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MilsatMagazine

INNOVATION² October 2019

This soldier is using the Viasat BATS-D radio. Image is courtesy of Viasat.

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Dispatches:

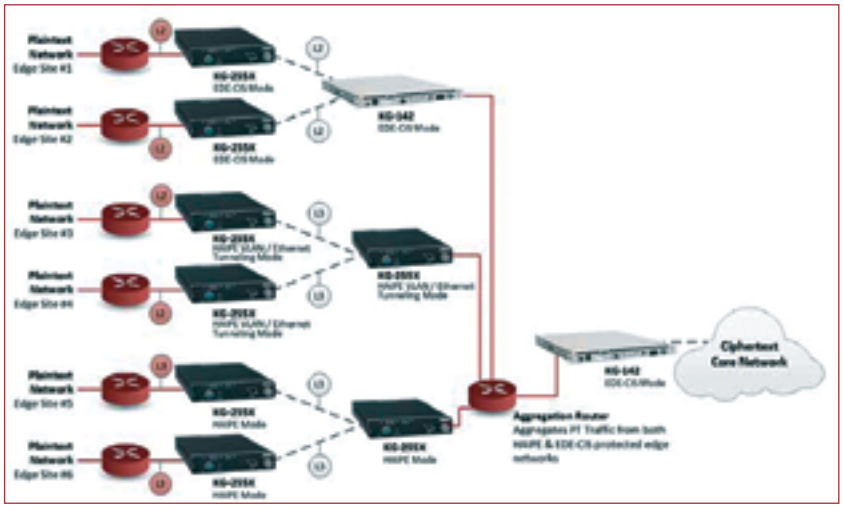
Five Eyes coalition forces select Viasat's network encryption products

Viasat (NASDAQ: VSAT) in London announced at Defence & Security Equipment International — DSEI 2019 — that their expansive line of network encryption products are available for use by all Five Eyes (FVEY) partner nations.

Viasat has more than two decades of experience protecting the integrity of governments' most sensitive information that include the Five Eyes (FVEY) partner nations that are Australia, Canada, New Zealand, United Kingdom and the United States.

Viasat's network encryption products use patented programmable cryptographic technology that is designed to safeguard sensitive information across today's battlespace — from the cloud to the tactical edge.

Viasat is also currently the only U.S. company to support Type 1 encryption for both Layer 2 EDE[1] (Ethernet Data Encryption) and Layer 3 HAIPE® (High Assurance Internet Protocol Encryptor) network protocols.



Ken Peterman, President, Government Systems, Viasat commented that the explosion of connected devices, cloud-centric networks and today's rapidly evolving cyber-threats has put the need for enhanced, interoperable network encryption solutions center stage.

He added that by offering support for different network topologies across our portfolio of encryption products, we are able to help FVEY government and military organizations secure their communications and sensitive data across next-generation network infrastructures and cloud-based systems. Viasat stated that the company has a proven track record of first-to-market products in the information assurance and network encryption market, and cited as an example, Viasat was first to offer a 100-gigabit-per-second Type 1 network encryption device, known to the U.S. Government as the KG-142.

www.viasat.com

[1]Pending certification from the U.S. National Security Agency

Dispatches:

iDirect Government acquires Glowlink

iDirect Government, a wholly owned subsidiary of ST Engineering iDirect, has acquired Glowlink Communications Technologies, Inc., a Mountain View, California, leader in innovative solutions for mitigating satellite interference and improving the quality of satellite communications.

As a result, Glowlink will add intellectual property, engineering personnel and proprietary technologies to iDirect Government's family and product portfolio including Communication Signal Interference Removal (CSIR™) anti-jam technology and associated products, which will benefit defense and government SATCOM customers globally.

iDirect Government's bandwidth-efficient, scalable and highly secure satellite solutions are deployed throughout government and defense agencies worldwide. This enables critical intelligence, surveillance and reconnaissance (ISR), airborne, maritime and communications on the move (COTM) connectivity to support force protection, logistics, situational awareness, disaster recovery and emergency response.

Glowlink is an industry leader in innovative solutions for fighting satellite interference and improving the quality and integrity of satellite communications.

Glowlink's Jeffrey Chu (left) and iDirect Government's John Ratigan shake hands regarding the acquisition.

Products span carrier and spectrum monitoring, interference detection and mitigation, geolocation and satellite capacity planning which will directly complement the iDirect Government product line.

John Ratigan, President of iDirect Government, said adversaries have increasingly sophisticated capabilities to jam transmissions over any satellite or a digitally modulated carrier, and the CSIR signal excision anti-jam solution provides immediate benefits to the company's user community.

John added that the best-in-breed CSIR anti-jam technology does not require additional bandwidth compared to existing technologies. This saves customers costs while helping the military overcome threats. Additionally, the nation's military and government customers now will have the best engineering teams from both companies to accelerate innovation cycles, resulting in a fast time to market with anti-jam technology to support their critical connectivity needs whenever and wherever they may be located.

www.idirectgov.com

www.glowlink.com

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Dispatches:

Environment testing of USAF SMC's WFOV satellite completed by Millennium Space Systems

Boeing [NYSE:BA] subsidiary Millennium Space Systems recently completed environmental testing for the U.S. Air Force's Space and Missile Systems Center (SMC) Wide Field of View (WFOV) satellite at Boeing's Space Environment Test Facility in El Segundo, offering new synergies to the customer.

The geosynchronous satellite will support the next-generation overhead persistent infrared (OPIR) mission and provide critical risk reduction and mission data that will inform Air Force Space Command's next-generation missile warning system.

According to the WFOV program office, SMC is pleased with just how well the thermal vacuum (TVAC) campaign was conducted and the complete access to the test facility. The TVAC campaign went very smoothly and eliminated significant potential program risk.

Testing being completed by Millennium Space Systems on the U.S. Air Force's Space and Missile Systems Center (SMC) Wide Field of View (WFOV) satellite at Boeing's Space Environment Test Facility in El Segundo.

The test teams subjected the satellite to a series of sound tests to simulate liftoff and ascent as well as to extreme temperature swings in the large thermal-vacuum chamber to simulate the space environment. The satellite's systems were also evaluated for potential electromagnetic interference in a highly specialized, noise-free anechoic chamber.

Sponsored by the Space and Missile Systems Center and managed by NASA's Ames Research Center, the mid-sized geosynchronous spacecraft is based on Millennium's AQUILA M8 affordable platform series and hosts a transformational OPIR six-degree staring sensor developed under a separate contract by L3Harris Technologies.

WFOV is manifested on a United Launch Alliance ATLAS V rocket currently targeted for launch in 2021.

Major *Brian Curd*, Chief, OPIR Advanced Payloads and Demonstrations, said that one of the largest hurdles remaining for the WFOV program has now been passed. All primary phases of the environmental test campaign have been completed and all look forward to buttoning up the satellite and getting it on-orbit as soon as possible. It will be a great asset to national defense.

