem, even once it is synced, introduces lag and other system inaccuracies.

Second, to detect a meaningful signal drop across the beam requires moving off the maximum by at least 1 dB, introducing significant mis-pointing and reducing the gain.

Third, the signal level can be reduced by many other factors besides the mis-pointing, such as scintillation or fading, fooling the tracking system.

Fourth, this also means the tracking error can never be known, since the calibration between mis-pointing angle and signal level depends on a variable reference signal influenced by other factors. Using conical scan or step track to acquire and point the antenna, it is quite feasible that errors of 0.2 degrees or more persist.

### **Is Smaller Better?**

EM Solutions has additional experience to prove the company's point. From the firm's network of point-to-point, terrestrial, 80 GHz, E-band radios installed over 15 km links in New Jersey, which use 1.2 meter dishes where the total 3 dB beamwidth is 0.22 degrees, we know that optical alignment of the antennas is impossible and that small movements — even due to thermal variations or wind — can cause sufficient mis-pointing to lose the link entirely.

Similarly, at Ka-band frequencies and with large dishes — even stationary ones — pointing accuracy must be within a fraction of a degree to establish a link and genuinely reap the benefits of a large antenna.

If the system must be aligned in the field, let alone on-the-move, it could be far better — for cost, performance, and size — to use a smaller monopulse pointed antenna instead of a larger one that relies on brute force alignment.

*Smaller can, indeed, be better!*

[www.emsolutions.com.au/](http://www.emsolutions.com.au/)

*Author Rowan Gilmore joined EM Solutions as a Director in 2007 and became Managing Director and CEO in October 2011. His role is to lead EM Solutions to achieve its vision to become recognized internationally as the leading designers and manufacturers of the most innovative and highest quality microwave product technology.*

*Rowan will be known to those in the microwave engineering community who have attended his short courses on microwave circuit design and RF wireless systems offered by Besser Associates and CEI Europe since 1990.*

*His previous experience includes Vice President, Engineering at Compact Software, where he introduced the world's first harmonic balance nonlinear circuit simulator, and as Vice President, Network Services Europe for SITA-Equant, the global airline IT company, now part of France Telecom's Orange network. Most recently he was CEO of the Australian Institute for Commercialization, where he helped numerous start-up companies and worked to accelerate technology transfer between research institutions and industry.*

*Rowan obtained his D.Sc. in Electrical Engineering from Washington University in St Louis. He is an adjunct professor of both Business and Electrical Engineering at the University of Queensland, and was elected a Fellow of the Academy of Technological Scientists and Engineers in 2009.*





# MISSILE WARNING AND DEFENSE

**For today, tomorrow and beyond...**

By Brad Bolstad, Director, Raytheon Space Systems

**In 1946, melted chocolate in the pocket of a Raytheon engineer led to the invention of the microwave oven, a technology whose core function and use has remained pretty much the same for decades.**

However, unlike the microwave, missile warning and defense has changed and cannot rely on decades-old technology. The threats we face are more complex than ever and evolving every day.

The 2019 *Missile Defense Review* (MDR) highlighted the imperative for the U.S. to provide effective, continuing protection against threats today, tomorrow and in the future. Raytheon is developing a wide-range of technology to answer the call — from space-based sensors to ground-based data processing systems to missiles that can take out other missiles in space.

"I cannot stress enough how important it is to stay ahead of the threat," said Wallis Laughrey, Vice President for Raytheon Space Systems. "This is why the U.S. Air Force's Go Fast acquisition

strategy is so important. It is not optional: it is about the safety of our country and our allies."

As noted in the MDR, space-based sensors offer something ground-based detection systems do not: Limitless geographic flexibility. Countering a threat starts with seeing it.

To give military commanders that first-look capability, **Lockheed Martin** turned to **Raytheon** to design the payload for its *Next Generation Overhead Persistent Infrared (OPIR) Block 0 resilient missile warning satellite*.

The U.S. Air Force recently implemented Next Gen OPIR as a rapid acquisition program, targeting the first geostationary satellite delivery in 60 months. It keeps pace with adversary advancements, replacing the Space Based Infrared System by providing more survivable and resilient missile warning.

"We are enabling Go Fast acquisition with high-Technology Readiness Level components,

including focal plane arrays and electronics," said Roger Cole, program manager at Raytheon's Space Systems. "This approach ensures all program requirements are met on schedule and within cost."

To meet future mission requirements, missile warning and defense systems with an open systems architecture must be designed. OSA is at the heart of Raytheon's Next Gen OPIR Block 0 payload design to accommodate rapid and affordable performance upgrades. It is also suitable for polar orbit, with minimal modification.

Limitless geographic flexibility is not limited to the GEO orbit.

The *Missile Defense Agency's Space Sensor Layer*, or SSL, is a new addition to the nation's missile warning and defense capability. Data from SSL and the Next Gen OPIR system will be networked through the ground system and shared and provide persistent missile detection



A rocket launch. Photo is courtesy of Raytheon.

and tracking from space to enable the earliest possible intercept.

The **Missile Defense Agency (MDA)** recently received completed SSL architecture studies from industry, including Raytheon.

The **Defense Advanced Research Projects Agency (DARPA) Blackjack** satellite will provide further persistent global coverage in **Low Earth Orbit (LEO)**. Blackjack will develop and demonstrate a low size, weight and power OPIR sensor that can be mass-produced to fit on multiple buses from multiple providers.

One application for Blackjack capabilities could be missile warning. The satellite will deliver the required find, fix, track, target, engage and assess loop to the last tactical edge of the battlefield and will do so with low latency and high data quality.

*"The beauty of Blackjack is it's an autonomous system,"* said **Mike Rokaw**, director for Raytheon Space Systems. *"It will be self-aware of satellite tasking and satellite health, automatically adjusting to deliver the mission to the end-user without operator intervention."*

### **Getting the Data to the Decision-Makers**

To help protect against adversaries who want to prevent the U.S. from operating freely in space, Raytheon has developed a prototype system for managing floods of satellite data to accelerate the **Future Operationally Resilient Ground Evolution Mission Data Processing Application Framework**, or FORGE.

The U.S. Air Force FORGE ground system will process satellite data from the **Space Based Infrared System (SBIRS)** and the Next-Gen OPIR solution that will eventually replace it. Raytheon's prototype FORGE framework offers significant improvements over the system that is currently in place, he said. *"Our solution is scalable, flexible, efficient and extensible,"* said **Dave Sutton**, Global Intelligence Solutions manager at Raytheon. *"Plus, it will offer the Air Force a low cost system architecture that is very open and non-proprietary."*

Raytheon's FORGE technology has been tested with SBIRS data, weather satellite data from the company's satellite-based **Visible Infrared Imaging Radiometer Suite (VIIRS)** and with ground radar data. It can also process data from a wide range of other civil and environmental sources.

*"The most critical application will be one that provides missile warning notifications, alerting the Pentagon and National Command Authority and letting them know something has been launched,"* said Sutton.

### **Eliminating the Threat**

Detecting and tracking a threat is only as good as the ability to destroy the threat. Missiles are fast, traveling up to 15,000 mph. They can cover long distances, with the most advanced missiles reaching into space and traveling over the North Pole to hit targets.

The U.S. and its allies have developed several overlapping systems to stop missile attacks. Raytheon plays a major role in almost every one of them.

Developments — in what can literally be considered "rocket science" — take time to accomplish. Designing, engineering, testing and producing the world's most sophisticated missile defense technologies, especially at a program's inception, are purposeful and create opportunities to learn and test the limits of the system.

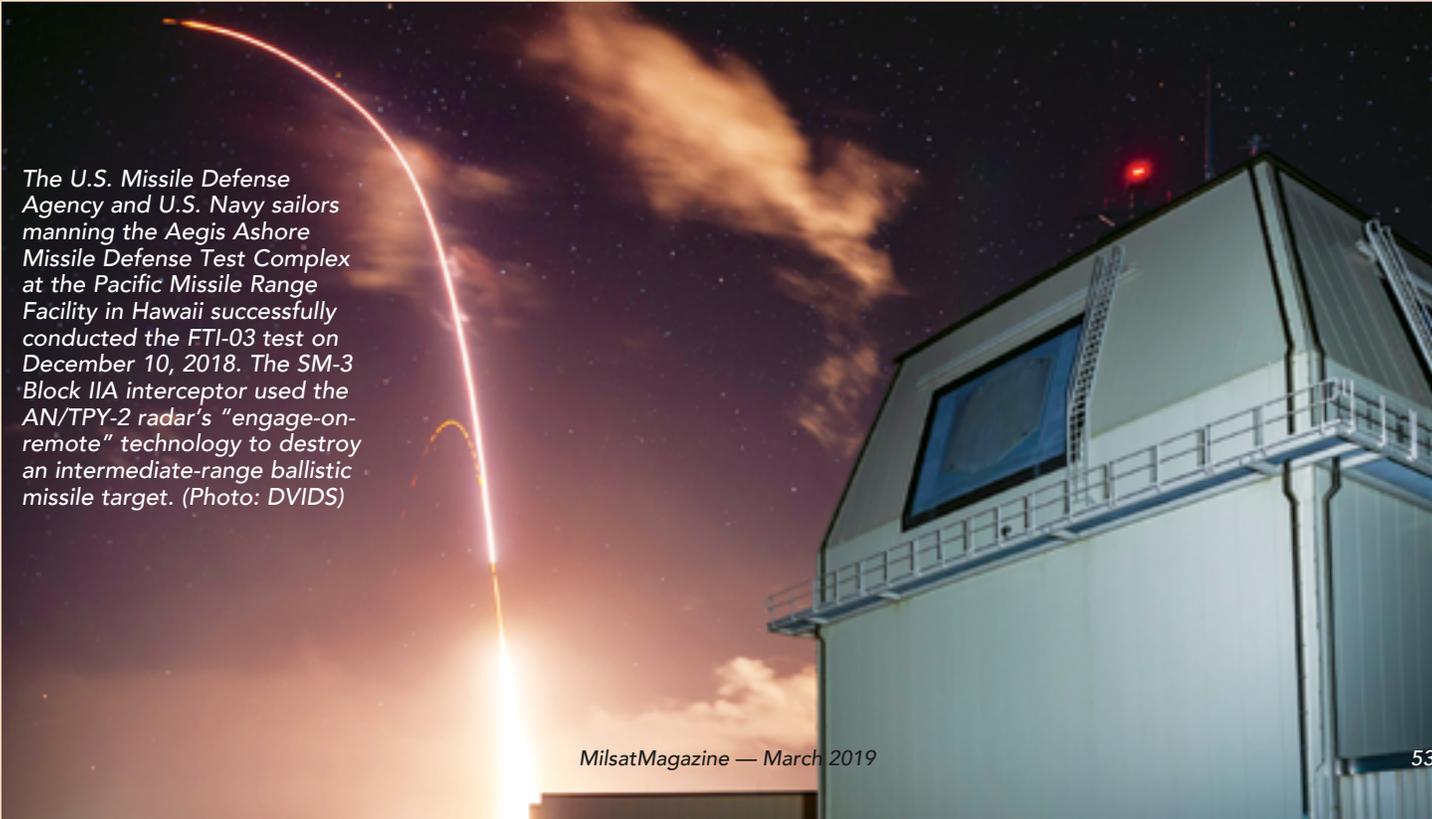
Raytheon designs missiles with evolution in mind — to build a solution that grows with the needs of the customer and stays ahead of the threat. The rapid development of technologies is only able to occur when a robust base of engineering, production and testing expertise exists to build upon. Ballistic missile threats continue to advance, and in the same way, missiles such as the **Standard Missile-3** are evolving with the help of innovative engineering.

A "crawl, walk, run" development approach that builds on proven systems has created an unparalleled ballistic missile killer. It destroys short-to-intermediate range ballistic missiles in space by colliding with its target — such as hitting a bullet with a bullet. The SM-3 missile is the only weapon in existence today that can be launched from a ship at sea or from land, offering extraordinary versatility to the warfighter.

Going fast is the new normal and Raytheon's technology must evolve at that same rate of change.

Raytheon's heritage in space-based sensors, data processing and the most effective family of ballistic missile defense interceptors has the company poised to deliver solutions to a wide-range of customers to meet the evolving threat — today and tomorrow.

[www.raytheon.com](http://www.raytheon.com)



The U.S. Missile Defense Agency and U.S. Navy sailors manning the Aegis Ashore Missile Defense Test Complex at the Pacific Missile Range Facility in Hawaii successfully conducted the FTI-03 test on December 10, 2018. The SM-3 Block IIA interceptor used the AN/TPY-2 radar's "engage-on-remote" technology to destroy an intermediate-range ballistic missile target. (Photo: DVIDS)

# THE PORTABLE RADOME

## Protecting SATCOM terminals from environmental hazards in the field

By David Walton, Vice President, Walton De-Ice (W.B. Walton Enterprises, Inc.)

**SATCOM-On-The-Move (SOTM) or SATCOM-On-the-Pause (SOTP) systems have proven to be effective tools for providing secure, beyond-light-of-sight communications on land for military troops in remote locations and "austere" tactical environments.**

Today's smaller, distributed forces, operating on rugged terrain beyond the horizon from their nearest base, are faced with the need to communicate more data, more often, than ever before. Land expeditionary forces that operate in complex terrain require robust and adaptable networks, and ruggedized hardware.

Tactical teams, mobile command posts and other units can use man-pack SATCOM terminals, vehicle-mounted and handheld SATCOM systems for users in harsh, isolate environments, to provide high bandwidth data from remote regions. Portable terminals such as these can range in sizes from .45 meter man-packable systems to nearly 4 meter lightweight antenna systems.

They are capable of rapid, high-bandwidth service activation and access DISC, WGS and commercial satellite services. Flyaway and transportable terminals in the 0.5 to 2.5 meter reflector range are also employed by the U.S. military.

### Operating Challenges: Hostile Environments

Deployed SATCOM terminals of the type described above can be subject to extreme weather conditions that include snow, heavy rain and moisture, ice, wind and sand storms, and intense heat. 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 the extreme winds that can cause signal interference or outages and damage. In harsh snowstorms, windstorms, rain storms and other challenging conditions, antenna feeds and reflectors must be protected from all of the various elements.

Traditional antenna radomes are not built for transportable operation — yet, many of today's military and first-responder applications on land require deployable systems where harsh elements demand radome-like protection.

### A New Solution: The Portable Radome

The **Walton Portable Radome** (patent pending) is a new solution being introduced to the marketplace for protecting deployable MILSATCOM and SATCOM terminals.

The Walton Portable Radome unleashes a entirely new set of possibilities for operating **Satellite Transportable Terminals (STT)** and micro-VSATs in extreme and mobile conditions in support of the military requirements for high capacity data, voice and video capabilities across the globe.

This new product provides a uniquely deployable weather protection solution for applications such as military vehicular mount terminals "drive-aways," **Comms-on-the-Pause (COTP)** or at-the-



halt terminals, VSATs, transportable uplinks, some enterprise terminals, and MEO transportable or fixed terminals.

The lightweight, rapidly deployable Portable Radome protects VSAT and transportable antennas from rain, snow, ice, wind, sand, debris and heat. The unit helps make satellite networks more survivable and deployable into extreme or harsh environments, including windstorms, sandstorms, dust storms, blizzards, hail, torrential rains and burning heat and sun.