Duane Dier, Millennium's WFOV program manager, added that environmental test completion marks the end of the largest and most comprehensive set of space simulation tests in Millennium Space Systems' 18-year history. These successful tests further demonstrate Millennium's commitment to providing cost-effective and schedule-efficient solutions to the firm's U.S. government customers with flawless execution.

millennium-space.com

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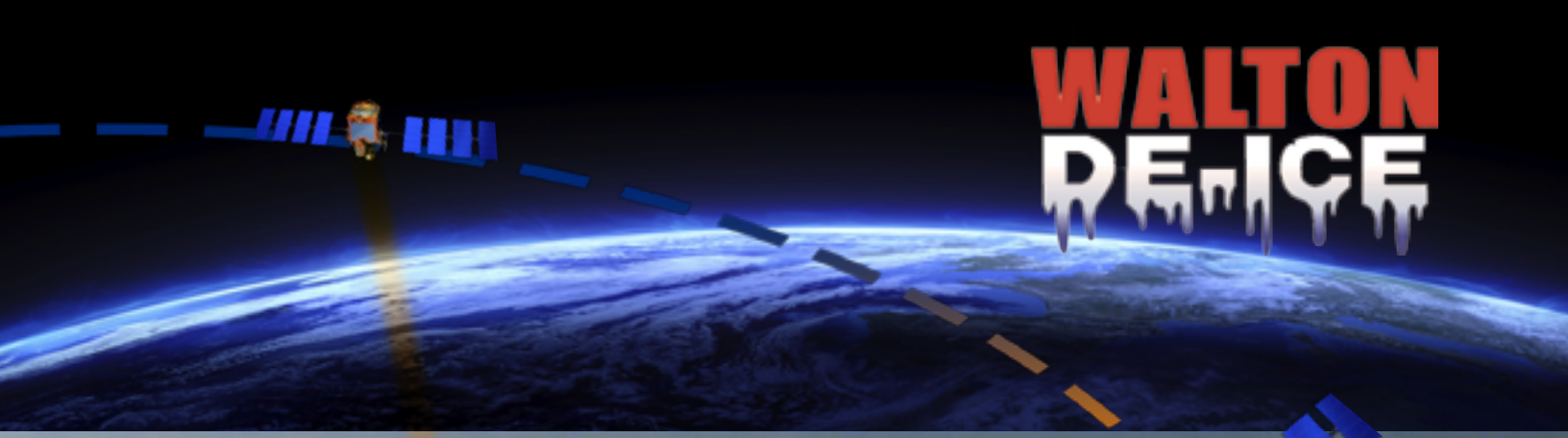

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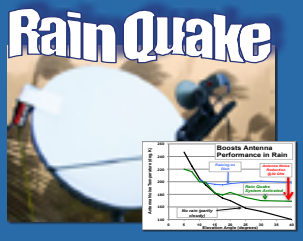

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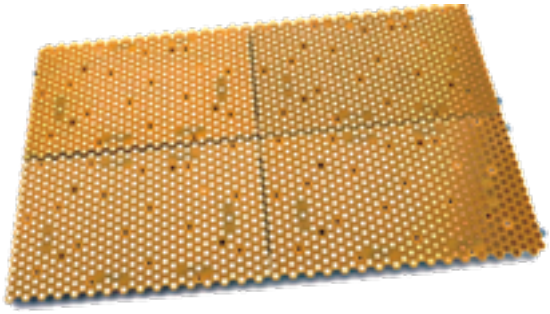
Dispatches:

New power architecture developed for Phasor's ESA technology

Phasor has worked with Vicor to develop a power solution for the company's new system that provides connectivity speeds and bandwidth previously unachievable while on the move, thanks to the Factorized Power Architecture™ (FPA) from Vicor that delivers extremely high current at low voltage to ensure robust mobile communications.

While the technology represents a major breakthrough in delivering reliable satellite connectivity in aeronautical, maritime, land mobile and defense applications, it will also enable the end user traveling on any mode of transportation to enjoy true mobile broadband connectivity, and all the applications that this will enable.

Phasor's modular, flat or conformal, solid-state electronically steered antenna systems are less than 1.5 inches thick, presenting an extremely low profile, and matching the performance of traditional parabolic dish antennas from 40cm to 1m or larger.



Using low-profile components operating at high power density, Phasor's mobile communications systems rely on Vicor's FPA to provide extremely high current at very low voltage.

Vicor's FPA package consists of a Pre-Regulator Module (PRM) and a Voltage Transformation Module (VTM)/Current Multiplier which together deliver the full, regulated, isolated DC-DC converter function.

The Voltage Transformation Module (VTM) is a resonant converter and therefore also has very low noise when compared to a hard switched converter.

Vital to realizing performance targets in small and large aperture Phasor ESAs is the ability of Vicor's systems to transform a 48V supply into a 1.5V supply (1V in the next generation of antenna with even higher current).
Phasor's desire to make this transformation at 65A (or even 80A) represented a major design challenge for powering their application-specific integrated circuits (ASICs).

Offering far superior power delivery and efficiency than traditional DC/DC converters, Vicor's approach to transforming voltage eliminates the need for multiple hard-switching converters with several different phases to attain 65A.
Mike Warren, SVP, Operations at Phasor, said Vicor is a valued partner in supporting the technical innovation helping to differentiate Phasor's products. The FPA technology plays an integral role in the company's ESAs and Phasor looks forward to continuing this work with Vicor.

www.phasorsolutions.com

www.vicorpower.com

Dispatches:

Air Force Space Command concludes wargames

The thirteenth in a series of Air Force Space Command Wargames concluded on September 13 — set in the year 2029, Schriever Wargame 2019 explored critical space and cyberspace issues in depth.

This particular iteration of the wargame was centered on the following objectives:

1) Inform people, processes, and technologies to advance USSPACECOM's joint/combined operational missions

2) Explore opportunities and challenges of national, commercial, and coalition architectures to synchronize effects that protect and defend the space enterprise

3) Examine unity of command/ effort to seamlessly integrate space operations and authorities across multiple classification and organizational levels

4) Advance shared understanding of responsible behaviors in the space domain and impacts on national and coalition decision-making

5) Investigate whole-of-government(s) and coalition options to control escalation across all domains.

The SW 19 scenario depicts a notional peer competitor seeking to achieve strategic goals by exploiting multi-domain operations.

It included a global scenario with the focus of effort toward the U.S. European Command area of responsibility.

The scenario also included a full spectrum of threats across diverse, multi-domain operating environments to challenge civilian and military leaders, planners and space system operators, as well as the capabilities they employ.

The SW 19 team conducted this wargame on behalf of Air Force Space Command (AFSPC), headquartered in Colorado Springs, Colorado.

Approximately 350 military and civilian experts from more than 27 commands and agencies around the country, as well as international partners from Australia, Canada, New Zealand, the United Kingdom and the United States participated in the Wargame.

U.S. commands and agencies who participated in Schriever Wargame 2019 included:

- *Air Force Space Command*
- *Army Space and Missile Defense Command*
- *Naval Fleet Cyber Command*
- *National Reconnaissance Office*
- *Executive Agent for Space Staff, Air Combat Command*
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- *U.S. Northern Command*
- *The Intelligence Community*
- *National Aeronautics and Space Administration*
- *Office of Homeland Security*
- *Department of Transportation*
- *Department of State*
- *Department of Commerce*

www.afspc.af.mil

The low-profile ThinKom ThinSat 300 demonstrated consistent, efficient high-speed SOTM during a coast-to-coast drive across the United States. Photo is courtesy of the company.

ThinKom Solutions, Inc. has supplied their ThinSat 300 flat-panel phased-array antennas for Indonesian Federal Police command center vehicles to access satellite broadband on the move (SOTM).

The project is a collaboration of ThinKom, Skyreach, Heimdall Defence and Newtec. ThinKom supplied the antenna, integrated with the Newtec Dialog® Hub. Heimdall was responsible for system integration, installation user interface and operator training, and Skyreach is providing VSAT connectivity.

Initially, the systems have been deployed on two Indonesian Federal Police vehicles. Other installations are expected to follow in the coming months.

The field-proven ThinSat 300 antenna is just 4.3 inches high and mounts on a standard roof rack. Total weight, including the radome, is 120 pounds.

Based on ThinKom's patented phased-array technology, the vehicle-mounted antenna enables robust IP networks, streaming video and voice-over-IP applications without stopping to deploy a fixed satellite terminal or waiting for a blockage recovery.

Darin Anderson, director of international business development at ThinKom, said the ThinSat 300 mobile SATCOM antenna provides uninterrupted communication links for the command vehicles, even at highway speeds and off-road terrain conditions. The antenna's spectral efficiency of up to two bits per Hertz delivers high throughput on narrowband channels without spreading the signal, resulting in a substantial savings in operational expenses.