### Multi-Band

The Walton Portable Radome (available for C-, Ku-, X-, or Ka-Band) also enables operators to gain significant cost saving versus conventional radomes for military networks.

Radome sizes range from 1.5 to 9.1 meters in diameter and from 1 meter to 7.6 meters in height. They can protect parabolic antenna reflectors in a variety of sizes.

### Advantages

Operational in an 85 miles per hour (136 kph.) constant wind load, the self-supporting structure requires no continuous power, unlike *Inflatable SATCOM Antennas (ISA)* antenna covers. Unlike Inflatable systems, the Portable Radome is self-supporting: it quickly assembles without tools in less than an hour, unlike conventional radomes, which can require two days and a crane to install, depending on specifications.

The small flyaway lightweight (2.13x1.68 meter / 44.45 kg.) model is airline baggage checkable, and yet, for all these benefits, it can also support permanent site requirements.

The Walton Portable Radome offers cost savings and other advantages compared to traditional radomes. Radomes are designed to protect satellite Earth station antennas from damaging and signal-busting weather effects and can also protect from ice and snow, battle the effects of rainwater accumulation as well as heavy winds. In the burning desert sun, the Portable Radome can keep antenna reflectors and outdoor electronics equipment cool, thereby preventing damage.

### RF Friendly

The Walton Portable Radome employs rugged, RF-passing, hydrophobic antenna cover materials and materials similar to those used in Walton De-Ice's field proven **Snow Shield** and **Ice Quake** systems deployed around the globe to protect Earth stations. For example, field testing performed by performed by the **ACTIA Telecom Group** in France has shown a minimal G/T decrease of only 0.31 dB at 20 GHz when the



Portable Radome covers a .98-meter **Skyware Global Ka Band** terminal type used by the French **Ministry of Defense**.

### Keep Cool, Stay Warm

In extremely hot environments, an efficient *Air Conditioning Unit* can be added in order to cool temperatures underneath the radome — and prevent over-heating damage to equipment under the dome.

For snowy and icy environments, various **Walton Electric Heater** configurations to perform De-Icing functions for the Portable Radome. Automatic de-icing also conserves energy. Other functions that can be remotely controlled and monitored include snow detection and precipitation sensing.

### Sets up Quickly

Operators can quickly assemble this lightweight, rapidly deployable radome and no tools are necessary. The radome assembles in less than an hour. For some remote sites, crane installation is simply not an option. For many remote and deployed sites, installation with a crane is cost-prohibitive.

A Walton Portable Radome can operate at twice the wind load of some popular inflatable systems at sizes suitable for field deployable terminals. However, unlike inflatable antenna covers that require a continuously powered blower to stay inflated, the Walton Portable Radome structure is self-supporting.

During the past year, the **U.S. Department of Defense (DoD)** has invested in network services that leverage the low-latency, MEO, O3b commercial satellite constellation for applications under CENTCOM, AFRICOM, and other regions. Several terminal manufacturers are supplying the antenna subsystems for terminals to operate with

the O3b system. For example, transportable O3b terminal packages offered to DoD buyers include antennas from **General Dynamics** and **AVL** that range in size from .85 to 2.4 meters.

The Walton Portable Radome can protect MEO tracking antennas of various sizes from harsh elements and the units can be built to specifications for protecting O3b Dual Transportable Tracking Antennas and similar O3b Ground Terminals.

### Protecting SATCOM Terminal Assets

The Portable Radome can protect SATCOM terminals from disabling damage and loss-of-use due to temporary environmental hazards in the field — preventing loss of critical communications links. The radome can provide an “extra-ruggedness insurance policy” for a mission — repair/replacement parts simply cannot be provided during such intense actions.

Another way the Walton Portable Radome offers cost-savings: highly ruggedized antenna terminals can be costly. Spares and repairs are not inexpensive.

Transportable SATCOM terminal acquisition costs can be in excess of \$230,000 to \$300,000 for some ruggedized MEO configurations, depending on the unit. By protecting field deployable terminals from environmental damage, the Walton Portable Radome can extend the life of SATCOM terminal assets and equipment, reduce mean-time-to-repair, reduce fleet maintenance costs, and help reduce replacement costs. This can free organizations’ budget dollars to spend on other critical items.

The introduction of the Portable Radome solution from Walton De-Ice has created new opportunities for the rapid deployment of high-bandwidth SATCOM terminals and their operations in harsh environments. Simultaneously, this radome offers a practical solution for protecting transportable assets, extending the useful life of field terminals, potentially reducing maintenance and other costs, and providing insurance against loss of use.

*David Walton is Vice President of Walton De-Ice (W.B. Walton Enterprises, Inc.), where he is responsible for the Snow Shield, Ice Quake products and new product development. He has over 37 years of satellite industry experience in the design, manufacture, and deployment of Earth station technology, and holds several patents for his inventions in this field. He can be contacted at: [david@de-ice.com](mailto:david@de-ice.com), or visit [www.de-ice.com](http://www.de-ice.com).*

# THE TCPED INFORMATION REVOLUTION



## Adapting to the 21st century

By Mark Knapp, Director of Business Development, National Security Programs, Kongsberg Satellite Services (KSAT)

**The information management model of *tasking, collection, processing, exploitation and dissemination* (TCPED) deserves renewed attention in an era when the volume and value of information is expected to increase at exponential rates.**

The level of recorded knowledge has ballooned in just a handful of years as endless sensors and cloud-computing architectures churn through data at unprecedented rates. Labeled an information revolution, the ripples impact a range of fields including national security, agriculture, finance and health.

Information as a commodity now holds more worth than ever, with access and use often determining who wins and losses. Despite the changes, TCPED remains a viable construct for governments and militaries to inform decision makers and efficiently align resources with priority activities.

Given that government, military and commercial space operators may hold varying levels of familiarity with TCPED, an overview of the information management model and suggestions for successful implementation during an information revolution:

### **Tasking**

Commands prioritized and sent to collection assets. In the space sector, satellite sensors most often represent collection assets with global ground antenna networks and satellite-relay communications ensuring near real-time tasking.

### **Collection**

Assets acquire raw data and deliver to processing centers. Satellites with increasing numbers of sensors now catalogue a wide range of space vehicle, in-orbit and terrestrial activities as raw data. The satellites subsequently feed raw data to collocated edge computers or deliver to processing centers via the same communications infrastructure used for tasking.

### **Processing**

Data is converted from raw to exploitable at processing centers. The rise of edge computing and cloud-based architectures presents the space sector with opportunities to adapt to the 21st Century information revolution by scaling and increasing automation.

### **Exploitation**

Processed data loaded to exploitation platforms, reviewed and used to create derived information. Comparable to processing routines designed to complement the information revolution, edge computing and cloud-based architectures foster scaling and increased automation of exploitation routines. In addition, the introduction of new analytic ecosystems can consolidate, organize and refine algorithms used to exploit satellite-collected data.

### **Dissemination**

Derived information delivered to end users who review and share feedback that drives new tasking. Besides traditional decision makers, end users may be automated systems that deliver feedback after acting upon metadata, usage statistics or other derived information, dramatically reducing TCPED timelines. It remains important to have feedback that drives new tasking and continued TCPED iterations.

*TCPED guided military operations as early as World War I, when aerial surveillance and other intelligence specialties began using the information management model.*



Examples of TCPED populate history, and World War I marks an important point when government and military organizations embraced the information management model.

TCPED rose to prominence during World War I as commanding officers sought to keep informed and execute decisions in increasingly complicated security environments. The scale of World War I operations exceeded anything to date, with personnel, equipment and adversaries extended across wide geographies and continually changing.

To comprehend and influence events, commanding officers implemented regulations that gave way to primitive forms of TCPED. TCPED eventually dictated activities such as where reconnaissance units surveyed and who analyzed aerial photography.

The advances enabled decision makers to review previously incomprehensible volumes of information while justifying priorities and allocation of limited resources.

Embedded as a government and military practice since World War I, TCPED again surfaced as an indispensable information management model during conflicts including World War II and the Cold War, when several intelligence disciplines adopted and refined to suit specific needs. Missions dedicated to aircraft early warning, targeting and signals interception benefited from TCPED.

Deployment of new technologies and sensors often correlated with ever-increasing amounts of data and created ideal conditions for applying TCPED. Regardless of the domain where an asset operated—ground, sea, air or space — TCPED guided operations and made possible timely cataloging, review and delivery of relevant information to decision makers.

Recent and anticipated growth in the space industry represents fertile ground for TCPED adoption. The number of launch operators continues to expand, bringing down costs and making possible more missions on orbit.

Meanwhile, smallsats and other innovations challenge legacy practices by significantly increasing data generation, storage and transfer rates in space environments. Comparisons to Moore's Law suggest space capabilities could double every two years.

For more than five decades, Moore's Law has witnessed the evolution of semiconductor processes at extraordinary levels, and equivalent systems once occupying buildings are now available in smartphones and smaller.

If similar changes affect the space industry, incredibly compact and proficient hardware would accelerate mission numbers and diversity. Coupled with robust and cost-effective launch options, an information explosion would result and demand implementation of an effective, proven model such as TCPED.

Paradoxically, the commercialization of space since the late 20th Century has slowed opportunities for market-oriented actors to innovate and design systems around TCPED.

In the United States and elsewhere, governments and militaries have commanded space markets by awarding large, multi-year contracts that reduce competition, limit growth and maintain status quos. Contracts detailing specific technical requirements leave little margin for invention and risk taking, further hindering the commercial space industry.

TCPED rarely receives consideration from commercial space organizations supporting governments and militaries because contract requirements fail to identify the need. Until governments and militaries step aside and allow the commercial space industry to develop with more independence, TCPED and rapid advances in technology, speed and innovation will struggle to take hold.

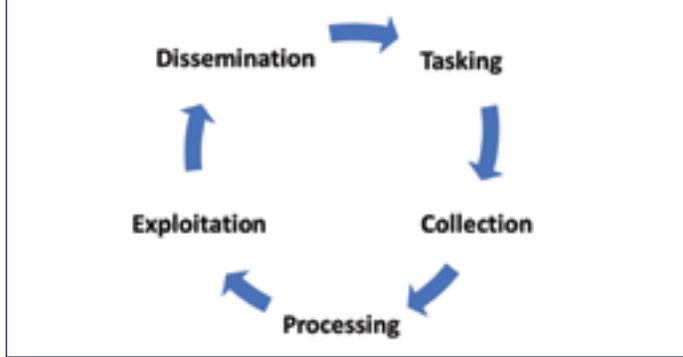
The importance of creating conditions for a dynamic, healthy commercial space industry that applies TCPED cannot go ignored because government and military space operators now depend on outside support as much as at any point in history.

Gone are the days when space programs of the United States and USSR comprised resources that matched percentages of gross domestic production and could internally design, build and deploy new technologies incorporating TCPED. Instead government and military space organizations around the world solicit assistance from industry and academia, who may or may not recognize TCPED as a useful concept.

An effort to raise awareness and implement TCPED throughout the space industry should stand as a priority for government and military space operators.

Alternative information management models exist for the space industry, but none embodies the same flexibility, scalability, and historic

## TCPED Information Management Model



The TCPED information management model enables governments and militaries to inform decision makers while efficiently aligning resources with priority activities.

accomplishment as TCPED. The *strategies-to-tasks framework* (STTF) and *tasking, posting, processing and using* (TPPU) perform well in tactical environments where individual leaders or units offer streamlined feedback that guides follow-on iterations of information cycles.

Using STTF or TPPU in non-tactical environments would require ever-increasing numbers of feedback agents, likely misallocating resources and overwhelming operations. *Activity based intelligence* (ABI) holds great promise and has proven to scale while incorporating a wide range of information sources. Nonetheless, ABI depends on rich metadata, extensive archives and statistical analyses to achieve success, encountering accuracy issues when limited metadata or information libraries skew insights derived from sample sets.

Assuming the commercial space industry grows unencumbered and governments and militaries integrate the best inventions, TCPED stands as an ideal model for informing decision makers and efficiently aligning resources with priority activities.

An information revolution in the space sector would present countless challenges to governments and militaries, but application of TCPED would ensure knowledge gaps were addressed with timeliness and reduced strain on limited capabilities.

[www.ksat.no/](http://www.ksat.no/)

Mark Knapp has served as the Director of Business Development, National Security Programs, at Kongsberg Satellite Services (KSAT) since August of 2018. He holds extensive experience in the private and public space sectors and has led several complex project rollouts from strategic planning to completion including collaborations in the United States, Europe and Asia.

Mark may be contacted at [mark.knapp@ksat.no](mailto:mark.knapp@ksat.no).

# THE HUNT FOR TALENT

## How to attract viable and reliable candidates for your company or organization

By Barry Vince, Founder and Owner, 2Roads Professional Resources



**During a meeting among masterminds in the United States defense industry in San Jose, California, several prime military contractors, educational and political leaders, sounded an alarm.**

*"The biggest obstacle facing our country is the shortage of science and engineering talent."*

This meeting occurred 20 years ago and that alarm is still sounding.

Several industries across the United States are currently facing the consequences of a severe shortage of talented people who hold technical degrees including national security and defense. Unfortunately, there is no easy way to dig ourselves out of this hole and when it comes to securing our nation, this is one of our biggest obstacles.

There are several competing nations who produce more degrees in science, technology, engineering and mathematics, otherwise known as STEM degrees, in a month than the United States produces in a year.

This is especially alarming when talking about job openings that require secret clearance. Only U.S. citizens can obtain a secret clearance, so when national security is the subject, and secret clearance-holding personnel are the desired talent, we can look no further than within our own offspring. Citizens of other countries cannot be in this specific talent pool.

One of the biggest challenges facing companies who provide services and support to our defense industry is the competition faced from sexier industries. Many qualified professionals are drawn to the high-tech sector and dream of working on campuses housing companies such as Google, Apple, and Amazon.

While creativity and technical expertise is a hot commodity across the board, companies in the defense industry are using technology and driving innovation across all sectors. What can government contractors do to be able to compete with these companies?

The answer is not simple nor foolproof. We are not going to solve the dearth of STEM degrees produced by universities across our country overnight.

However, there are a few very important things that companies across the nation operating in the defense industry need to keep in mind when they are recruiting top technical talent.

### **Competitive Salary and a Streamlined Process**

Who doesn't want to make money? Nobody, and today's economy is providing for unparalleled salaries and growth opportunities for technical talent.

Top candidates can pick and choose not only which company with which they want to interview but also which industry. Competition is fierce, and candidates regularly receive offers that are 20 to 30 percent above their current salary.

Bidding wars including counter offers and incredible lifestyle perks are commonplace in today's hiring market. **Know your market.** A company is not going to be able to attract top talent if their offer is not competitive.

An efficient hiring process is equally as important. The ability to turn around a resume, book an interview and extend an offer quickly will put any company ahead of its competition.



All too often, resumes sit in an inbox for a day before they are reviewed by human resources. Two days later, they are sent to a hiring manager.

After a week, the resume has been reviewed and a phone screen is scheduled. It is more than likely that two weeks can pass before a candidate has had a face-to-face meeting.

Nail down your process and timeline and stick to it. Use modern communication tools, such as Skype, to conduct interviews rather than phone screening a candidate.

Speed to hire is incredibly important in a tight market, and STEM candidates, especially those with a secret clearance, will be picked up quickly.

### Corporate Culture

Prospective employees list "Company Culture" as the number one reason to pursue a specific opportunity. The workplace is evolving as younger generations demand more connection, communication, fun, and remote work environments.

Campus environments are becoming more popular, encouraging socialization among employees and providing a fun and connected environment among staff members. What does your company offer? How is it different from anything else out there? What is the coolest thing about what your company does on a day to day basis?

In today's world, a company's culture must be communicated across multiple platforms and is a key advertising tool for candidates. A significant presence on social media is critical to communicating not only your brand but also the culture or "vibe" of your company.

Instant-gratification from watching streamed videos and incredible graphics on realistic video games keep our youth fascinated. They want to see cool stuff — videos of rockets, missiles and planetary exploration comprise some of YouTube's top video hits.

Progressive companies consistently reach out via all means of social media to portray their culture, vision, and work.

Equally as important as culture is the delivery of a company's message. What is portrayed in public must hold true within the workplace. Senior level management, human resources, and hiring managers must believe in and be presenting the identical message.

A prospective candidate is analyzing every aspect of his or her interview process, so everyone involved in hiring must be aligned in their selling of a company's strengths and culture.

Every candidate will ask, "why would I want to work at your company?" Each answer must be interesting, quantifiable, tangible, and identical across all divisions.

### Talent Mining and Retention

Chrome Books and Apple iPads have changed the lives of elementary, middle school and high school students across the country. Students use them for research, notes, and test taking.

Tablets are embedded in kids' minds. Young people buy school supplies, clothing and skateboards from Amazon before ever walking into a retail location.

Mobile devices, especially those produced by Apple, are the primary means of communication among today's youth. The names of notable high-tech companies are embedded in the brains of our younger generations early and often.

Rockets are cool, too. So is the idea of living on Mars. However, the offerings of the defense industry are less tangible to America's youth. Space exploration, new satellite technology, advanced tactical communication tools, and advanced communication tools are fascinating, but kids need access to this type of technology.

Elon Musk from SpaceX has led the charge with public notifications of rocket launches, videos on social media, and a vibrant presence. Like it or not, your kid probably knows his name.

America's defense industry can be integrated into science and math curriculums. Data can be interesting and practical applications make learning more interesting. Get involved in the education process, early and often.

College recruiting is more powerful than ever — get good people in and get them in quickly. Take a chance on an inexperienced go-getter that can't wait to change the world. Then, work like hell to keep them.

Culture, promotions, and salary increases will help retain your best employees. Every recruiter in the industry is attempting to fill open technical positions by poaching it from top-tier competitors. Make it impossible for someone to leave. Money is always important, but a progressive company with a solid vision, creative culture, and upward mobility will always win.

Our economy is strong. Nearly every prime contractor and supplier are fighting an uphill battle for cleared professionals in the engineering and information technology fields.

This shortage of talent will not be solved in short measure; however, creating a clear and fascinating vision, applying the appropriate resources to recruiting, and investing in the future of your employees will help you to attract and retain top technical talent in a vicious technical labor market.

### Barry's Top Keys to Attracting Talent

1. Create the Dreamers! Create local programs that give our youth access and information
2. Branding & Culture
3. High caliber talent acquisition team. Internal and/or external
4. Streamlined Recruiting Process. Management & HR aligned. Speed to Hire
5. Retain your current talent!! Avoid high turnover. Create internal retention plans.

[www.2roads.com](http://www.2roads.com)

Barry Vince is the Founder and Owner of Two Roads Professional Resources. Barry resides in Long Beach, California, and has 30+ years of supporting aerospace and defense recruiting efforts. He is recognized as an industry leader in creating corporate retention and talent acquisition strategies. Two Roads provides direct and temporary placement services across the United States. Barry may be contacted at [bvince@2roads.com](mailto:bvince@2roads.com).



# THE GOVERNMENT SATELLITE REPORT



## mPOWER — What is it and when can we expect it?

By Ryan Schradin, Executive Editor, GSR, and MilsatMagazine Senior Columnist

In September of 2017, SES, one of the world's leading satellite operators, announced that they'd be ushering in a "new era in global cloud-scale connectivity and high power data services," by launching a new networks system they called "O3b mPOWER."

This new network of systems would combine terrestrial networks and ground-based infrastructure with a constellation of seven extremely powerful and flexible high-throughput satellites (HTS) that would reside at Medium Earth Orbit (MEO). The result would be a system with the ability to deliver flexible, agile, fiber-like connectivity to practically anywhere on Earth.

We sat down with Mike Blefko, the Vice President of Business Development at SES Government Solutions, to obtain some insights on O3b mPOWER and its interoperability.

The differences between O3b mPOWER and the existing O3b MEO fleet were discussed as well as the technology's potential use cases by the federal government and when customers can expect O3b mPOWER to become available. Here is what Mike had to say:

### Government Satellite Report (GSR)

At the close of 2017, SES announced that they were introducing something called mPOWER. What is O3b mPOWER, exactly?

#### Mike Blefko (MB)

mPOWER is our next generation Medium Earth Orbit constellation. It builds on the legacy MEO O3b solution that is operational today delivering services to many United States Government (USG) customers worldwide.

O3b mPOWER continues our leadership at the MEO arc delivering high throughput, low latency services to our customers with orders of magnitude leap in capability. Our seven satellite constellation implements more than 30,000 beams allowing customers to connect with Gbps speeds at a latency of less than 150 msec.



### GSR

How does O3b mPOWER differ from the satellites and constellations that SES already offers?

### MB

SES is the only true MEO/GEO global owner/operator. We have 55 GEO satellites, 16 O3b MEO satellites growing to 20 this Spring, and 7 next generation O3b MEO mPOWER satellites launching in 2021. We offer services at C-, X-, Ku-, and Ka-band and both for commercial and military customers.

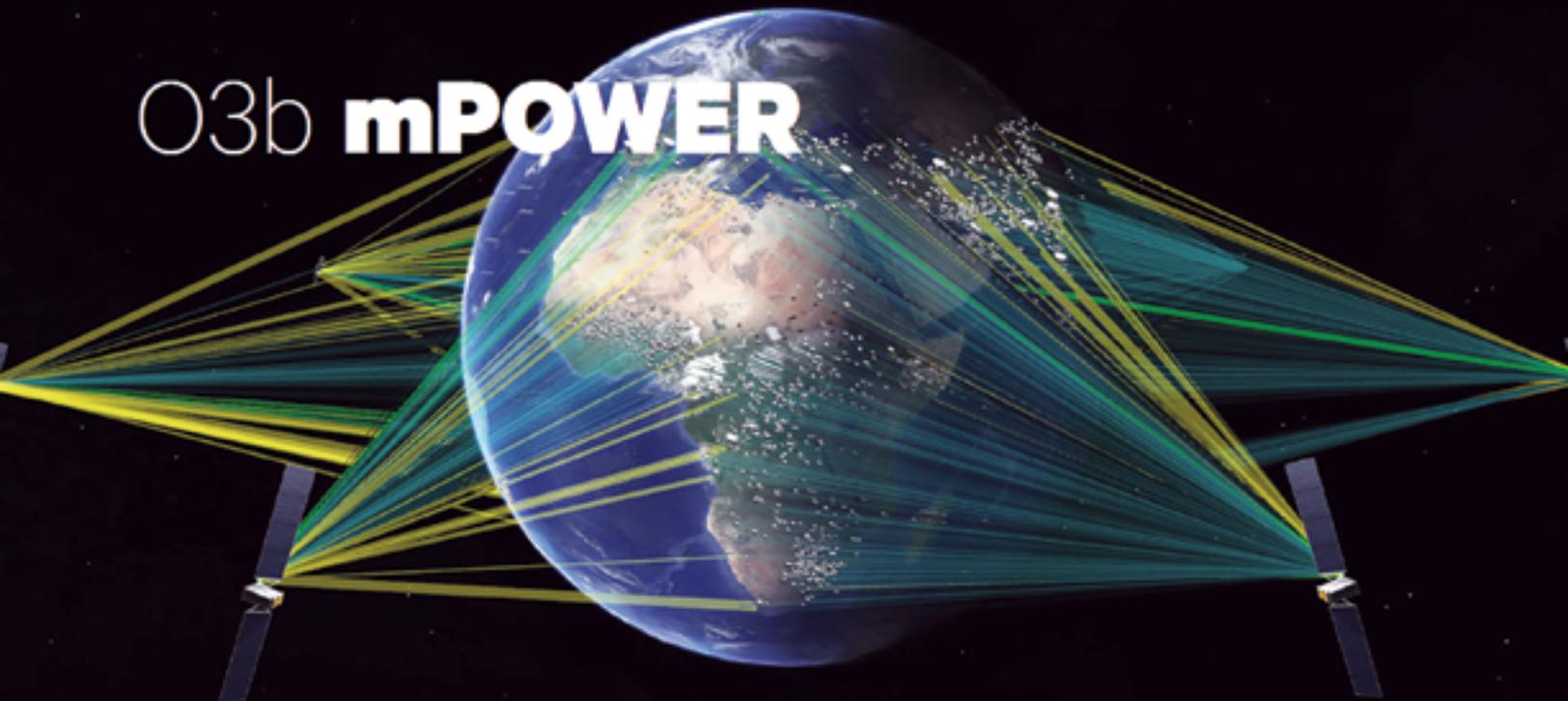
Both the current O3b MEO constellation and the next generation O3b mPOWER are at the MEO arc. This O3b MEO constellation enables truly remarkable data rates today for fixed, mobile, maritime and aero customers.

The cruise industry has been a significant commercial adopter of the technology due to the Gbps of capacity being delivered to each cruise vessel.

Defense customers take advantage of the high throughput low latency services for terabyte size file transfer, 4G and next gen 5G LTE backhaul, 4k HD video dissemination and fiber like speeds and performance from the remote terminal back to the end user.

O3b mPOWER also incorporates advanced electronically scanned phased array technology both in the air and on the ground. Our Boeing 5th generation phased array on the satellites will deliver more than 5000 beams per satellite and per region, with bandwidth per channel that is scalable from 15 MHz up to 2500 Mhz.

# O3b mPOWER



This flexible coverage is delivered directly to customers without requiring a gateway infrastructure or a corresponding terrestrial overlay from that gateway, thus saving the customer money, increasing the security of the network, and making each circuit more reliable and more resilient. O3b mPOWER will support customers that have very low data rate requirements in the 5 to 10 Mbps range all the way up to customer doing enterprise redundant, protected backhaul in the 10 Gbps rate.

This flexible coverage is delivered directly to customers without requiring a gateway infrastructure or a corresponding terrestrial overlay from that gateway, thus saving the customer money, increasing the security of the network, and making each circuit more reliable and more resilient. mPOWER will support customers that have very low data rate requirements in the 5 to 10 Mbps range all the way up to customer doing enterprise redundant, protected backhaul in the 10 Gbps rate.

### **GSR**

*What differentiates the mPOWER satellites from the existing O3b MEO constellation?*

### **MB**

Each satellite in the current constellation has 10 customer beams. For O3b mPOWER each satellite has up to 5000 beams, a 500 times increase.

For the current O3b MEO constellation, data rates of up to about 1 Gbps are realizable. For the next generation O3b mPOWER data rates up to 10 Gbps over a full beam are achievable. The beams for O3b have 432 MHz of capacity. For O3b mPOWER the capacity per beam is over 5 times as much at 2500 MHz.

Both MEO constellations have a model where we sell a managed service to the customer by the Mbps. Customers contract for a certain non-contended data rate – 250 Mbps x 250 Mbps for example, at a Service Level Agreement (SLA), and then we implement, monitor, manage, and control that service between the two customer ethernet ports in a true managed service delivery model.

Only seven O3b mPOWER satellites are needed to be launched and controlled to deliver this next generation differentiated service. This is in contrast to the planned LEO constellations that require hundreds of satellites to be launched, configured and maintained to deliver contended services, three to four years from now.

### **GSR**

*What is the status of mPOWER? Are the satellites launched? If not, when will they be launched?*

### **MB**

The O3b mPOWER satellites are in development at Boeing and will be launched in late 2021.

### **GSR**

*From a U.S. Government perspective, what agencies or government organizations would have need of mPOWER?*

### **MB**

All of the COCOMs that have high throughput, low latency requirements in austere locations as well as at sites that require a true satellite backhaul capability would benefit from O3b mPOWER. Given the low latency on the network implementation, cloud-based applications can be based on remote server access. Architectures that benefit from 'anywhere to anywhere' in a  $\pm 50^\circ$  latitude around the planet can be implemented for these COCOM customers.

Navy vessels that require both en route as well as connectivity at the final end point could have secure beams pointed at them to provide fiber like services. Comms-On-The-Move (COTM) land vehicles traveling across a continent could be connected throughout the entire movement with services that provide real time visibility to command posts in the rear or overseas.

Airborne assets that require significant resources to backhaul collected information will be able to securely connect to remote locations while in flight as well as when they return to the base. Tactical teams that need a capable backhaul solution from their forward operational location could use small mobile terminals for 10s of Mbps connectivity.

### **GSR**

*What types of use cases would they need that level of bandwidth and throughput for?*

### **MB**

ISR backhaul, efficient video dissemination, 4G and 5G LTE connectivity for files and for voice comms, remote medical support, world wide database access for any server application via low latency connectivity, large file transfer to both upload and download files in real time reliably and affordably.

### **GSR**

*Flexibility seems to be one of the key differentiators and value proposition of mPOWER — the flexibility and agility that comes with shapeable and steerable beams. Why would this be particularly interesting for government users – especially military users?*

### **MB**

Our US Government warfighter missions are not static. They change in real time. Our warfighters need a flexible, agile, resilient network to meet their mission critical needs. O3b mPOWER meets these demands with a secure, low latency, high throughput, flexible, agile network.

Beams are both fixed and movable providing resources for all forms of communications. Bandwidth can be allocated from low to high throughput, and intentional and unintentional jamming is mitigated by the MEO orbit, multiple layers of redundancy including polarization, frequency, beam, and satellite diversity.

A wide ecosystem of terminals for the various fixed and on-the-move markets makes competition within the solution and benefits both commercial and military end users.

For current applications, SES Government Solutions has a 5-year Blanket Purchase Agreement (BPA) with Defense Information Systems Agency (DISA) to streamline and rapidly contract for O3b services. Pre-negotiated rates for full and partial beams as well as purchase and lease options for the equipment and certified field service representative make the warfighter defense dollar stretch further.