Jo Rudy Haryoto, Founder and CEO of Skyreach, added that since the beginning, Skyreach, with its experience in mobile SATCOM technology, has responded to users' needs for high-quality video surveillance on the move, and the suitable choice has been identified as a combination of ThinSat 300 and Newtec MxDMA technology.

Haryoto added that SATCOM-on-the-Move is also useful in urban areas, especially at busy times when a mobile network will not be able to accommodate constant data transfer and cellular 4G bonding technology will fail to accommodate video-streaming.

Riana Ng, Heimdall regional account director, noted that this SATCOM-on-the-move capability will be a tremendous asset to the Indonesian Federal Police in sustaining mission-critical operations across the 6,000 inhabited islands in the Indonesian archipelago. Many of them have limited or no terrestrial mobile communications network coverage.

Andrew Faiola, head of mobility at Newtec, related that emergency services have to deal with life-threatening situations, often with little warning, and in areas where terrestrial connectivity has been degraded, or even destroyed. Yet, communications and coordination are mission critical.

Faiola also noted that the communications solution delivered to the Indonesian Federal Police is a winning combination from ThinKom, Heimdall Defence and Newtec that is cost-effective, easy to use, reliable and secure. It dramatically improves the capability of the police to do their jobs while reducing risk and uncertainty.

www.thinkom.com/

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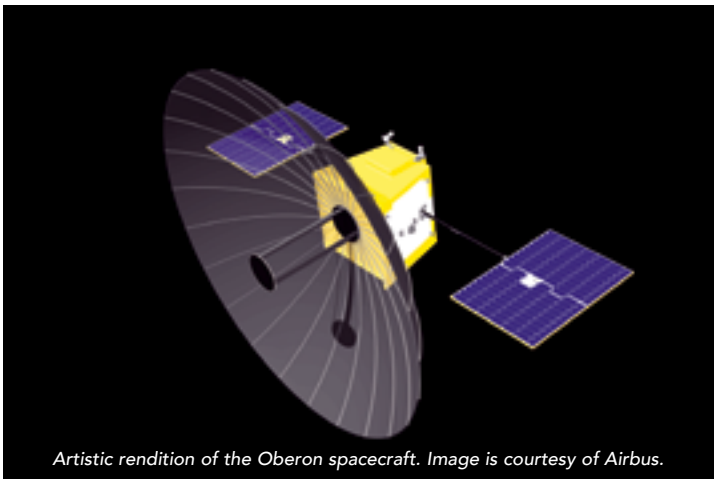
Dispatches:

Airbus awarded UK MoD contract for development of SAR satellites



Artistic rendition of the Oberon spacecraft. Image is courtesy of Airbus.

Airbus has won a design study from the UK's Defence Science and Technology Laboratory (Dstl) to develop the technologies for a cluster of ultra-high-resolution Synthetic Aperture Radar (SAR) satellites for the UK Ministry of Defence (MOD) — the satellites will also have the ability to collect radio frequency (RF) signals.

Called "Oberon," the project will see Airbus develop the technologies that could lead to an on-orbit demonstration in 2022 and potentially an operational capability as early as 2025.

The innovative techniques and technologies developed within the project will allow the ground to be seen in outstanding detail regardless of darkness, or of cloudy weather conditions.

Oberon follows the success of the SAR satellite, NovaSAR, designed and developed by Airbus and SSTL, which was launched in September of 2018.

Since NovaSAR was conceived, Dstl and Airbus have made significant leaps in technology, allowing the Oberon system to achieve high performance from a small and compact satellite system.

Colin Paynter, Managing Director of Airbus Defence and Space UK, said Project Oberon builds on Airbus' expertise in space radar technology developed over 40 years. The company looks forward to seeing this study that will lead to a new world-class surveillance capability for the UK MOD, helping to protect the nation's armed forces across the world.

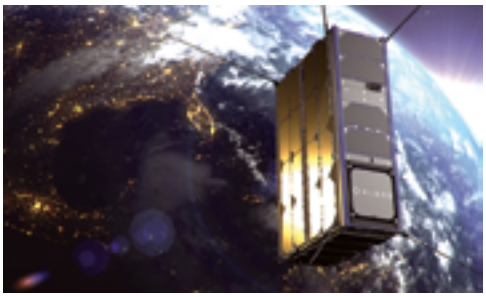
Gary Aitkenhead, Chief Executive of Dstl, added that this addition to the firm's capability is a valuable part of the future of Defence Space. Partnership between Dstl and Airbus on this project secures UK jobs as well as continuing to exploit advances in the UK space sector.

www.airbus.com

www.gov.uk/government/organisations/defence-science-and-technology-laboratory

Dispatches:

Kleos Space awarded USAF contract for the Space Accelerator program



Kleos Space S.A. (ASX: KSS, Frankfurt: KS1) has been awarded a contract to participate in the United States Air Force Space (USAF) Vehicle Directorates Catalyst (AFRL/RV) Space Accelerator program (CSA).

With the contract comes an invitation to the newly appointed VP of Business Development for the program, ***Danny McGrane***, who will represent Kleos Space in the 12-weeks, semi-residential program located in Colorado Springs. The CSA is sponsored by Air Force Research Lab's Space Vehicles Directorate.

The CSA is designed to increase the USAF's awareness and rapid acquisition of commercial dual-use space technology by providing relevant business development training to CSA companies and connecting them with users, decision makers, and potential new customers in the U.S. Department of Defense and commercial realms.

The program is unique in connecting participants with customers and providing 'sherpas' to steer military and commercial engagement. The program has delivered roughly 9 million euros in follow-on funding and more than 100 military contracts to its past participants over three cohorts, so far. The CSA will support the company through the Kleos Scouting Mission.

Kleos' CEO ***Andy Bowye***r said that they are entering an exciting era in space where technologies, long considered to be things of science fiction, are becoming reality.

"*Since the first space-based reconnaissance imagery was captured on photographic film by the Discoverer 13 nearly sixty years ago*," Bowyer said, "*U.S. space-based intelligence, surveillance, and reconnaissance (ISR) technologies have greatly evolved and transformed the nature of warfare, providing an unprecedented level of "foreknowledge" to U.S. Service Personnel and to U.S. national security. To deliver the needed capabilities requires the development and integration of advanced sensors, complex algorithms, data processing, and novel ideas that result in disruptive technology.*"

Danny McGrane has been appointed by Kleos Space to deliver the CSA program and the resulting opportunities. He is a highly experienced former Royal Navy officer, NATO Deputy Chief in the U.S. and Program Manager for Joint Forces Command in the UK.

The multi-satellite Scouting Mission system will form the foundation of a constellation that delivers a global picture of hidden maritime activity, enhancing the intelligence capability of government and commercial entities when AIS (Automatic Identification System) is defeated, imagery is unclear, or targets are out of patrol range.

The first scouting mission is made up of 4x smallsats built by GomSpace in Denmark, each the size of a shoebox.

Bases and units have access to: Army Base – Fort Carson, Air Force Bases – Buckley, Peterson, Schriever, Air Force Academy, Cheyenne Mountain; Military Units; National Space Defense Center, Headquarters Air Force Space Command, Headquarters NORAD and U.S. Northcom, U.S. Space Command, Space & Missile Defense Command/ Army Strategic Command, Missile Defense Agency.

Dispatches:

Hughes realizes USAF contract for enterprise management and control prototypes for SATCOM

Hughes Network Systems, LLC (HUGHES) has been awarded a $2.2 million contract that is funded by the U.S. Air Force Space and Missile Systems Center (SMC), through the Space Enterprise Consortium (SpEC), to produce an Enterprise Management and Control (EM&C) prototype for satellite communications (SATCOM).

The prototype will include the Hughes Flexible Modem Interface (FMI) which will enhance interoperability across military and commercial SATCOM networks to form a unified hybrid network architecture.

Under the agreement, Hughes will demonstrate a solution that enables automated mission planning for SATCOM terminals to roam between networks through automated control processes.

In this way, when an active transmission becomes degraded or disrupted, the terminals can "self-heal" to maintain connectivity using alternate networks, enabling higher resiliency.

Leveraging the company's Artificial Intelligence (AI)-based FMI and Mission Management System (MMS) prototypes, Hughes intends to develop and demonstrate the capability for terminals designed for Unmanned Aerial Vehicles (UAVs) to intelligently roam among diverse satellite networks and services.

The demonstration will also use the Hughes HM System which enables UAVs, helicopters and other aircraft to transmit real-time feeds of HD video and other Intelligence, Surveillance and Reconnaissance (ISR) data over satellite.

Dr. ***Rajeev Gopal,*** VP of Advanced Defense Systems for Hughes, said this is the second follow-on contract that Hughes has been awarded by the USAF, a testament to the company's commitment and ability to support the U.S. Air Force Space Enterprise Vision of a more resilient national security space infrastructure using advanced software technologies.

Using the company's AI-based terminal management and control technologies, Hughes will show fixed and mobile terminals intelligently roaming among available commercial and military satellite systems for exponential improvements in network resiliency, capacity and cost models.

Rick Lober, VP and GM for Hughes Defense and Intelligence Systems Division, noted that this contract is another step forward as DoD continues making rapid progress in building high resilience and interoperability across their communications networks. Warfighters can no longer rely on single-threaded systems in contested environments, which is why it is critical the Space Enterprise Vision becomes reality as quickly as possible.

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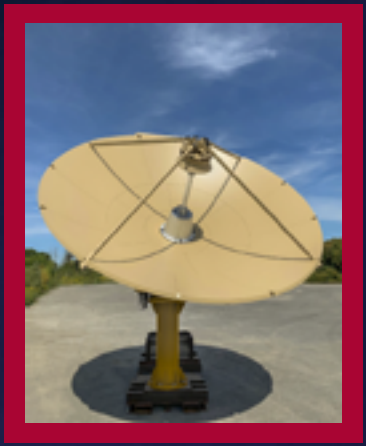

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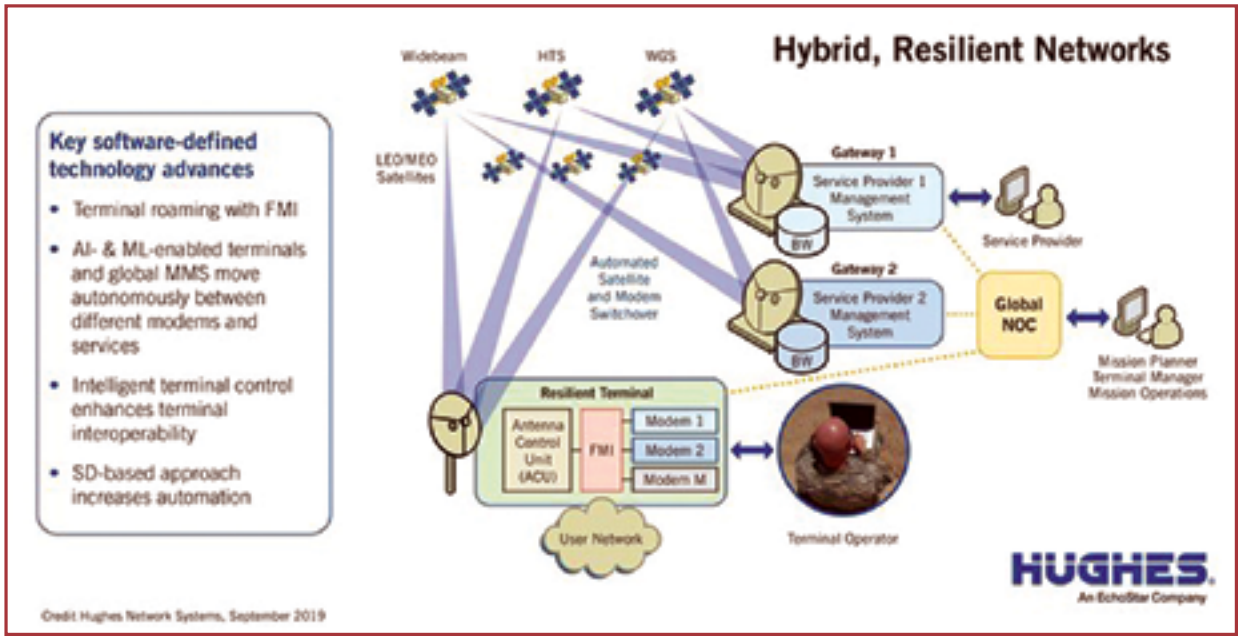

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Dr Graham Turnock, Chief Executive, **UK Space Agency**

Dr Michael O'Callaghan, Space Programme Manager, **Dstl**

Mr Barry Austin, Skynet 6 Project Manager and Deputy Head of Networks, ISS, **UK MoD**

Wing Commander David Black, SKYNET 6 EC Lead, ISS, **UK MoD**

INTERNATIONAL KEYNOTE SPEAKERS:

Major General Sergio Tratz, Deputy Chief of Army Staff, G2, **Brazilian Army**

Major General Jose Vital, VP, Brazilian Space Systems Commission, **Brazilian MoD**

Colonel Andrew Burks, Chief of C4i Operations, J6, EUCOM, **US DoD**

Colonel Cameron Stoltz, Director of Space Requirements, **Canadian Armed Forces**

Colonel Laurent Jannin, Head of SATCOM, **DGA**

Ms Deanna Ryals, Chief, International Partnerships Office, SMC, **US Air Force**

Mr Hirohisa Mori, Director of National Space Policy Secretariat, **Japanese Self Defence Forces**

Ms Clare Grason, Chief, Commercial Satellite Communications Office (CSCO), AFSPACE, **US Air Force**

GLOBAL MILSATCOM MILITARY AND GOVERNMENT SPEAKERS INCLUDE:

Colonel Jim Dryburgh, Director Service Integration CIO Department, **New Zealand Defence Forces**

Colonel Young-Ell Kim, Chief, Defence Communication Command, **ROK Armed Forces**

Colonel Nilsson, Head of Space Programmes, **Norwegian MoD**

Colonel Ilime Bin Ibrahim, Commanding Officer MAF Satellite Communication Centre, **Malaysian Armed Forces**

Colonel Mihai Burlacu, Deputy Head of Communications and IT Branch, **Romanian MoD**

Lieutenant Colonel Mick Hose, Deputy Director, C4 Capability Branch, **Australian DoD**

Ms Demaryl Singleton, DoD Teleport System Lead, **DISA**

Mr Michel Leenaarts, MilSatCom Programme Manager, Defence Materiel Organisation, **Netherlands MoD**

4TH NOV 2019 — SMALL SATELLITES AND DISRUPTIVE SPACE TECHNOLOGY FOCUS DAY SPEAKERS INCLUDE:

Mr Luis Gomes, Chief Technology Officer, **Surrey Satellites Technology**

Mr Mark Boggett, CEO, **Seraphim Capital**

Dr Juan Reveles, Chief Technology Officer, **Oxford Space Systems**

Mr Sean Goldsbrough, Senior Orbital Analyst, **UK Space Agency**

Dr Douglas Liddle, CEO, **In-Space Missions**

Mr Craig Clark MBE, Chief Scientific Officer and Founder, **Clyde Space/AAC Clyde**

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CPD CERTIFIED

Dispatches:

Santander Teleport to provide comms services to Spanish Armed Forces

Santander Teleport has joined forces with Hisdesat Servicios Estrategicos and Telefonica de España to provide advanced welfare and recreational services to Spanish forces deployed on ground and at sea in several areas of operations.