For additional information about mPOWER and how it can be used in government implementations, download the information sheet, "O3b mPOWER for U.S. Government Missions" at this link: [ses-gs.com/govsat/resources/o3b-mpower-for-u-s-government-missions/](https://ses-gs.com/govsat/resources/o3b-mpower-for-u-s-government-missions/)

*This article first appeared on GovSat. To read additional, informative articles, please visit [ses-gs.com/govsat/#](https://ses-gs.com/govsat/#)*



*Ryan Schradin is the Executive Editor of GovSat Report. A communications expert and journalist with more than a decade of experience, Ryan has edited and contributed to multiple popular online trade publications focused on the satellite, unified communications and network infrastructure industries.*

*In addition to editing content and establishing editorial direction, Ryan also contributes articles about satellite news and trends, and also conducts both written and podcast interviews for the GovSat Report. Ryan also contributes to the publication's industry event and conference coverage, providing in-depth reporting from leading satellite shows. Ryan is a Senior Columnist for MilsatMagazine.*

# ENHANCED COMMS FOR THE WARFIGHTER

*Meeting those needs...*

*By Aaron Titus, Business Development Manager, Norsat International*

**Enhanced communications capability has always been the cornerstone of modern warfare and the key to any successful mission. Considering modern warfighter communications, the reality is soldiers are not bound to predetermined areas and fixed home bases for secure data transmission.**

The modern warzone demands live surveillance, airborne intelligence and reconnaissance missions and warfighters are mentally prepared to be deployed at a moment's notice. Hence, the top demand in the design of satellite communications equipment is mobility, reliability and ease of use backed by ruggedness.

Defense organizations are faced with increasing demands to provide real time data to and from the battle field for both mission focused and *Morale, Welfare and Recreation (MWR)* purposes.

The reason being — the informed soldier is an effective soldier and a connected soldier is a happy soldier.

To meet this demand, companies are being called upon to develop more sophisticated communications tools for rapid deployment into the harshest of environments sometimes with special customizable size, weight, power or feature requirements to meet the needs of a specific application. *DoD SATCOM* (Department of Defense Satellite Communications) or *military satellite communications (MILSATCOM)* systems, tied impeccably into the terrestrial infrastructure, must deliver secure communications on demand, on the move, and across the globe.

The design of such responsive future architecture, with the precise balance of both military and commercial satellite capabilities, must be based on real-time situational analysis of necessities.

Warfighter requirements are paramount to the design of forthcoming satcom capabilities.

## **Response Time**

Quick-assembly communications equipment, such as fly-away satellite terminals, are becoming increasingly important to specialized '*Rapid Deployment Forces*'. Such services typically consist of elite military units of warfighters as well as special forces, search and rescue teams, marines, paratroopers, etc., that need to respond to emergencies, establish communication networks and carry out tasks successfully in a matter of hours.

Most of the time, the rescue window or response time is just 30 minutes. Niche groups like a *U.S. Air Force Rescue Squadron's Ready Reaction Force (RRF)* are capable of rapid response to situations that develop in a very short time frame.





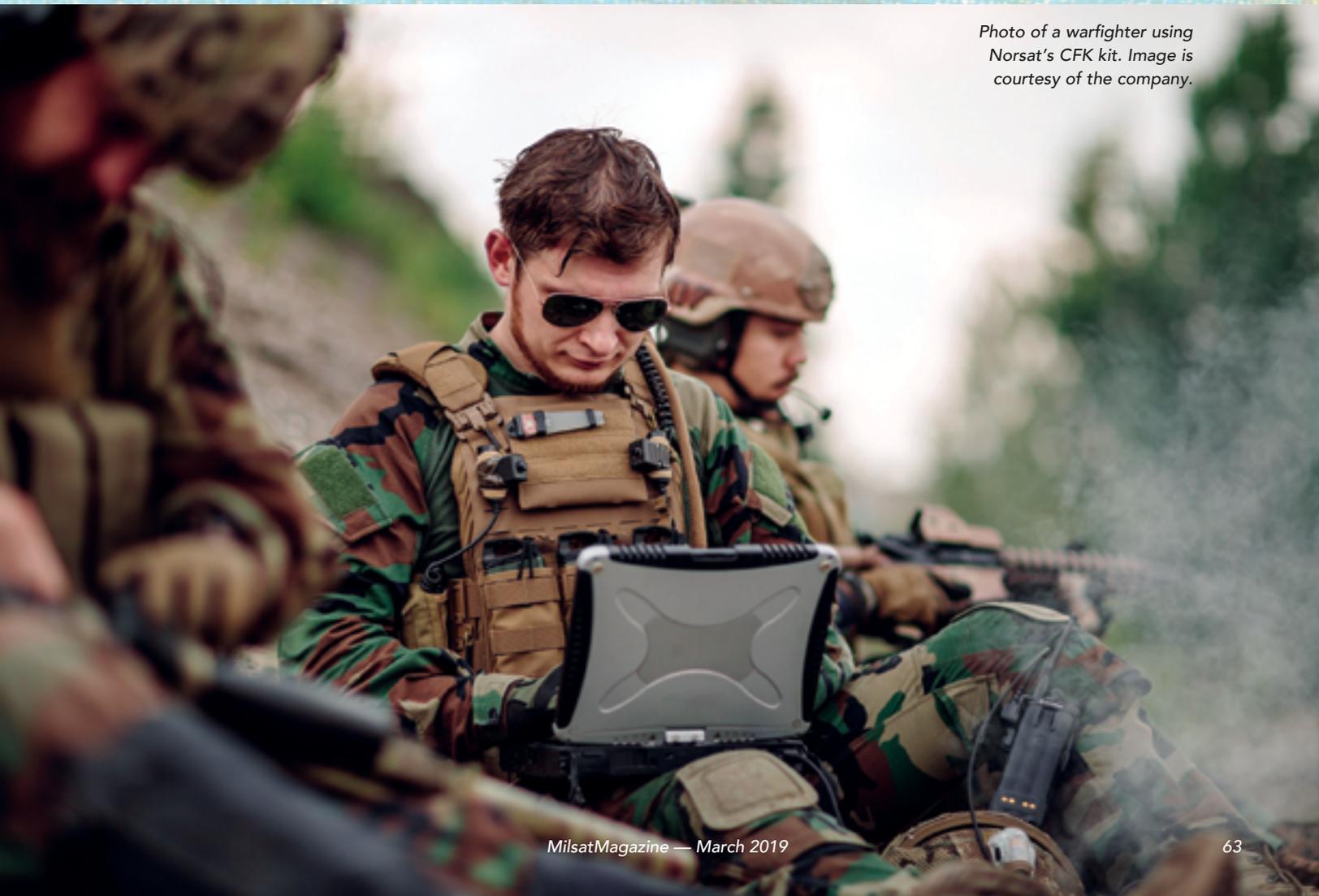
For such situations, **Norsat** has developed Specialized components like the universal military fly-away satellite terminals such as LNB allow automated frequency selection the **GLOBETrekker 2.0** with a one-touch for worldwide deployments. Moreover, its interface that enables easy operation and rapid modular architecture enables easy sub-assembly deployment, with set accomplished in only ten replacement and RF band switching in the field. steps and the unit can auto-acquire a satellite in less than five minutes.

Currently deployed by militaries around the world, the GLOBETrekker 2.0 includes IP65 compliant sealed equipment for all weather use and digital leveling technology for deployment in uneven terrain. Norsat's GLOBETrekkers are being used for warfighter comms by **38th Rescue Squadron (38RQS)** and **31st Rescue Squadron (31RQS)** — *Defense Media Activity (DMA)*) fielded GLOBETrekkers are also being used for the transmission of video from the field in support of the **U.S. Department of Defense (DoD)**. The GLOBETrekker is also being used by the **National Geospatial-Intelligence Agency (NDA)** for transmission of imagery to support warfighters in the field.

### **Warfighter Command and Control (C&C)**

For the warfighter, communication does not simply encompass two-way radios to give or receive orders and updates.

Modern militaries require secure on-demand communication ranging from email to HD video feeds and *Voice-over-Internet-Protocol (VoIP)* to simpler services like instant messaging. Portable satellite systems are central to enabling military personnel to stay connected by internet and email service and, where appropriate, through videoconferencing.



*Photo of a warfighter using Norsat's CFK kit. Image is courtesy of the company.*

A portable system is able to establish a link as

needed and can be redeployed at the end of any mission.

Keeping this requirement in mind, Norsat developed SATCOM-baseband kits — integrated fly-away units packaged in two small airline carry-on cases that provide secure and non-secure communications via an Ethernet connection.

For example, the **CFK-100E** model supports simultaneous voice, video and data communications over classified and unclassified networks anywhere in the world via two removable **Cisco ASA5505** security appliances for red/black separation and an **Explorer 710 BGAN** satellite terminal. The kit is packed in two airline carry on backpack cases and includes a HD 720p webcam and headset for remote video conferencing, enabling live updates from the field. For extremely remote warzones where electricity is not readily available, the CFK-100E integrated power supply and SMART UPS can be powered via AC, DC or standard BB-2590 or UBI-2590 batteries.

### Surveillance

Surveillance and monitoring of RED zones critical warzones enables soldiers to stay two steps ahead of the enemy by anticipating the next move.

This sector is going through unprecedented changes as militaries have moved toward a holistic network-centric approach to their communications. From war zone operations to disaster recovery and homeland security operations, surveillance in modern times involves SATCOM systems syncing data effortlessly to report developments on land, air and sea.

Realizing this, Norsat has developed products and components for UAV's, monitoring of coastal regions, borders and high-value targets and assets.

### Military Certifications

While considering warzones, one tends to visualize an actual battlefield on

land or an aerial attack. However, approaching the warzone via sea is an important part of strategic planning for naval warfighter communications.

Tracking a narrow satellite beam in geosynchronous orbit 35,000 km. away from the oceans' surface, while the ship below rolls and moves through storms toward warzones, is no easy feat. Hence, modern militaries are investing in MILSATCOM products manufactured by specialists in the maritime industry. Moreover, the data transferred by the navy between vessels, maybe highly classified — so maintaining resilient and secure communications is a necessity.

Norsat has strengthened its presence in the naval SATCOM market by manufacturing products with the most stringent MIL-STD and ARSTRAT/WGS specifications. Manufacturing military standard products helps achieve standardization objectives laid down by the DoD. Such standardization testing helps maintain the quality and functionality of products. It is helpful in achieving interoperability, consistency and logistics systems compatibility. Norsat's **MarineLink Naval Series** are designed to meet the new-age demanding requirements of modern navies as outlined in the following Military Standards:

- **Mechanical Shipboard Vibration: MIL-STD-167-1A**
- **High-Impact Shipborne Shock: MIL-STD-901D**
- **Military EMI / EMC: MIL-STD-461G**

Following such rigorous and standardized certifications enables organizations to provide military customers with demonstrated, high-capacity communications systems that are designed to perform under even the most extreme maritime environments, in or out of the warzone.



Members of the USAF setting up a Norsat CFK kit.

Additionally, the MarineLink Naval series are certified for use on the **Military Wideband Global Satcom (WGS), CE0678, Intelsat** and **Anatel** networks. In particular, the ARSTRAT WGS certification project for Norsat's COM15X required rigorous program management and planning as well as technical expertise from RF engineers to complete the required testing, over multiple years. Advanced RF expertise was required to understand all of the WGS requirements based on MIL-STD-188-164B, apply those requirements to the design of the product, and then execute the necessary tests to verify that the design is compliant.

### Capability Will Always Be The Best Defense

Deployability, mobility, **Beyond-Line-Of-Sight (BLOS)** capability, and data security requirements drive military satellite communications development in modern times.

Enhancing these capabilities will deliver consistent and reliable communications throughout a mission, whether stationary or mobile. Complete consideration of the drivers, trends and technology that fuel the military communications sector, will help development of superior SATCOM equipment.

Norsat is also harnessing the power of AI (Artificial intelligence) for quick auto-satellite acquisition and instant communication, which is predicted to be absolutely essential to win on the modern-day battlefield.

Immediate action must be taken to ensure that near-term MILSATCOM needs and evolving requirements are identified, documented and reproduced in a responsive, integrated, and reasonable architecture to support the modern warfighter well beyond the turn of the century.

[www.norsat.com/](http://www.norsat.com/)



# COMMAND CENTER: JOHN SERAFINI

Chief Executive Officer, HawkEye 360

John Serafini is the CEO of HawkEye 360, developer of space-based radio frequency (RF) mapping and analytics capabilities.

He previously served as Senior Vice President of Allied Minds where he led the formation of and the

investment into HawkEye 360, along with other Allied Minds companies such as BridgeSat, Federated Wireless, Optio Labs, Percipient Networks, and Whitewood Encryption Systems.

John's investment activities and management expertise center upon the intersection of profit-maximizing private capital and the unique requirements and R&D capabilities of the U.S. government. A former Airborne Ranger-qualified U.S. Army infantry officer, John is a graduate of the US Military Academy, Harvard Business School and Harvard Kennedy School of Government.

HawkEye 360 launched its first small satellites into space December 2018 to offer customers a new type of radio frequency (RF) remote sensing data. In this interview with



**CEO John Serafini, the significance of this mission and why space-based RF analytics will bring clarity to previously undetectable activity is discussed, providing new insights for government, maritime, emergency response, and spectrum analysis applications.**

What does HawkEye 360 do?

## John Serafini (JS)

We are an RF analytics company with a unique constellation of satellites that geolocate RF signals across a broad spectral range. We are the first company to bring this type of capability to market, offering remote sensing of a wide variety of RF signals on a global scale, in all weather, day and night conditions.

Using this data, we offer analytical products and services that provide spectrum awareness for many applications. We also fuse our data with other sources, such as electro-optical, synthetic aperture radar imagery, and open source information, to further enhance our products.

We recently launched and completed checkout of our first satellites, a cluster of three small satellites that are flying in formation and successfully identifying and geolocating RF signals. Our technology enables independent geolocation, which refers to our ability to triangulate a signal's position on the earth. This provides us a unique vantage, from which we

build foundational products that describe and map signal locations.

In addition to our foundational products, we build second-tier analytics and services to deliver behavioral analysis of objects that emit RF. One of our first products will focus on identifying and tracking maritime vessels, but that same concept can be applied to the aerial, border, and battlefield domains.

Never before has space-based RF data been commercially available for performing global spectrum awareness. Since spectrum awareness is essential to understanding human activity and our environment, the information we supply will help customers make better decisions.