A completely new network is being deployed to provide secured broadband internet access, telephone calls, e-learning, live TV as well as on demand content (TV series, movies, documentaries, books, news…).

Users will be able to access these services through their own mobile devices (BYOD). The overall service will consolidate all communications under a common network architecture, improving bandwidth efficiencies and tightening the security of all communications.

Santander Teleport will be responsible for all the X -and satellite communications network, using the satellites of the Spanish governmental satellite operator (Hisdesat).

All designated bandwidth will be enhanced through traffic management, quality of service, acceleration, compression and optimization services.

Luis Garcia, CEO of Santander Teleport, said the company is delighted to contribute to the improvement of the morale and welfare of the brave soldiers who spend long periods of time away from their family and friends.

www.santanderteleport.com

Dispatches:

Comtech Mobile Data Corporation awarded U.S. Army Blue Force terminal funding

Comtech Telecommunications Corp. (NASDAQ: CMTL, during the company's fourth quarter of fiscal 2019, have reported that the firm's Command & Control Technologies group, through its Maryland-based subsidiary, Comtech Mobile Datacom Corporation, which is part of Comtech's Government Solutions segment, was awarded $4.2 million in rapid innovation funding from the U.S. Army for an enhanced version of Comte.

The contact is for the next generation MT-2025 Blue Force Tracking ("BFT") satellite terminal that will incorporate a dual-mode BFT satellite transceiver and new antenna nulling technology.

Comtech's next generation MT-2025 transceiver, which is also known as the Blue Force Tracker-2 High Capacity ("BFT-2-HC") Satellite Transceiver, meets BFT-2 protocols, provides best-in-class reliability and is fully backward compatible with the U.S. Army's Blue-Force Tracking-1 system ("BFT-1").

Comtech currently provides sustaining support for the U.S Army's BFT-1 system and previously shipped over 100,000 BFT-1 mobile satellite transceivers.

The Command & Control Technologies group is a leading provider of mission-critical, highly-mobile C4ISR solutions.

Fred Kornberg, President and CEO of Comtech Telecommunications Corp, stated that these awards demonstrate the U.S. Army's high confidence in Comtech's BFT technology and innovation capabilities that can be used on future BFT systems.

He added that Comtech remains committed to providing the U.S. Army and its soldiers with the most innovative technology, enabling them to successfully complete all their missions, regardless of electronic warfare environments.

www.comtechmobile.com

www.comtechtel.com

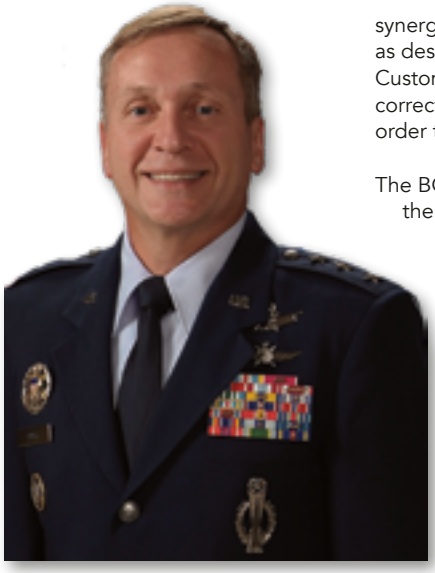
Dispatches:

Buck Consulting Group opens doors for clients involved in space, cyber and nuclear domains

Former Commander, Joint Functional Component Command for Space, Commander, U.S. Air Force 14th Air Force, and AFSPC Vice Commander, Lieutenant General (Ret) David Buck, has founded Buck Consulting Group (BCG).

The BCG matches capabilities with government requirements, applies unique knowledge of operational needs and leverages existing relationships to provide winning solutions and shape clients' strategic direction in the Space, Cyber and Nuclear domains.

According to the company, in other words, the objective is to understand the landscape... what's real, who are the competitors, who are the decision makers, and develop the correct engagement strategy.



The BCG diligently tracks government BAAs, RFIs, RPPs and RFPs to match them with clients' core competencies, and suggests synergistic teaming arrangements, as desired.
Customer engagement (at the correct level and time) is critical in order to understand requirements.

The BCG helps clients tell their story through white paper development, compelling/complete/compliant proposals, tying capabilities to government requirements and enhancing customer to client communication.

Dave Buck pulled together some of the best retired officers and industry professionals to help companies succeed in their domains.

The Buck Consulting Group brings a deep bench of subject matter experts across the Acquisition, Operations, Research & Development, and Test and Evaluation communities.

They developed government RFPs, executed various contract types, led source selections, and worked within nearly every government agency, directorate and location.

www.buckcg.com

COMMAND CENTER
PETER HADINGER,
CHIEF TECHNOLOGY OFFICER, INMARSAT

Peter Hadinger is Inmarsat's Chief Technology Officer (CTO). He is responsible for all programs and previously led the development of the government-focused capabilities and services of the company's new Global Xpress program. Peter also spent 30 years as a leader in technology development, engineering and government spacecraft programs at Northrop Grumman.

He holds multiple patents in advanced communications. Peter's diverse regulatory and policy background includes leadership roles in the World Trade Organization Telecom Services Agreement, the FCC World Radio Conference Advisory Committee, the President's National Security Telecommunications Advisory Committee and a fellowship in the U.S. Senate.

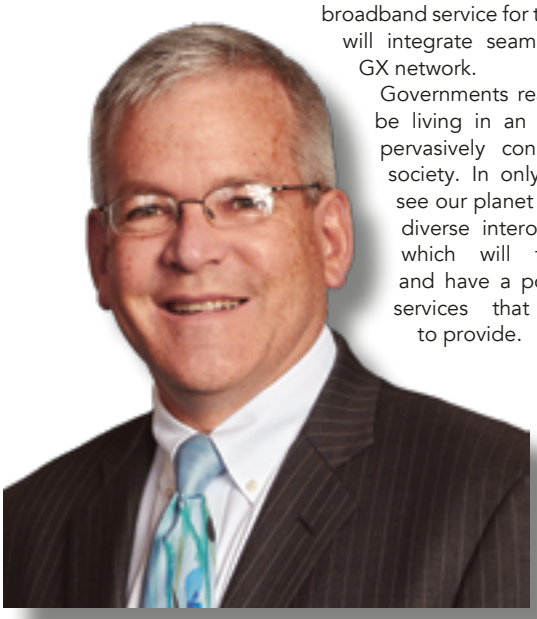
Peter received his Bachelor of Science in Electrical and Electronic Engineering from California State Polytechnic University, an MBA from George Mason University, and serves on engineering advisory boards at Virginia Tech.

Good day, Mr. Hadinger, we appreciate you taking the time to chat with our readers. This year marks Inmarsat's 40th anniversary. Following such a remarkable legacy, what's next for the company?

Peter Hadinger (PH)
Forty years on, I am proud to say that Inmarsat remains a leading technology pioneer in satellite communications. We strive to be disruptive innovators, introducing continuous network improvements that lead the evolution of global mobile connectivity. Our history and the strong relationships with have with partners and customers allows us to anticipate future demand as we strive to enable a truly connected world.

During the past few months alone, we have announced unprecedented enhancements to our world-leading Global Xpress (GX) service, which will deliver significantly enhanced capacity and capabilities to existing and future customers.

We also announced the world's first dedicated broadband service for the Arctic region, which will integrate seamlessly into the global GX network.



Governments realize that we will soon be living in an era of the always-on, pervasively connected global digital society. In only a few years, we will see our planet empowered by dense, diverse interoperable 5G networks, which will transform enterprises and have a powerful impact on the services that Governments need to provide.

Additionally, as the world continues to present a host of unpredictable challenges, military satcom planners need to remain abreast of technological developments and adopt the best of them in a flexible, secure and cost-effective manner. We believe that this is most efficiently achieved by working with trusted, proven commercial providers who are adapting and innovating at the speed of the market.