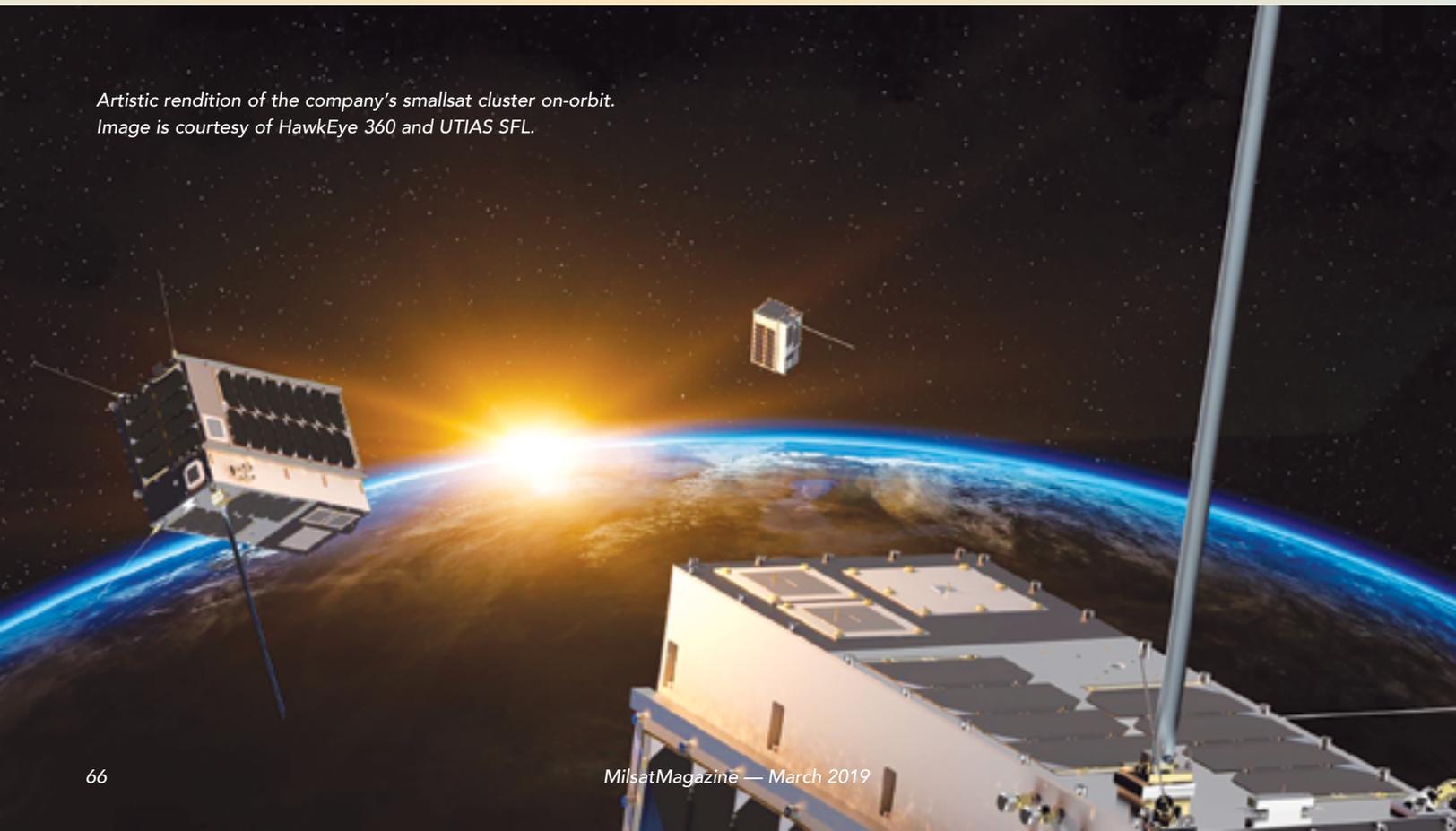
*Your satellites recently began gathering data. Why is this such a huge milestone?*

**JS**

If you think about the space ecosystem, there are three primary domains of functionality: you can communicate, you can take images, and you can analyze signals. The first two have been commercialized for decades.

Companies such as SES, Iridium and Intelsat have successfully commercialized satellite-based communications. Imaging has been handled by companies like DigitalGlobe, and more recently, Planet and BlackSky. However, governments have

Artistic rendition of the company's smallsat cluster on-orbit. Image is courtesy of HawkEye 360 and UTIAS SFL.





The smallsats before their launch on December 3, 2018. Photo is courtesy of HawkEye 360.

predominantly led the signals domain, largely due to the technical and cost barriers.

It's a major step forward to have satellites flying in formation that are capable of identifying, processing, and analyzing a wide range of RF signals. We've designed and launched a set of satellites tailored for this specific purpose. And we are pleased to have this first-mover advantage and capability to convert this RF data into highly refined and valuable insights for our customers.

*What products are you excited to bring to market this year?*

**JS**

RF signal geolocation is our foundational product. We can identify and track a wide variety of signals between 144 MHz and 15 GHz. We use these signals of interest to create object-based behavioral analytics where we track specific objects like a vessel, a vehicle, or an aircraft. Just being able to bring this foundational RF signal of interest capability to market is major accomplishment.

Equally important is our RF survey capability, which analyzes how spectrum is being utilized, provisioned, and deployed at any given frequency, location, and time. Delivering space-based RF surveys on a subscription basis provides our customers timely insights critical to their operations; mitigating the need to deploy survey teams across the globe. These surveys will also offer quick assessment of communications infrastructure after natural disasters, such as hurricanes or earthquakes.

*What types of customers are you seeking to serve?*

**JS**

We've built a robust set of customers whose operations will see high-value impacts from using our products. Both within the United States and internationally, we've seen how our RF analytics will positively impact a diverse range of organizations, such as defense, intelligence, law enforcement, civil government, maritime, insurance, and telecommunications.

In the maritime sector, data gathered by HawkEye 360 can provide visibility for law enforcement into suspicious vessel behavior, giving them better information in their pursuit of illicit activity.

We are also using our RF geo-location to help serve search and rescue missions. Instead of having to trust that a GPS beacon is offering an accurate location, we can independently verify the actual location of the signal, which can help speed rescue efforts when time is critical.

*Why is tracking dark vessels in maritime so important? What's the benefit?*

**JS**

There are trillions of dollars of illicit activity occurring worldwide in the maritime environment. This number reflects the negative impacts generated by illicit activities such as illegal fishing, smuggling of arms, drugs, and people, counterfeiting, oil sanction violations, and piracy.

The challenge is that there aren't great cross-border law enforcement technologies to detect when vessels are attempting to do something illegal. Vessels have a voluntary signal called the Automated Identification System (AIS) that broadcasts their location, but it can easily be turned off, spoofed by the operator, or a third party could spoof it maliciously.

If someone is going to do something illegal, they are incentivized to be as quiet about it as possible, which means they are going to turn off any voluntary signals. By doing so, they basically disappear from the radar of law enforcement.

Our on-orbit capabilities allow us to identify RF signals of interest emitting from ships and use those signals to create a signature that allows us to track individual ships. We can help determine where they are going and be able to predict their activities and locations.

*Who are some of the other people currently trying to solve this problem, and what are their challenges?*

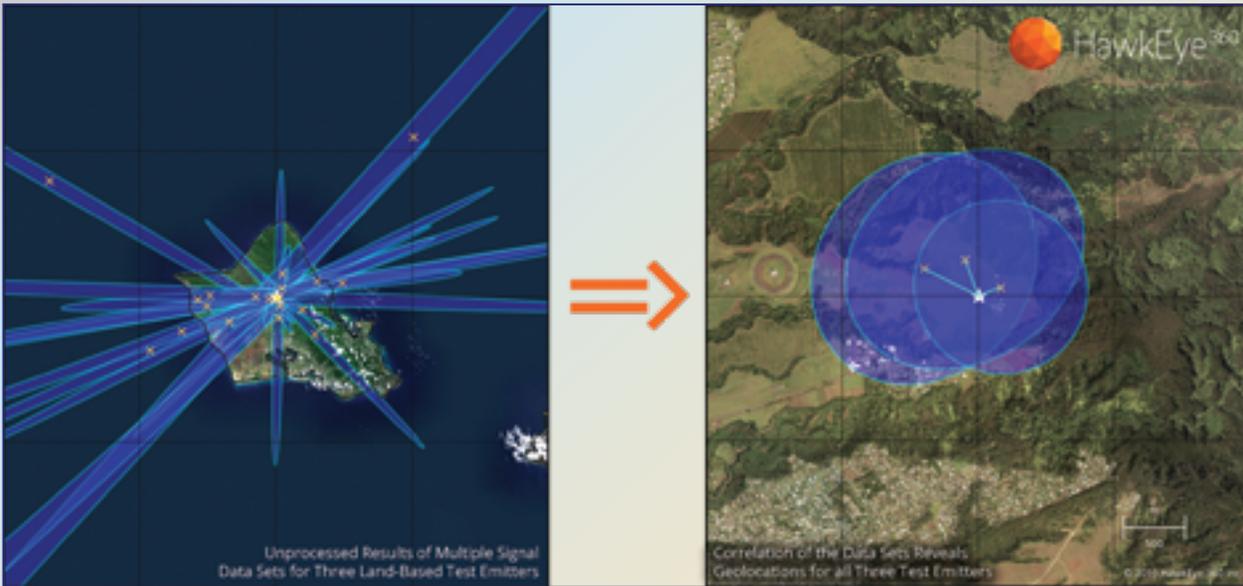
**JS**

If you are trying to track dark vessels using just AIS, it's an incomplete technology by virtue of the fact that it can be turned off at any given time. It's not difficult to pull up a map of AIS traffic and then look at the total anticipated volume of traffic and you can see that there is a significant delta between the two. It is clear that vessels are turning off their voluntary AIS signal, or in some cases, if the vessel is small enough, it's not required to have AIS.

Any single approach to detecting and tracking the presence of dark vessels will be limited. For example, sending out aircraft or ships to survey is costly and can only cover so much area. Or trying to accomplish this through satellite imagery alone is like looking through a straw down into the ocean. It's challenging to detect a dark vessel, and it's even more difficult to pick up that same vessel on the next pass.

We can build an RF profile for a vessel that will help us detect and find that vessel anywhere in the ocean. But more than just using our RF capabilities to detect a vessel, we plan to fuse additional sources of information to create reporting that describes what that vessel is doing.

Many different sources can contribute value: coastal radar systems, satellite imaging, synthetic aperture radar, aerial and UAV platforms, vessel databases, and lists of vessels known to be malicious.



Test of the land reference signals in February of 2018.  
Image is courtesy of HawkEye 360.

The challenge is fusing all this data together into a usable format to provide insight about what kind of illegal activities might be involved, at what port the vessel will likely try to disembark its cargo, what kind of trans-shipment opportunities might arise, and potential rendezvous partners the ship has worked with in the past. All this information can be used to support the detection and interdiction of bad actors who are performing illegal activities in the maritime domain.

By combining our unique RF analytics with our ability to fuse data sources, HawkEye 360 will be a leader in delivering contextually relevant solutions to our customers.

*How might the information you produce help satellite communications providers?*

**JS** One challenge that the satellite communications industry deals with is identifying and managing interference. This problem is only going to proliferate as satcom providers grapple with frequency conflicts arising from cellular operators in the emerging 5G space.

Today, that's typically managed on an as-it-occurs basis. When a quality of service problem arises, satellite communication providers have to identify the source of the interference and interdict the problem in order to remediate the issue.

Once our satellites are conducting routine RF surveys, we will be able to provide continual heat maps identifying interference as it occurs, and in some cases even before it occurs. We believe we will be able to help our customers alleviate the time-consuming process of rolling out trucks

or aircraft to geo-locate interference terrestrially, and instead be able to efficiently accomplish that from our on-orbit position.

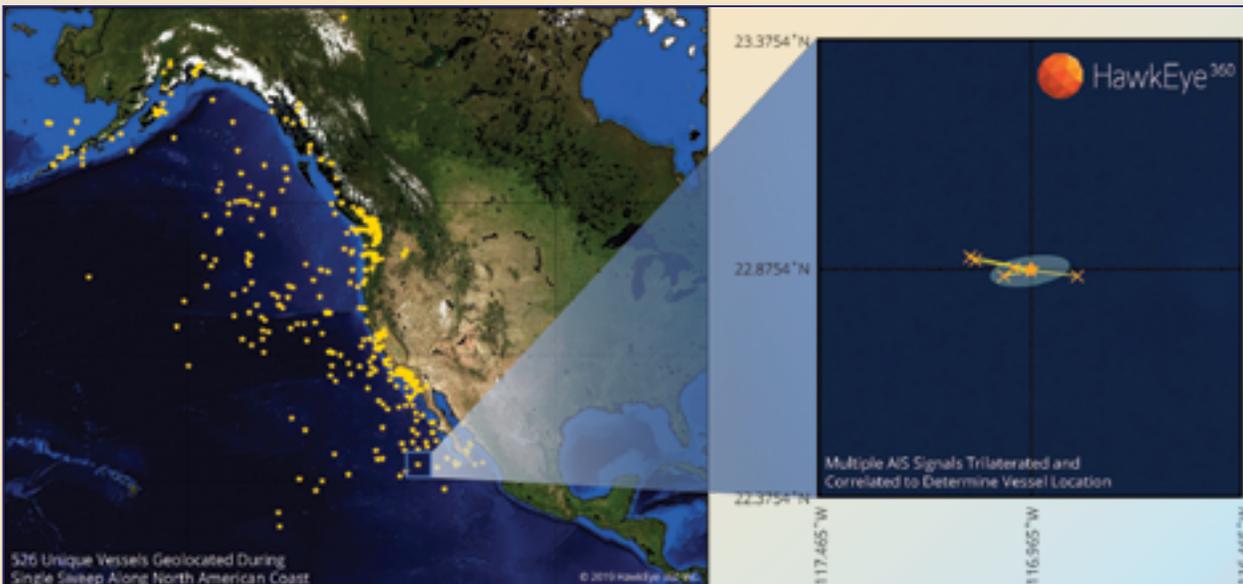
*What are the next steps for HawkEye 360?*

**JS** Now that our satellites are in orbit and operational, the rest of 2019 is going to be very busy. We'll be bringing four products to market over the course of the year. We'll be

launching an additional cluster of satellites with increased functionality to further deliver value to our customers. And we'll be scaling our business to support a diverse ecosystem of customers.

Long-term, we plan to continue building the size of the constellation to bring revisit rates under a half-hour.

[www.he360.com](http://www.he360.com)



Test of vessel geolocations in February of 2018.  
Image is courtesy of HawkEye 360.



# A COMMON GROUND SYSTEM

## More than a step forward

By Andrew Werner, Director for Space Products, a.i. solutions



**A common ground system is seen by many in the space industry as a mechanism to recognize significant cost and schedule reduction for space missions.**

With new entrants into the space industry, an ever-rising number of launches and dozens of constellation satellites planned for launch over the next decade, there is an opportunity to evolve ground system architectures. This is driving the need for increased automation, shorter delivery times as well as a desire to not reinvent the wheel for each new spacecraft or mission.

The space industry has been talking about “common ground systems” for years. A search through the *Satnews Publishers* archives reveals common ground systems referenced in many articles over the past decade for military, civil and commercial missions.

Those articles and others speak of three main staples of a common ground system:

1. *Reusable architecture: the components that make up the ground system and larger workflow are well defined*
2. *Baseline requirements: each component has clear responsibilities for generating output*
3. *Well-defined interfaces: there is an agreed upon format and mechanism for exchanging input and output data*

In addition, scalability has emerged as a necessary trait for common ground systems. A real test of “commonality” is if the ground system can support everything from a single spacecraft to a constellation of hundreds.

Scalability will also need to address folding in upgraded and/or modified satellites as a constellation is maintained and refreshed over time. This has implications on the architecture and requirements, given the emphasis on automation and management by exception.

The **U.S. Air Force Space Command (AFSPC)** is making strides to transition from stove-piped ground segments to a common ground system through its **Enterprise Ground Services (EGS)** approach. Past ground systems achieved some cost and schedule reductions using **Commercial-Off-The-Shelf (COTS)** software but were largely built from scratch. EGS will allow for enhanced resiliency, automation of routine tasks, and easier transitions for operators from one mission system to another.