At Inmarsat, our approach of augmenting existing government networks, while introducing commercial capabilities in parallel, has been increasingly adopted by governments. As a result, our Government business has been experiencing sustained growth as uniquely powerful, flexible and secure services, such as GX, have come to the market.

With GX, as with our L-band constellation, our commercial focus has always been on users requiring mission critical communications, which can be deployed anywhere in the world and often at a moment's notice.

What is Inmarsat's current fleet configuration?

PH
Inmarsat's current fleet is comprised of 13 active satellites — nine (I-3/I-4) in L-band and four (GX1-4), delivering global, resilient coverage on land, at sea and in the air. Inmarsat's strategy is based on layers of coverage from multiple satellites to ensure best possible network performance under all conditions.

To remain ahead of market needs, we are in the process of augmenting our global coverage by launching two advanced L-band satellites and eight further GX payloads by 2023. Three spacecraft are already far along in construction with the next launch scheduled by the close of 2019. The remaining payloads are all under contract and design work is underway with our manufacturing partners.

The new GX satellites are part of a generation we call Inmarsat-7. Their software-driven, all-digital designs are the most advanced telecom satellites ever built and represent a dramatic-increase in what we can deliver to our growing customer base. Each of the GX7, 8 & 9 satellites, built by Airbus, will have more than twice the equivalent capacity of our entire fleet today.

The recently announced HEO GX10 payloads, being built by Northrop Grumman for Space Norway, will use similar digital technology to deliver the world's first dedicated broadband capacity for the Arctic region: seamlessly integrating with Inmarsat's GEO GX satellites.

Following Inmarsat's recent announcement about two new satellite payloads dedicated to the Arctic region, what do you see as the next frontier for the industry?

PH
There is a lot more innovation to come from Inmarsat in both our L-band and GX networks, and this will keep us busy for some time.

However, at Inmarsat we are continually exploring new technologies, new capabilities and new markets. While it would not be prudent to provide any specifics at this stage, I can certainly promise that pace of innovation will only become faster and finish by saying "watch this space."

Where do you see the greatest potential, industrywide?

PH
So many satellite networks are still patchworks, which creates its own issues.

Artistic rendition of an Inmarsat GX satellite on-orbit. Image is courtesy of the satellite's manufacturer, Boeing.

One of the great things about working at Inmarsat has been the company's vision of uniform and seamless global networks - the commitment to safety, reliability and performance in everything that we do.

In a nutshell, our focus is on enabling Inmarsat customers to get away from thinking about communications and get back to the business of business. We achieve this by creating the world's largest managed networks and designing every aspect — from the space and ground infrastructure to the antennas and all other equipment — based upon an intimate knowledge of what the customer requires — knowledge that we have been building since 1979.

Our customers are already telling us of their plans to use our new Arctic coverage to extend their critical operations across the North. Governments, shipping companies and airlines are increasingly present in the Arctic and it is a great time for us to extend our global capabilities to include this critical region.

Looking more broadly at Inmarsat's global strategy, the key factors for our customers, particularly our Government customers, are flexibility, reliability and security. These attributes have driven and will continue to drive our investment strategy over the coming years. And it was these requirements that led to both our investment in GX7, 8 and 9 and our recently announced Arctic GX payloads.

With GX, as with our L-band constellation, our commercial focus has always been on users requiring mission critical communications, which can be deployed anywhere in the world and often at a moment's notice. It is the market for globally available, mobile satellite communications that continues to show the greatest growth potential, and these markets — including government, aviation and maritime — have been served by Inmarsat for decades.

Would you expand on the company's commitment to geostationary orbit?

PH

Inmarsat has 13 satellites in geostationary orbit, the latest four of which are Global Xpress. A further six GEO satellites will be launched over the coming four years.

While Inmarsat has traditionally been associated with geostationary spacecraft, as can be seen in our recent announcement of HEO satellites with Space Norway, our first priority is not a particular orbit but rather the needs of our customers.

As we have stated publicly in the past, while we remain a predominantly GEO satellite company, we continually examine new technologies and new ways of delivering the reliable connectivity services are customers require. Our hybrid space-ground European Aviation Network is a great example of this. If demand and new technologies suggest a different approach for future connectivity, we would certainly consider such opportunities.

What about megaconstellations? Does Inmarsat have any plans to collaborate or collaborate with one of the LEO players?

PH

We have no current plans to do so as those we've seen are not as well suited to commercial or government mobility applications as some might suggest. However, we continually explore new technologies, news ways of working and the potential of new partnerships.

We are not trying to make an impression on consumer markets with ever-higher satellite counts for hypothetical future constellations. What is most important to Inmarsat is our ability to meet the real, current and anticipated demands of our government and business customers and to do so through services that offer the highest quality, reliability and cost-efficiency. Those are always the deciding factors in any decisions to collaborate or partner with other companies.

www.inmarsat.com/service/global-xpress/

AI: HELPING THE DOD INTEROPERATE SATCOM NETWORKS

By Dr. Rajeev Gopal, Vice President of Advanced Programs, and,
Rick Lober, Vice President and General Manager, Hughes Defense Division

Today, most military and commercial satellite communications networks are closed, "stove-piped" or "single-threaded" systems that do not interoperate with one another. This traditional architecture leaves remote military terminals vulnerable to disruption and interference, a glaring problem at the tactical edge. Without a secondary or tertiary network path to back up the primary satellite connection, anything from a sophisticated adversary or a tall line of trees could cut off communications.

Defense networks of today and tomorrow call for reliable communications in any global location, without having to wait weeks or months to repair connections. Communications systems must evolve to integrated modular, open standard network architectures that can be efficiently controlled across the global military enterprise. It won't be easy. However, it can be done, and it can be done efficiently by leveraging advanced Artificial Intelligence (AI) and Machine Learning (ML) capabilities.

By using advanced AI and ML software, standardized interfaces and network optimization tools, Hughes is helping the Department of Defense (DoD) modernize multiple networks for higher resilience and availability. The end result will be an intelligent, "managed network" that provides the required level of service quality and data capacity — measured in Mbps available in theatre versus the DoD traditional method of procuring bandwidth (MHz), equipment and resources to build and operate a network.

Commercial satellite operators have long pursued innovative ways to manage their networks as efficiently as possible to protect the bottom line. As a case in point, Hughes owns and operates its own service networks on four continents, as well as managing those for a wide range of enterprise and government customers globally.

The flagship HughesNet service resembles one big enterprise-like satellite network connecting over 1.4 million endpoints — each typically connecting to one or more High Throughput (HTS) and/or conventional satellites using different generations of systems technologies. The latest versions of these employ advanced data analytics and ML tools for network optimization, security firewalls and fault recovery. That same network engineering expertise — and the technologies and services that result — is now bringing new levels of efficiency to military SATCOM operations.

Military networks must possess intelligent, self-healing capabilities which leverage alternative network paths, so they can recover from threats that disturb normal operations, whether it's a minor deficiency or a deliberate attack. This will enable warfighters to focus on their missions instead of being pre-occupied with maintaining their network connections.

The DoD needs trustworthy sources for integrating artificial intelligence capabilities across all services, and specifically in the satellite communications infrastructure that is overdue for improved performance, resilience and responsiveness.

AI for Hybrid Military-Commercial SATCOM Networks

Exploring the benefits that AI can bring to defense SATCOM is already well underway by the DoD, including programs for the U.S. Air Force and the U.S. Army.

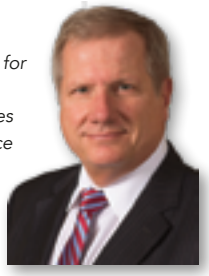
In late 2018, Hughes demonstrated its Flexible Modem Interface (FMI) technology to leaders from the DoD as part of a SATCOM pilot study to create a more interoperable enterprise network management and control prototype. This management and control prototype demonstration gave leaders a first-hand look into the future of resilient satellite communications.