Late last year, USAF Lieutenant General **John Thompson**, Commander, **Space and Missile Systems Center (SMC)**, and Commander, AFSPC spoke to this concept and said, “Not every satellite or satellite system, whether it’s communications or not, needs to have its own independent ground system. We need to be able to do things more as an enterprise.”

**a.i. solutions**, a mature small business based in Lanham, Maryland, has focused on a critical component of a common ground system — the **Flight Dynamics System (FDS)**. An FDS controls the spacecraft orbit through orbit determination, ephemeris/product generation, contact analysis, maneuver planning, fuel accounting, and collision avoidance.

Every maneuverable satellite has an FDS component to perform these functions and many of the requirements can be similar for each orbit regime, such as **Low Earth Orbit (LEO)** and **Geostationary Earth Orbit (GEO)**. The company has built the FDS for dozens of satellite systems (single satellite, formations, constellations) over the past 20 years for military, civil and commercial missions, incrementally improving the firm’s technologies over time.

With the tenants of a common ground system in mind, a.i. solutions developed its **Meridian** offering to be the FDS of the future. “*Meridian is not an incremental improvement built to meet the next customer’s requirements. It’s built based on the past 20 years of requirements, the latest advancements in technology, and where we think our industry is heading,*” said Paul Noonan, Vice President at a.i. solutions.





Those who develop ground systems, in whole or in part, have a great opportunity to meet that increased demand. However, it requires a common ground system that is a culmination of where the industry has been and where it's going, not simply an incremental advancement from where we are today. a.i. solutions has executed several successful deployments of its Meridian FDS by taking an approach based on those staples of commonality.

Soon, an operator will get a text alert during lunch that one particular spacecraft in a constellation of hundreds has a potential conjunction. The operator will review a recommended collision avoidance maneuver that previously performed best in handling thousands of problematic cases within the cloud and the operator will select that identified maneuver for execution to solve the incident.

### Meridian's Flight Dynamics System

Meridian's reusable architecture can swap out modules from one deployment to the next, exchanging LEO drag makeup maneuvers for GEO station keeping, all within a common framework and a modern operator interface.

The common interface means that operators are trained and certified on one set of procedures, quickly transitioning to new missions without having to restart that entire process.

Meridian is built to meet a standard set of requirements, generating products from definitive ephemerides to eclipse predictions, in a way that any remaining mission-unique needs can easily be layered on top of the baseline functionality. It enables external interfacing in a variety of common formats like CCSDS and common messaging mechanisms like GMSEC.

The Meridian software has been developed for single- and multi-spacecraft operations and can scale to fly thousands of operational spacecraft. It is built using modern technologies such as the MEAN stack, so while it is deployed on secure standalone networks today, it can be used tomorrow to predict coverage times from a mobile device or run launch window analyses on cloud architectures. These technologies make automation easier; an operator can specify each input to generate a set of output products — or review automated processes for anomalies and jump in where needed.

### A Streamlined Operator Interface

There is an inherent risk in operations with using new technology. To mitigate that risk, Meridian is built on the proven and powerful astrodynamics engine within **FreeFlyer®**, a COTS software with decades of use supporting hundreds of operational spacecraft.

Its algorithms have been verified and validated time and time again, as it's used in current operations for the GPS fleet and the *International Space Station* (ISS) as well as future missions, such as the *James Webb Space Telescope (JWST)*.

Further reducing risk is a world-class technical support team of orbital mechanic experts who are available to help build solutions for critical needs. With FreeFlyer being used at more than 35 universities across the world, companies and organizations can hire the next generation of engineers with skills already in place to ensure mission success.

There are new countries, companies, and agencies entering the space industry each day, with more spacecraft being launched and larger constellations on the horizon. These entrants come with a need for shorter schedules and costs that don't balloon out of control as the number of spacecraft increase.

The USAF is transitioning to EGS for these same reasons, while providing enhanced resiliency and allowing for increased automation so airmen can spend their time on mission effects and not routine product generation.

That's not an incremental change — that's a leap forward and is possible with software like Meridian and is certainly indicative of what's to come with a common ground system.

To learn more about a.i. solutions and its software, visit [ai-solutions.com](http://ai-solutions.com) or stop by **booth #528** at the **35th Space Symposium** in Colorado Springs, Colorado, U.S.A., April 6 to 8, 2019.

*Andrew Werner is the Director for Space Products at a.i. solutions, which includes the development and support for Meridian, FreeFlyer, and other astrodynamics software. He holds a MS in Systems Engineering from the George Washington University and has managed contracts across civil, commercial, military, and international customers.*



# ARE MISSION CRITICAL COMMUNICATIONS...

...stuck in 1912?

By Anatoli Levine, Director, Products and Standards, Softil



**The time has arrived for public authorities and first responders to use 21st century technology to work smarter and better.**

The ability to instantaneously talk to a group of people is essential for those involved in emergency communications. A police officer must be able to inform his or her partners regarding the actions of a suspect being chased for apprehension.

The fire fighter needs to be able to warn the entire brigade about dangerous conditions being experienced within a burning structure.

The miner has to advise a crew about suspicious gas infiltrating the area.

The truck driver should be able to warn all other drivers in any given area about traffic delays.

The need to instantly talk to groups is crucial for many occupations, including airport dispatchers and technicians, railroad engineers and mechanics, to name but a few.

The technology used today for group communications has its roots in an invention of 1912 — the two-way radio. Whatever the underlying technology — UHF, VHF, DMR or even P25 or Tetra — all the user needs to do is push the PTT (*Push-To-Talk*) button to speak with an associated group.

When it comes to two-way radios, voice is really “it,” even though the modern *Digital Mobile Radios* (DMR, P25, Tetra) can offer some additional capabilities, but it is still all about the voice. Additionally, with traditional radios, communication is done in silos — a team’s boundaries cannot be crossed, even if there is a

need to do so. Firefighters can’t talk directly to the police in situations where joint coordination is a critical necessity.

At the same time, any consumer, anywhere in the world, armed with a smartphone, can go far beyond just voice communications. Pictures, videos, location and chat can be shared in an instant as well as a multitude of data which any smartphone is able to collect about a user.

When **3GPP** started work on the next generation of technologies for mobile networks and introduced the term “**5G**,” this international standardization organization set out to address the technical disparities.





before entering a great impact and it is much needed now — not yesterday. The time has come to move forward and leave the 1912 communications technology behind as an historical note.

[www.softil.com](http://www.softil.com)

Anatoli Levine is Director of Products and Standards for Softil, Ltd., responsible for developing strategy and product roadmap for the Softil's portfolio of enabling products for developers, including technologies such as Mission Critical Communications (MCC) over LTE and 5G, WebRTC, VoLTE/VLTE/RCS, SIP, IMS and many others. Mr. Levine actively participates in the development of open international communication standards at industry bodies such as 3GPP, ETSI, IETF and other SDOs.

From 2006 until 2017, Mr. Levine served as a President of International Multimedia Telecommunications Consortium (IMTC) – an industry organization facilitating interoperability of multimedia communication products and technologies. After merger with MEF in 2017, Mr. Levine became an Associate Director on the Board of MEF Forum. Currently, Mr. Levine also serves on Executive Advisory Council at Public Safety Technology Alliance (PSTA).

Softil is an enabler for more than 800 corporations across the globe. The company's technological achievements include the pioneering of Voice and Video over IP, with a wide range of embedded technologies and testing solutions, combining our unique expertise in standards-based signaling, multimedia and IMS.

Softil's award-winning suite of Protocol Stacks, including IMS, Diameter, SIP and H.323, as well as its state-of-the-art BEEHD client framework, provide the core technology behind the rich media applications and products of today's Enterprise, IMS/VoLTE, and Mission Critical communications industry and greatly simplifies their development by ensuring earliest time-to-market.

The new technology, called *Mission Critical Communications* (MCC) became the cornerstone of future mobile networks, along with advanced network design, enhanced broadband and massive *Machine-to-Machine* (M2M) communications that are the backdrop of the *Internet of Things* (IoT).

The work on MCC started with 3GPP Release 13, when *Mission Critical Push-to-Talk* (MCPTT) was introduced. In Release 14, *Mission Critical Video* (MCVideo) and *Mission Critical Data* (MCData) were added. The Release 15 extended technology to the areas of interconnecting between different mission critical systems and interworking with traditional *Land Mobile Radio* (LMR) systems.

From the point of view of architecture, Mission Critical Communications are implemented as an application service using the concept of *IMS Application Server* (IMS AS) which, in the case of MCC, is known as *Mission Critical System* (MC System). The MC System consists of several individual service elements (servers) for group management, configuration management, security and encryption management, as well as MCPTT, MCVideo, MCData and others.

As MCC technology was designed to be a part of a mobile network, the network itself provides essential services such as priority, preemption and the quality of service needed to ensure that MCC will be always fully available to MCC service users.

Think of the implications of mass deployment of new MCC technology for users in various verticals. When it comes to public safety, think about police officers being able to receive videos from an accident location before their arrival on the scene and being able to share the video with fellow officers once the investigations are started. Think about a dispatch center being able to easily redirect the video from the 911 caller to the responding officer, or an officer being able to obtain video from surveillance cameras in real time. Think of a firefighter who can instantly receive a floor plan outline of an incident location

“officer down” and propagate this information as needed without any human intervention. Perhaps most importantly — the police, firefighters and emergency medical personnel can communicate with each other using all of the advanced MCC capabilities — with a push of a button — no more silos.

In transportation, a truck driver should be able in real time to map the position of other trucks and can address all of the other drivers within a given radius by voice or share a video with them. If needed, the same MCC application can be used to obtain remote assistance from a mechanic or a technician to fix a problem that would otherwise require a long wait for assistance.

In mining, communications are a crucial element to ensure worker safety. The ability to add a picture of a crack in a mined tunnel to a verbal description could become a life-saving advantage. Adding reliable communication and control of a robot using the same MCC device and network makes everyone's job far easier. Again, adding information from all the different sensors (gas, vibration, radiation) to the communication stream of any miner is truly a game changer.

Offering mission critical communications as the service of the core mobile network, properly designed from the ground up to take advantage of all the features the enhanced network offers, is a giant step forward and will lead to all involved in mass communications to work smarter and better.

While MCC over LTE and 5G is still in its infancy, there is no doubt that the technology will have a



# A NEW CHAPTER IN...

## Government procurement of satellite solutions

By Skot Butler, President, Intelsat General

**At the end of 2018, division chief Clare Grason and her entire satellite communications team at the Defense Information Systems Agency moved over to work in the same capacity under General John ("Jay") Raymond at the U.S. Air Force Space Command (AFSPC).**

As she said of the transfer in November of last year at SMI's *Global MilSatCom* conference in London, "We're ready to start a new chapter."

The change has been a long time coming. We industry veterans here at Intelsat General and our colleagues at other commercial satellite providers have been pushing for reform for the past decade.

This move is not simply a shuffling of the deck chairs. Rather, it is an important step toward a future wideband SATCOM architecture that defines a clear role for COMSATCOM.

Several Air Force leaders, including General John Hyten and General Jay Raymond, have long been advocates for the U.S. Government (USG) solidifying the COMSATCOM role in the Department of Defense (DoD) space mission and taking full advantage of commercial capability.

General Raymond, in particular, was instrumental in supporting the decision to shift commercial satellite services procurement from the Defense Information Systems Agency (DISA) to the U.S. Air Force, which is also responsible for the nation's military satellite constellations.

As Grason said at *Global MilSatCom*, she now wants "to elevate commercial satcom to where it needs to be, as vital infrastructure."

We were also pleased to hear Grason say that once her group is part of AFSPC, she will change their procurement practice of primarily using "lowest price technically acceptable" (LPTA) evaluation criteria.

As she said at the conference, "Over the next year we have an initiative to compete our contracts on a best value tradeoff basis while we develop a more comprehensive acquisition strategy for buying and using satcom differently."

We have long argued that LPTA contracting does not provide the end user — often a warfighter — with the best satellite solutions. Quite the opposite: it often rewards bad behavior.

I think both taxpayers and our lawmakers would be stunned to know that companies would bid on a DoD LPTA contract with a premeditated plan to change the technical solution after award — as we saw in a recent COMSATCOM acquisition.

Ask yourself: *Why would they need to change the technical solution before it was even implemented?*



Artistic rendition of the Intelsat Horizon-3e satellite.

While this may or may not violate federal rules, it is clearly not the intended use of LPTA — which is meant for use in purchasing commodities that are identical regardless of supplier.

After years of industry input that at times seemed to fall on deaf ears, we are excited to see significant change in how the U.S. military will be using commercial satellite services.

The changes could not come at a better time for Intelsat General, as we complete the final piece of our **Intelsat Epic<sup>NG</sup>** high-throughput satellite constellation.

The **Horizons 3e** satellite, launched in September of 2018, has entered service with coverage over East Asia and the Pacific.

With H-3, military and other government users will have access to a seamless global fabric of high-throughput spot beams overlaid with Intelsat's constellation of widebeam satellites, providing coverage of operations around the world.

The global Epic coverage is the underpinning of our fully managed **FlexAir** service, providing a variety of mobile communications solutions for the military's manned and unmanned aircraft operations.

FlexAir takes advantage of the high data rates provided by the Intelsat Epic<sup>NG</sup> constellation, giving users up to 10 times the data throughput of other managed networks.

FlexAir is a perfect example of how the COMSATCOM marketplace responds to the needs of the USG and DoD user.

With an integrated COMSATCOM—MILSATCOM architecture, there is so much we can do.

From unique coverage and resilient hosted capacity, from beam forming to fully software-defined satellites even mission specific busses, the DoD's change in how it acquires and uses COMSATCOM has the potential to be a game changer for both government and industry.

[intelsatgeneral.com](http://intelsatgeneral.com)

[www.afspc.af.mil](http://www.afspc.af.mil)

The preceding article is courtesy of Intelsat General's SatCom Frontier infosite and editorial team.



Skot Butler is responsible for managing an integrated sales, marketing and business development organization which serves all of Intelsat General's customers, including the U.S. Department of Defense, NATO, various civil agencies and commercial enterprises within the United States and Europe.

Mr. Butler brings to the position two decades of experience in the commercial satellite communications and telecom industries. He joined IGC in 2006 as Director of Hosted Payload Business Development and was most recently Director of Solutions Development. Preceding IGC, Mr. Butler held sales, business development and strategy roles at satellite services companies DRS, Spacelink and Verestar.

### About FlexAir

The company launched FlexAir in December of last year and offers a managed, end-to-end service that provides in-flight broadband connectivity to a wide range of military aircraft to support en route communications and intelligence, surveillance, and reconnaissance (ISR) applications.

FlexAir's broadband service uses Intelsat's global Ku-band satellite fleet and integrates layers of High-Throughput Satellite (HTS) coverage from the company's Intelsat Epic<sup>NG</sup> fleet — these wide-beam satellites deliver the added redundancy and security needed for the most critical missions. FlexAir also offers committed capacity for ISR applications, such as sensor data, video transmission, and communications relay to deliver immediate access at 3 Mbps from the aircraft with optional scalability to 6 Mbps.

FlexAir answers the call and delivers the performance and agility that government aviation requires. With the multi-layered coverage of FlexAir, government customers can ensure that each aircraft has global access and guaranteed availability whenever or wherever it is needed. The scalability, throughput and improved economies of scale provided by FlexAir enable government users to quickly address changing broadband demands while providing maximum mobility in the most cost-effective manner.