DoD can scale AI's impact across the military enterprise, including sensor data processing, based on a common foundation that enables new or enhanced capabilities. To achieve this, defense leaders must engage U.S. commercial partners who have implemented the technology and demonstrated its value.

Hughes will continue to work together with the DoD to leverage its expertise in advanced satellite networking so our warfighters and decision makers can pursue missions aggressively with the network performance, flexibility and resiliency needed to succeed.

www.hughes.com

Dr. Gopal is Vice President, Advanced Programs and is responsible for resilient communications, LEO, HTS, AI/ML and cyber initiatives within Hughes DISD. He is the Hughes PM for USAF Protected Tactical Enterprise Service (PTES). He is involved in the design of a LEO broadband system using 4G/LTE and IP network technologies. He earlier served as Network System Engineering lead for Transformational Satellite (TSAT) space segment and was on the SPACEWAY® 3 (onboard L2 processing) architecture and Mobile Satellite systems (Thuraya, ICO, LEO Teledesic), development teams. He was the chief architect and software manager for SPACEWAY, a $1.8 billion development, Network Operations Control Center.



Rick Lober is the Vice President and General Manager of the Hughes Division (DISD) and he is responsible for applying the company's broad range of SATCOM technologies and services to the worldwide defense marketplace and intelligence community. This includes both fixed Ku-, Ka- and X- and VSAT and mobilesat products and systems. Applications cover satellite communications on the move for both ground based an airborne platforms along with numerous classified development programs. He has over 25 years experience with both COTS-based and full MIL communications and intelligence products, systems and major programs starting as a design engineer and progressing to a P&L executive.

To ensure superiority in contested environments, military leaders need to be enabled to quickly test, acquire and deploy these types of cutting-edge commercial technologies to support higher mission assurance.

The DoD has made it clear that higher network resiliency is a priority and is already building tremendous momentum to make it a reality. The U.S. Air Force awarded the second contract of a new satellite program in late 2018, called the Protected Tactical Enterprise Service (PTES). As part of the Boeing team, Hughes will develop mission management, system control, networking and ground hub capabilities to support the program's anti-jam communications.

To further strengthen its resilient SATCOM architecture, the U.S. Army recently awarded Hughes an $11.8 million R&D contract to improve availability and interoperability among narrow band SATCOM systems. Hughes will demonstrate a new, end-to-end Narrowband SATCOM (NBS) technology that incorporates AI and ML features to illustrate how the military can enhance their network capabilities cost-effectively. The NBS software-based technology will be designed to improve three critical areas: Network management, automated control and system interoperability. Much of this can be applied to not only narrowband communications, but next generation Blue Force Tracking and IoT networks.

Inspired by the award-winning HughesON™ Managed SD-WAN Solution, the Hughes-proposed solution for satellite networks is expected to enable remote terminal and network management, including the ability to automate network path roaming in case of interrupted transmissions. System interoperability will be created using standardized interfaces and the Hughes Flexible Modem Interface (FMI) control software.

By using AI/ML within FMI, processes and rules-based decision-making can be automated based on customer priorities — and implement changes much faster for greater efficiency.

Changes can be driven by adding simple new rules or policy-based declarative logic rather than having engineers perform manual design and coding, as in the old days. This new implementation approach is much faster and more efficient, reducing lengthy processes that used to take weeks or months to perform, down to days or even hours.

What's Next?

The NSCAI Initial Report was submitted in July of 2019 by the National Security Commission on Artificial Intelligence in response to its mandate from Congress "*to consider the methods and means necessary to advance the development of artificial intelligence, machine learning, and associated technologies by the United States to comprehensively address the national security and defense needs of the United States.*"

With intensifying interest throughout the government and these emerging programs, Hughes is seeing the buildup of momentum from the DoD in leveraging AI-enabled interoperability and commercial network management expertise to ensure availability and resiliency throughout global operations.

The DoD needs trustworthy sources for integrating artificial intelligence capabilities across all services, and specifically in the satellite communications infrastructure that is overdue for improved performance, resilience and responsiveness.

PROFILE: U.S.A.F.'S 216TH SPACE CONTROL SQUADRON

California airmen at the front lines in America's space wars

By Staff Sergeant Richard D. Lewis

California Airmen are making history in the fight in America's space wars here at home and down range. The mission of the 216th Space Control Squadron is to conduct offensive and defensive space control and space situational awareness missions in support of global and theater campaigns. In simple terms, these airmen provide electronic attack to deny our adversaries the use of space assets.

"*Which is huge,*" said Lieutenant Colonel ***Randy Tingle***, the 216th Space Control Squadron's Director of Operations. Tingle says space is essential in today's wars. "*We could not fight a war today without space. Our adversaries use space. We rely on it.*"

Long gone are the days of space only playing a supporting role.

"*We directly engage the enemy in space electronic warfare,*" said Tingle. "*We are forward-deployed right along with the warfighters and geographic combatant commanders. We are able to slow the enemy down, acquire targets, provide security and disrupt adversaries' abilities to further their objectives.*"

A small, nondescript group of buildings behind a remote, fenced-in area on Vandenberg Air Force Base, California, provides garrison location for the 216th. The sprawling base, filled with brush and teaming with wildlife, offers striking views of the natural coastline along Wall Beach — so close to the squadron you can hear the surf. Set-back, out of view, it would be hard to know just how much groundbreaking work our airmen are doing in the name of space defense.

"*We are doing new things all the time. We consistently rise to the challenge,*" said Senior Airman ***Alec Voorhies***, Space Systems Operator. "*All of our stuff is TS [Top Secret],*" *says Tingle. "We can't even talk to each other [space operators in other units] about what we do.*"

Put succinctly, Master Sergeant ***Sebastian Stevens*** said, "*We do cool stuff every day.*"

"*This mission is not at home — it requires forward movement. You surge to it,*" said Major ***Robert Glas***, Director of Operations and Crew Commander on team one. "*You become experts in communication and command and control. It really fits the Guard construct.*"

"*We are the only tactical space unit in the California Air National Guard fighting alongside tactical warfighters,*" said Tingle. "*It's a very exciting mission to get to be a part of. It's the best thing I've done in 18 years.*"

"*If the enemy has a hard time communicating, we have a tactical advantage,*" said Voorhies. "*It's important work.*"

"*Our mission is important,*" agreed Tingle. "*It's another set of tools to the geographic combatant commander.*"

The mission is not one that's been around for generations, it has taken a lot of work to man the front lines of the space wars.

The squadron took up residence at the old Defense Meteorological Satellite Program (DMSP) facility at Vandenberg in late 2016. The location still houses empty rocket fuel containers and vintage control panels — connected to once active satellite high-bays, and former clean rooms — now filled with the down and dirty business of airmen training for electronic warfare.

"*We built this squadron from the ground up,*" said Voorhies. "*We ran Cat-5 cable, set up cubicles, took full ownership. Knowing the importance of your mission, knowing that lives depend on it,*

Space is serious business. With the debate of a Space Force occupying recent headlines, it may seem like a passing trend, but there is a reason space is the top priority for leadership.

Space Control – Major Mark Masterson and Lieutenant Colonel Randy Tingle evaluate operations at the 216th Space Control Squadron, Vandenberg Air Force Base, California. The 216th SPCS is the only space control unit in the Air National Guard. Photo is courtesy of U.S. Air Force — Staff Sergeant Richard Lewis.

helps people focus. It's important to get things right. I'm honored to be a part of a guard unit that's doing it."

"We currently operate a Counter Communication System," said Tingle. "*We are also working on a Quick Reaction Capability system. And our capabilities can be mobilized to deploy nearly anywhere in the world."*

The 216th achieved mission success and the remarkable accomplishment of being the first space unit deployed for the Air National Guard.