### Guaranteed Availability

FlexAir aggregates Intelsat's high-performing space segment with the IntelsatOne ground infrastructure into a simplified and streamlined ecosystem. It is anchored on industry-leading technology and utilizes the redundancy created from a fabric of overlapping beams. As a result, government users are assured coverage and connectivity for any operation, conducted in any area of the world, without interruption.

### Ensures High Data Rate Transmissions

Intelsat uses Ku-band, wide beams, spot beams, and frequency reuse technology to provide a host of customer benefits. Intelsat Epic<sup>NG</sup> can deliver up to 15x more throughput per satellite, ensuring high quality connectivity.

Multiple Intelsat Epic<sup>NG</sup> spot beams enable a high concentration of power on smaller areas, improving efficiency and the aggregate amount of capacity available. With the bigger channel size of bandwidth going into each Intelsat Epic<sup>NG</sup> beam, government organizations benefit from as much as 10x the capacity of competitive offerings, ensuring that they can support 10x as many users without impacting performance. In addition, FlexAir is designed to be compatible with a wide range of fuselage and tail-mounted antennas, maximizing the performance of carriers for the various end-user antennas.

### Redundancy and Security

FlexAir leverages the security enhancements of Intelsat Epic<sup>NG</sup>'s advanced digital payload. The design of the digital payload enables the user to quickly identify when someone is trying to jam a signal and then quickly switch to a different beam, mitigating any impact from the interference attempt. FlexAir provides additional security as only designated beams with frequency bands carrying authorized signals that are cross-connected and as a result, any interfering signals are muted, analyzed, and mitigated.

### Flexible Service Plans

According to the company, the FlexAir service provides the most competitive offering in the marketplace, delivering the highest data rates at the lowest cost per bit. The service also enables government users to select among several service offerings, allowing them to choose the right plan based on their data rate and geographic needs without having to make an upfront commitment.

With multi-layered, seamless, and consistent coverage, government users have the agility to optimize their service, provide a predictable cost structure that meets budget requirements, and deliver real value to Warfighters.

The FlexAir Resource Center:

[pages.intelsat.com/FlexAir-Resource-Center-LP.html](http://pages.intelsat.com/FlexAir-Resource-Center-LP.html)

# THE CRUCIAL NEED FOR MOBILE HEALTH



## The case for a global telemedicine vehicle network

By Drew Klein, Director of International Business Development, C-COM Satellite Systems

**Nearly 50 percent of the world's population<sup>1</sup> have no access to basic health services. The vast majority of this population live outside cities, in peri-urban areas<sup>2</sup>, where few hospitals exist.**

Geographical areas with limited to no healthcare accessibility regions are called 'medical deserts'<sup>3</sup> and they continue to expand as people move out of rural regions and into cities.

Medical deserts can be found in both developed and developing countries alike. In the United States, approximately 30 million people live more than 30 miles from a hospital<sup>4</sup> that provides emergency care. In Niger, more than 60 percent of the population<sup>5</sup> (10 million people) live further than a one hour walk to a basic healthcare center.

While Africa is urbanizing, approximately 63 percent<sup>6</sup> of the total Sub-Saharan population still live in rural areas. Even France, often lauded as a prized model<sup>7</sup> for national healthcare, has struggled with a steady decline<sup>8</sup> in rural doctors, notably general practitioners.

Both the CDC<sup>9</sup> and the NIH<sup>10</sup> have confirmed that a direct correlation exists between distance to hospitals and an increased risk of preventable

death. In India, for example, it was estimated that 50,000<sup>11</sup> deaths (out of 72,000) from sudden abdominal conditions in 2010 could have been averted with better medical access. Those who lived more than 100 km. from a hospital were at the highest risk.

A 2016 study showed that only 1 in 8 high income countries<sup>12</sup> had developed a national policy on hospitals in rural or remote areas. Rural healthcare facilities have historically been a poor investment and their sustainability is concerning. Even in the US, 83 rural hospitals<sup>13</sup> have closed since 2010 with another 673 vulnerable to shut down. The problem isn't likely to improve so long as the cost of building hospitals in rural areas remains prohibitive.

According to one Harvard study<sup>14</sup>, for every \$1 spent on mobile healthcare, there is a return of \$36 to the healthcare budget. Mobile surgical vehicles, mobile MRI/CAT/Mammography/Ultrasound clinics, mobile maternity, mobile primary health care (Medical/Dental/Vision), and many other types of telemedicine vehicles can be strategically circulated throughout the world's medical deserts, bringing healthcare to billions of people.

While healthcare costs vary dramatically from country to country, a sad reality is that it will never be economically feasible to build hospitals or health care facilities in all the world's medical deserts. Providing mobile clinics to people who live in hospital deserts is both cost effective and efficient.

### Recommendation

Identify the world's medical deserts and create a Global Telemedicine Vehicle Network. Build and deploy 216,000 telemedicine vehicles for the delivery of basic and specific health services to rural and peri-urban populations.

### Analysis and Case Study

Telemedicine, defined as the remote diagnosis and treatment of patients via telecommunications, has traditionally been encompassed by three modalities<sup>15</sup>:

- Real-time Diagnosis (RTD)
- Store & Forward Analysis (SFA)
- Remote Patient Monitoring (RPM)



For this article, the focus will be on RTD and SFA as they relate to accessibility and cost per patient. Innovations in medical technology, vehicle design, and mobile satellite Internet now have the potential to bring any clinic to any patient. State-of-the-art facilities on wheels, combined with Broadband connectivity, can connect the rural patient to urban hospitals via satellite. Doctors, specialists and patients can now be instantly linked, to provide consultation, diagnosis and treatment.

### Nigeria Bayelsa Hospital Telemedicine Vehicle

This is Africa's first *Mobile Maternity Unit (MMU)* equipped with satellite communications, deployed in Nigeria by **Bayelsa Hospital**. The mobile clinics are focused on serving pre-natal women, but they are geared to assist throughout the entire maternity process.



The MMU is designed, integrated and maintained by **MST Specialized Vehicles (MSTSV)**, Cape Town, South Africa. MSTSV's focus is to provide comprehensive solutions delivering healthcare, education and administrative services to members of the public. Visit their website at <https://www.mstsv.net/>.

### Project Overview

Bayelsa is one of 36 Nigerian States and is located at the southern tip of the country and home to more than 2.2 million people.

It is the least populated region in the country but ranked 27th in geographical area. The state lies on major oil & gas deposits, and yet despite being one of the richest states in Nigeria (GDP per capita), most locals still live in rural poverty.

The initial plan was to build 2 MMU for Bayelsa State in conjunction with Bayelsa hospital. The MMU is to be fully staffed with professional doctors, nurses, midwives and volunteers who can perform pregnancy testing, immunizations, basic checkups, HIV testing, and ultrasound scans.



The vehicles would contain first class medical equipment including sonar, ultrasounds, fetal heart rate monitors and could assist during live births, newborn incubation, vital monitoring, and much more. Specialists in urban hospitals would assist patients, if needed, via satellite, and provide real time diagnosis and test results.

The long-term project was to expand to 72 total vehicles (two per Nigerian State) and see more than 1,000,000 peri-urban women per year, with the goal of drastically reducing maternal and infant mortality rates, while keeping the cost per patient low.

The project, in conjunction with the Bayelsa government, would be funded by local oil companies as a social investment in return for their license agreements. In this case, the oil companies procure the vehicles and pay maintenance costs for the first three years. The government, universities and hospitals staff the vehicle and pay for the medical consumables.

### Costs of the MMU

The cost of a delivered MMU is approximately \$500,000.

Monthly maintenance costs (staffing, medical supplies, satellite bandwidth, fuel and repairs) are estimated at \$30,000 / month.

Henceforth, the cost to purchase, operate and maintain one vehicle for three years is estimated at \$1,600,000.

Assuming 10 hour shifts, an average of 50 pre- and post-natal women can be seen per day per MMU throughout the Bayelsa State's peri-urban and rural areas.

Assuming the vehicle is on the road for 300 days per year, that would equate to 15,000 patient visits per year (45,000 over a three year period). Based on the above assumptions, a total of 72 vehicles would be able to see and treat more than 1,000,000 women per year.

The cost to build and maintain these 72 vehicles for three years would be \$115,000,000, at an approximate cost of just \$35 per patient per year

For comparative purposes, The 2018 proposed Nigerian government budget currently allocates over \$940 million<sup>16</sup> to the Federal Ministry of Health.

### Market Analysis Comparative Costs

One reason why mobile telemedicine clinics are so attractive is because the costs to develop are a fraction of what they are to create a dedicated brick and mortar facility. Hospital building is an extraordinarily expensive endeavor; acquisition of land, construction costs, equipment and staffing can create a range in price from millions to hundreds of millions of dollars. An increased number of hospital closings<sup>17</sup> has been seen in recent years.

**Cost per Bed (CpB)** is a generally accepted way to estimate hospital build, and this number can be very different depending on many factors.

Some statistics:

- **Canada, Oakville-Trafalgar Hospital<sup>18</sup>** (Urban), 457 beds = \$2.7Billion (CpB = \$5,908,986)
- **USA, Hampton Regional Medical Center<sup>19</sup>** (Rural), 32 beds = \$32.1 Million (CpB = \$1,000,000)
- **UK, Cramlington Hospital<sup>20</sup>**, 210 beds = \$134 Million (CpB = \$638,095)
- **Pakistan, Bilqees Sarwar Hospital<sup>21</sup>**, 50 dialysis chairs = \$9 Million (CpB = \$180,000)
- **India, Mysore Surgical Hospital<sup>22</sup>**, 200 beds = \$6 Million (CpB = \$30,000)
- **Nigeria, Bauchi Hospital<sup>23</sup>**, 300 beds = \$7 Million (CpB = \$23,333)

It's clear that there are significant variations to the cost of hospital and clinic building, depending on the country and quality of build. What is more evident is building a low-cost clinic in a rural area in a developing country is still a FAR more expensive endeavor than using mobile clinics. Telemedicine vehicles can see more patients, at a lower cost, in areas where no formal healthcare exists.

### Market Size

Assuming a schedule of 300 days per year, and estimating that one telemedicine vehicle can see, on average, 50 patients per day, it will require 216,000 operational vehicles to reach the three billion people worldwide who have no access to medical care.

Assuming the cost of \$1,600,000 per vehicle and three year maintenance/support costs, the price tag to build and operate a fleet of such vehicles would be approximately \$345 billion per three year period (average of \$115 billion per year).

To place those costs into perspective, according to a 2016 study, global governments spent approximately \$8 trillion dollars on healthcare in 2017. Creating a global telemedicine network would consume only 1.5 percent of global healthcare dollars per year.

## Other Examples of Telemedicine

### *The Transnet-Phelophepa Health Care Train, South Africa*



The Transnet-Phelophepa Health Care Train is a mobile clinic bringing medical care to rural South Africa. Phelophepa has 18 coaches and is equipped to provide general health, dental, eye and psychiatric care, as well as cancer screening tests, diabetes prevention and counseling sessions.

Operating since 1994, Roche is the largest financial contributor and Saab Grintek Technologies (SGT) is the provider of the satellite services. "SGT, with its technology partner C-COM, provide the technology to allow health professionals to have access to state of the art data communication for medical purposes instantly," says Suraj Ramlall –General Manager at Saab Grintek Technologies. "SGT ensures the 'Train of Hope' is always connected."

### *Mobile Diagnostic Center, Russia*



The main customer of satellite equipment for telemedicine complexes is the Federal State Unitary Enterprise "All-Russian Center for Emergency Medicine Protection" under the Ministry of Health of the Russian Federation. The first application of emergency medical response complexes in the aftermath of floods has already

showed the main advantages of using satellite technologies in emergency situations: rapid deployment and high quality of communication, providing unlimited remote diagnostics capabilities.

Currently, the customer already has a fleet of 14 mobile systems, equipped with the iNetVuDrive-Away Antennas, which are used in almost all regions of the country.

### *Missouri Hospital Association, USA*



Orbital Data Net (ODN, Inc) is a VSAT network supplier that supports critical communications for States and agencies across America. More than 20 of these ODN built medical units can be found in Missouri as well as several smaller units in Louisiana providing emergency services to the major hospitals. ODN is the provider of satellite services utilizing their novel satellite network.

Greg Heifner, founder and CEO of ODN said, "We have worked with the iNetVu satellite antenna systems for over a decade. We have found them to be a superior product from the aspects of performance, cost of acquisition and technical support. Our Transparently Meshed Ku-band network requires a high performance antenna system to properly maintain a lowered latency, encrypted life saving link from the remote trailers back to the hospitals."

### *New Zealand Health Services, New Zealand*



Eight Digital Mobile Breast Cancer Screening Clinics moved around the rural areas of New Zealand, and sent mammography scans back to specialists at Auckland hospital, via satellite, providing immediate results to patients.

### *Loma Linda University Medical Center, USA*



Mobile Surgical Vehicle, USA. Loma Linda University Medical Center (LLUMC) provides a self-contained, four-wheel-drive vehicle with sophisticated diagnostic equipment and connected to LLUMC via satellite for teleconferencing.

### *Emotion Health, Peru—Mobile Primary Health Care Clinics, Spain*



Used in Peru, these units educate and assist rural Peruvians in the early detection of prostate and breast cancers. The telemedicine vehicles make it possible to do specialized tests in remote areas, where doctors can receive and analyze results immediately, via satellite, and return a diagnosis on the same day.

### *CPHC, Canada Mobile Primary Health Care in Eastern Ontario, Canada*



## Why C-COM?

In many parts of the world, often in the same places where healthcare is limited, there exists no suitable communications infrastructure, which can be vital to the health of a compromised patient. Even without satellite connectivity, a mobile health clinic still offers tremendous value, providing basic medical services in locations that have limited access. However, when a satellite connection is added to the vehicle, the mobile medical clinic becomes especially more valuable, offering immediate access to specialists, doctors, test results, and more. The satellite component often represents less than 5 percent of the total build cost of a mobile clinic.

C-COM auto-pointing **iNetVu**® brand antennas are considered the most reliable and advanced mobile systems in the world. With the company's one-button, auto-acquire technology, users can simply push a button on the iNetVu® controller, and it will find satellite in under two minutes, providing high-speed Internet connectivity to your vehicle or surrounding area, all without the requirement of a satellite engineer.

Patients in rural locations can bridge the gap between them and a first-rate hospital, connecting with specialists that are only available in major cities. MRI, CAT, Mammography, X-ray, and other massively detailed files of significant size can be transferred effortlessly, securely, and rapidly, via satellite, to specialists hundreds of miles away, who can offer quick analysis, and provide medical advice, through video conference.

C-COM has designed, manufactured, and sold more than 8,000 antenna units into more than 100 countries. The Company sells its motorized, iNetVu® auto-deploy systems through a network of more than 500 partners, who also provide service and support to the local end user. C-COM employs 30 people, is publicly traded on the Canadian Venture Exchange, and has a strong balance sheet.

The company is also developing the next generation of mobile antennas: flat panel, electronically steerable, modular, conforming, and working while in motion, with the latest satellite constellations, in various orbits. This will be of significant value to future ambulances and telemedicine vehicles, offering a low cost and high-speed solution that can be used while the vehicles are in motion.

With bandwidth prices falling, and with companies such as C-COM developing smaller and more affordable solutions that offer broadband capabilities, it makes sense to equip all moving vehicles with solutions that afford connectivity anywhere, anytime.

For more than 20 years, C-COM has offered products which are extremely consistent, both in terms of quality and manufacturing repeatability. The iNetVu® line of products are easily field serviceable, often able to be fixed in minutes with just a few tools. The company also offers world class technical support, working with its partners to ensure an end-to-end solution that provides the final customer with a seamless Broadband experience.

## Achievable Global Telemedicine

*"The need for an effective and robust global telemedicine network is not only desirable but it's highly achievable,"* said David Hartshorn, CEO at **Geeks Without Frontiers**, a non-profit organization dedicated to leveraging technology and social enterprise to provide broadband for the next billion ("B4B"). He added, *"We have the know-how, we have the funds, we have the critical communications and technology –we just need the will."*

The potential to build tens, even hundreds of thousands of mobile health clinics is quite real. In 2018, more than three billion people have no access to medical care, and with 46 percent of the world living in rural areas, there exists a significant opportunity in the growing mobile health market. Hospitals continue to close and the expense to build and maintain them isn't sufficient to serve the needs of the global community.

The humanitarian and economic evidence is clear. It should be evident: a telemedicine vehicle cannot replace a hospital. A telemedicine vehicle is intended as a substitute for a fully functional, brick and mortar clinic, able to bring first-rate medical care to the rural public.

A suitably equipped telemedicine vehicle can finally connect a patient with a specialist that they would never have a chance to see, either because of distance to a high-quality hospital, or because of their urgent health status.

A simple vaccine, antibiotic, or routine checkup is often all that is needed to change a life. A Global Telemedicine Vehicle Network is the most cost effective and efficient way to solve this problem.

[www.c-comsat.com](http://www.c-comsat.com)

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# REALISTIC MISSION MODELING

## Underpinning the technological advantage in a complex space threat environment

By Mike Wasson, Senior Director for Department of Defense, Space Operations Business Development, Analytical Graphics, Inc. (AGI)



**Those of us who are well-connected within the space community hear the continuous drum beat of adversaries improving their organic space capabilities, closing the gap of the United States' competitive advantage in the domain.**

Social media is replete with examples, blogs, posts, articles, and commentary regarding the rapid advance of space technologies and the lowering cost of access to space.

### What's to be Done?

For the last 30 years, the vast majority of space professionals have focused on problems unique to their specific task, specific platform, or specific mission with little regard to the interaction between platforms or missions within the domain, nor has there been enough advanced thought in a multi-domain (i.e., space, air, cyber, land, sea, etc.) environment. In this rapidly paced dynamic environment, developing warfighter expertise has never been more critical; current operations environments cannot support a culture of trial and error with the limited number of very expensive on-orbit assets.

A realistic, simulation capability for space missions is necessary today to meet this emerging threat.

As is similar in other domains, space weapons system expertise can and should be developed via sophisticated simulation capabilities: a phased approach from understanding basic Keplerian motion in Earth orbit to mission-specific tasks.

Simulation is essential for efficient job performance and to develop progressive tactics, techniques, and procedures in an environment that allows for failure and where operators can experiment without retribution.

Intuitive tools, especially in three dimensions, help current generation operators quickly grasp the interaction between objects and take away the guess work when using "flat" presentation software or hand-held models.

A derivative benefit from the 3D visualization is the ease of describing both real and projected space object interaction to decision makers.

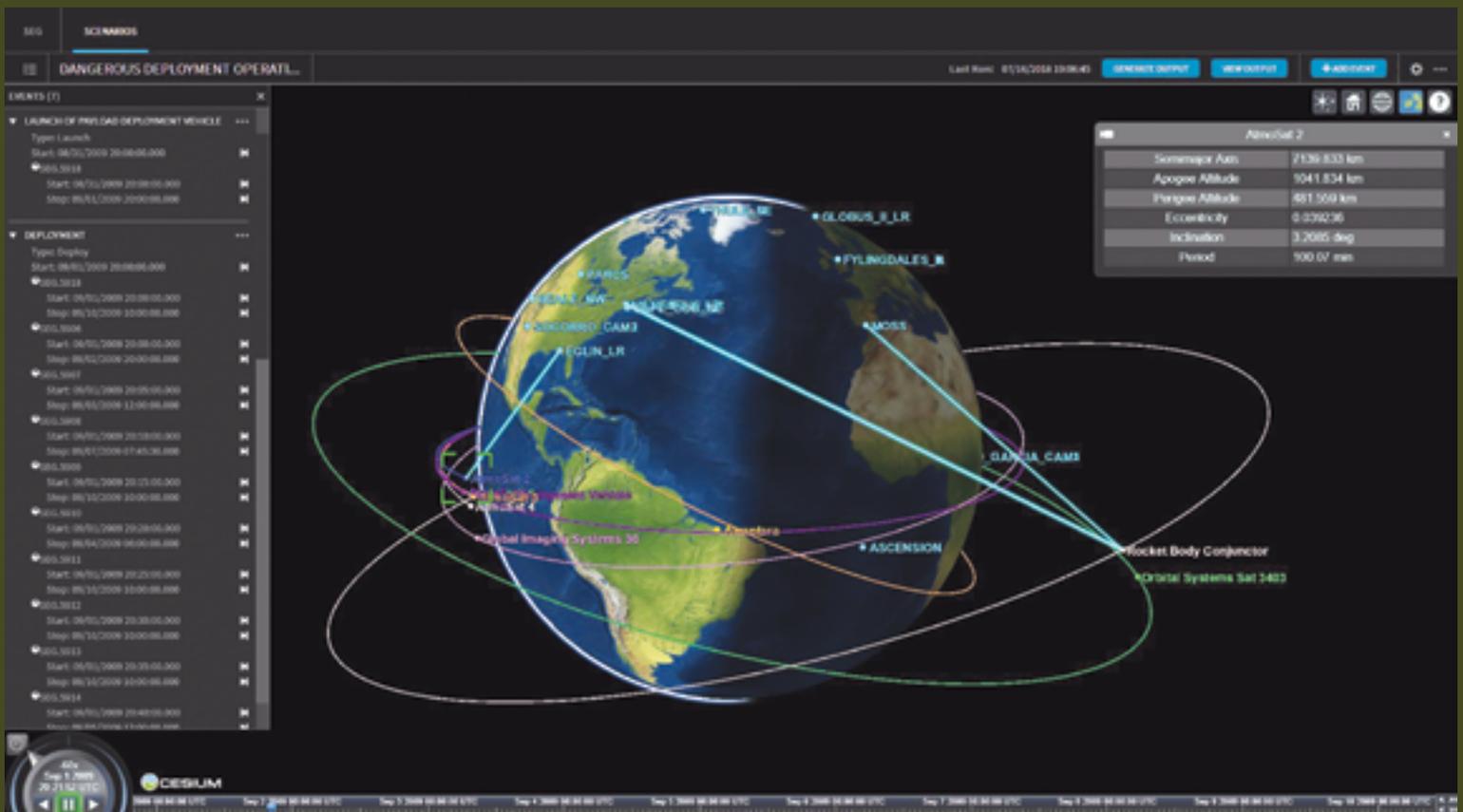
It's been an interesting... and accelerating... evolution of the complex space environment. Space threats are traditionally discussed as a concept in some comfortable future reality and in presentations of finite individual capabilities. However, the reality is that our single threat, single target mentality, leaves us unprepared for the realities we're experiencing today.

### How do we prepare for this emerging complex and dynamic system of systems environment?

First and foremost is solidifying operational knowledge of our own systems. Reinvigorating expert knowledge of our satellite systems, subsystems, components, and features is the foundation we stand on when conceiving of threats to those systems.

Cursory knowledge and routinely following checklists does not prepare us to expect the unexpected or to be innovative in times of crisis.

The good news is our senior thought leaders across government, civil and commercial



Modeling complex events allows operators to train with realistic conditions. Image courtesy of AGI's Space Event Generator.

communities have reinvigorated this weapon system expertise approach, hearkening back 30+ years ago to the early days of satellite operations.

Next, detecting threats as early as possible preserves the widest possible array of response options. A human-in-the-loop may be necessary for the foreseeable future, but leveraging machine-to-machine automation and artificial intelligence to model system behaviors can help extract clues from seemingly otherwise disparate data sources.

Stitching together likely tips and cues to alert a control center of a pending risk to operations is critical. This can be achieved by exposing many and diverse data sources to a central node where the data can be processed and analyzed in near real time with tailorable mechanisms in place to alert different control center audiences of those indicators that are most relevant to their specialties.

Quickly communicating threat warning and response actions across operations centers and up to senior management levels ensures the correct-sized action is selected to counter the threat. Facilitating this rapid response is aided by working from a common set of tools that interact efficiently in a machine-to-machine fashion.

Common tools in a common framework, especially if that framework reaches through and between classification levels allows data exchange and collaboration in effective ways. Linking diverse networks at geographically separated locations is necessary so decisions are supported at the speed of need.

A sophisticated space training capability has never been needed more than in today's complex threat environment. Most delivered space systems do come with detailed vendor software that are platform specific and highly technical. The problem is our organizational space culture emphasizes short learning timelines, rapid movement between functional specialties, and an up-or-out mentality. Compound this with our current culture phenomenon of continuous partial attention and we have a real and compelling challenge to overcome.

Current U.S. **Air Force Space Command** initiatives are attacking this lack of weapons' system expertise in earnest. Individual unit training has transformed over the last five years with the **Space Mission Force** concept to cycle the most experience operators back into the operational crew force.

Multi-unit Advanced Training "sprints" emphasize and leverage critical thinking in the domain and enable synchronization of response efforts. Nascent or untested response options continue to be evaluated via a robust series of experiments, exercises and war-games. Most recently, the advent of advanced, multi-mission, multi-unit Space Flag capstone events are introducing collaboration and improving our response readiness in both predictable and unpredictable ways. We're able to quickly validate or invalidate our domain assumptions and address new, unexpected challenges.

The key to these multiple layers of training is the ability to work with common, consistent, tailorable,

and realistic simulation tools that accurately represent both the finer details of the systems they model and also build in the dynamics of space environment. An added benefit to using these common tools is that it helps establish the "language" used when different units, in different locations, need to share their perspectives of the situation and animate their preferred courses of action in a way that can be coupled with other units' actions.

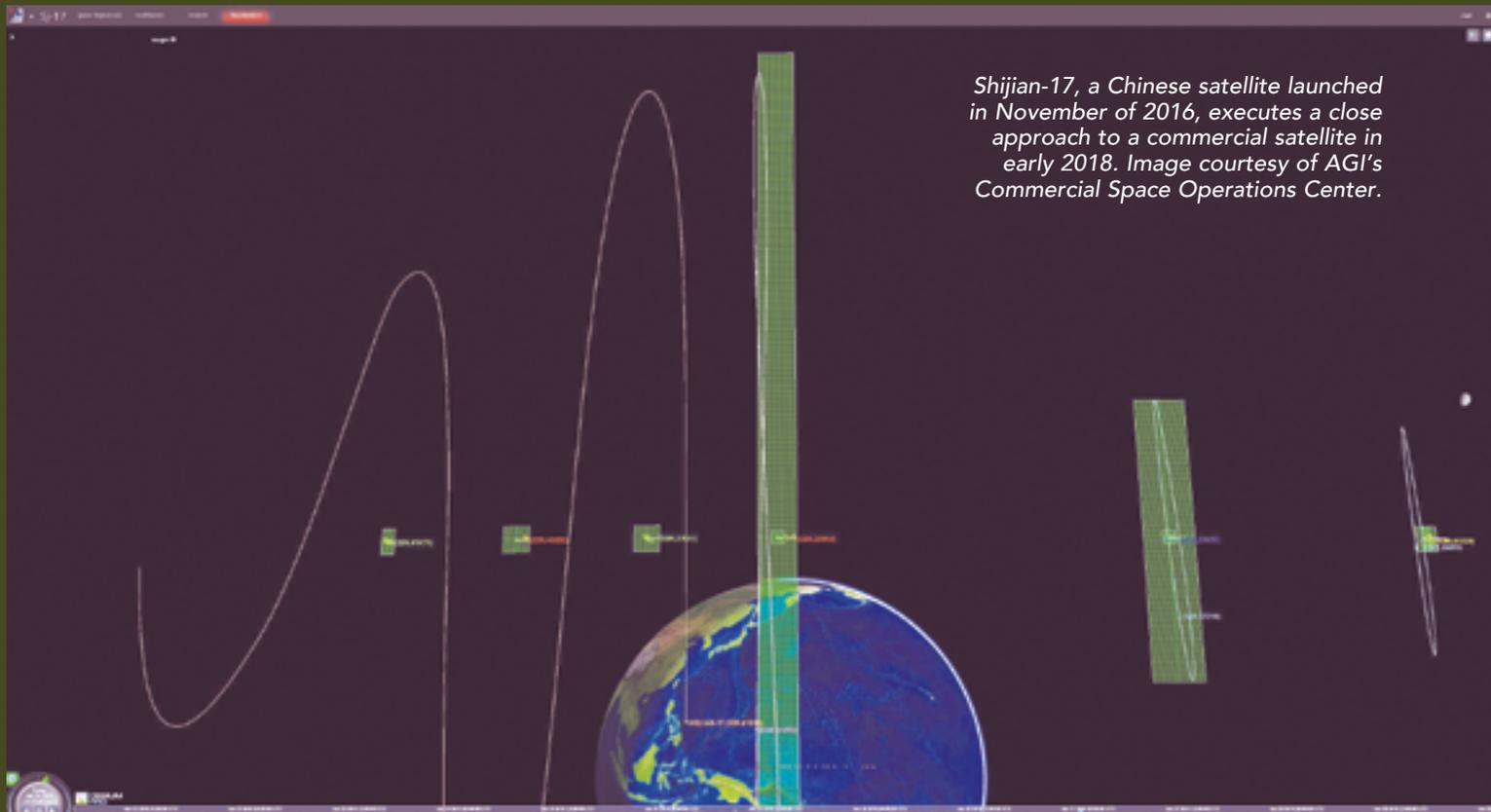
These are exciting times within the space operations community. Rapid advancements in technology, vastly increased numbers of space-faring nations, and a national-level awareness of the importance of space to our way of life, means that our time to leverage information technology to our full advantage is here now.

It's imperative for all us to bring the full force of our capabilities to bear, be transparent, accept critical peer review, and improve and advance the mission area for the generations of space professionals to follow in our footsteps.

[www.agi.com/ss](http://www.agi.com/ss)

*Mike Wasson is AGI's Senior Director for Department of Defense, Space Operations business development with over 30 years of space operations experience in satellite C2, launch range operations, space control and space surveillance within the U.S. Air Force, Civil Service, and commercial sectors.*

*Meet Mike at the 35th Space Symposium in Booth #515.*



*Shijian-17, a Chinese satellite launched in November of 2016, executes a close approach to a commercial satellite in early 2018. Image courtesy of AGI's Commercial Space Operations Center.*