A small but enthusiastic group of supporters at the Santa Barbara airport greeted members of the first team of deployers who made their return home on February 13.

"*It was a lot of fun*," said Tingle, who was the deployment commander for the first team. "*There were a lot of challenges connecting all the moving pieces with NGB [National Guard Bureau) and Space Command, as space forces in the guard had not deployed. People just didn't know the process — getting gear, getting orders, medical, training — but we made it happen."*

According to Major ***Mark Masterson***, Operations Officer, the strain can be especially tough on family members who also sacrifice to make the mission successful. For operational integrity and security reasons, loved ones do not receive advanced notice of the member's deployment or return dates until the last possible moment.

"*We can't tell families where we are going or what we are doing. They have an idea how long we will be gone but they do not know exactly when we will return*," said Masterson.

Team one deployer Senior Airman ***Josh Cheney***, father of three small children, said the late notice to deploy was tough on his family, but they got through it. Cheney says he was proud to do his part supporting this critical mission; and his wife and kids understand it's all part of the job.

Still, deployment to the Area of Responsibility (AOR) is an austere experience. The deployments are six months long to an undisclosed overseas location in the CENTCOM area. Team members work 12-hour shifts, seven days a week, and the operational tempo is 24/7. But Lieutenant Colonel ***Tingle*** says it's not all work.

"*No Starbucks*," laughed Tingle. "*But we have a 'Green Bean' coffee shop, a nice gym, a nice movie collection. We have our own compound, have our own cops."*

"We had a nurse, a doctor, several engineers, firefighters, police officers, maintenance troops, you name it," said Glas. "*The unique thing we bring to the fight as citizen airmen is diversity of background."*

Tingle said the best part about deploying is making a difference for our mission partners.

"*I was all over the AOR discussing our capabilities with operators: Air and Special Operations. Our adversaries are advancing in their space assets. It is important as space units to mitigate that."*

Lieutenant Colonel ***Steven Kimel***, Commander of the 216th, said the first deployment return represented a historic mission complete and changeover in theatre. *"It really validates the Guard's acceptance in this mission area and puts us shoulder-to-shoulder with our total force integration partners*," he said.

The squadron is part of the California Air National Guard's 195th Wing, located at Beale, Air Force Base. The Wing, made up of seven squadrons and six operating locations, is spread over 543 miles throughout the state.

"I am extremely proud of them," said Colonel ***Douglas Hire***, Commander of the 195th Wing. "*We are getting lots of accolades from the folks downrange."* Leaders at all levels are taking notice.

"*Things went great for them [team two]*," said Tingle, "*The 332nd Air Expeditionary Wing commander is very pleased."*

The second team returned to California on August 7 at the San Luis Obispo airport, following another historic changeover in theatre. They were greeted by a small reception of family, friends and coworkers, along with other supporters. It was an even more low-key affair than the first deployment return, which suited the smiling but weary returnees just fine. These airmen were eager to get home and spend time catching up with their families.

Team two enjoyed notable success oversees, having learned from the first groundbreaking deployment.

"*Oh yes, we had a much better understanding and it made it a lot better experience for them*," says Tingle. "*It was much more fluid, we were much more prepared. We understood medical and how to process orders and UTC packages — and our training was much better. This time we trained directly with the actual people [contractors] who designed our system."*

Perhaps the best thing about these space warriors and the mission impacts they bring to the fight is their adaptability.

"*We are making changes due to changes in the threat environment. We are flexible, making changes as threats emerge*," said ***Tingle***, "*we are getting more mobile, more efficient."*

What's on the horizon for the only space control unit in the Air National Guard?

"*Making sure we establish a robust training program that meets the standards of our active duty partners*," said Tingle. "*We look to integrate more with our mission partners in the future."*

Space is serious business. With the debate of a Space Force occupying recent headlines, it may seem like a passing trend, but there is a reason space is the top priority for leadership. The nation's adversaries are actively pursuing the means to extend the battlefield into space.

"*It's heading that way*," said Tingle. "*Space is a domain, like air, land, sea."*

Should it come to that, Lieutenant Colonel Tingle stated that the 216th will be ready, adding he couldn't be prouder of the team and he thanked everyone for their support, from the new, high-speed members recently hired, to senior leadership at the wing.

"*I've never worked with a better group of individuals*," said Tingle.

Richard D. Lewis is a print and television journalist: writer, interviewer and editor/ producer and is a graduate of the Defense Information School's writing, broadcast, and public affairs programs, Richard joined the U.S. Air Force in 1987 and spent 10 years as a Broadcast Producer stationed at Incirlik AB Turkey, Hill AFB Utah and the Air Force Academy, Colorado.

After separating in 1997, Richard began work in TV production in Salt Lake City, Utah. He was hired back as a civilian producer/director by the Air Force in 1999 and has since written about and documented Air Force mission activities at SMC Los Angeles, NORAD, Cape Canaveral AFS, Beale AFB, Vandenberg AFB, March ARB, Schriever AFB, Peterson AFB, Grand Forks AFB, Van Nuys ANG Station, Edwards AFB, NASA Ames Research Center and Wallops Island Flight Facility.

Richard has published bylines and TV clips in Blackbelt Magazine, FILMINK, Fangoria.com, Rocket Magazine, Geek Monthly, P3 Production Update, Campus Circle, The Astro News, BeyondHollywood.com, The History Channel, AMC Theatres, KTLA, Torrance Channel 3, AFN TV, PBS, The Pentagon Channel, Santa Maria Times and The Lompoc Record.

FLAT OR PARABOLIC ANTENNAS FOR MILSATCOM?

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

In today's satellite communications-on-the-move (COTM) terminal market, nirvana is represented by a compact, low-profile, and reconfigurable flat-panel antenna (FPA) as a replacement for its conventional counterpart, the dish antenna, dominated by its bulky parabolic reflector.

Indeed, low profile antennas are already in common use, and appear to be particularly useful because they provide low wind resistance on aircraft and low profile on armored or command land vehicles.

But as they say at the races, its horses for courses. You cannot expect a sprinter to win the Kentucky Derby or the Melbourne Cup any more than you could expect a stayer to win the Hong Kong Mile. A parabolic antenna, especially in a gimballed terminal such as EM Solutions' Taipan land mobile terminal (*Figure 1*) or Cobra maritime terminal, can provide exceptional multi-band or broadband performance, and constant gain and thus data rate over a complete range of look angles.

However, if the requirements for low profile trump all other requirements (to continue a gambling analogy), then be prepared to compromise on one or more requirements — which might be bandwidth, data rate, or range of look angles, dependent on the particular technology deployed. Flat panel antennas, or even low profile two-axis mechanically steered antennas, will never have the same bandwidth or gain compared with their parabolic equivalents, and will suffer lower data rates at off-axis look angles.

There are several ways that a low profile comms-on-the-move terminal solution can be achieved.

Monopulse tracking has been used with parabolic antennas for radar and satellite terminals for over 50 years.

1. ***Flat antenna with fixed radiation pattern, rotated mechanically in azimuth and elevation.***
   Terminals in this group are simple and straightforward; the flat panel antenna itself doesn't provide the beam steering function, it requires an external mechanical subsystem to rotate the antenna body and change the beam direction. "Chopped" parabolic dishes are another type of antenna falling in this category. Because the FPA generates a static radiation pattern, the antenna can be designed with a stable and high-gain radiation pattern over a wide frequency range, although it should be noted that low profile antennas that are elongated in shape (to achieve a higher gain) will have a fan-shaped beam that may fail certain certification requirements.

2. ***Flat panel steered electronically using a phased antenna array***
   In this group, FPAs are designed as two-dimensional antenna arrays excited by a feeding network of signals that are varied in phase or delayed in time. Best known in radar applications, a phased array antenna can generate a focused beam useful for satellite communications, but in low volumes such systems can be very expensive.

3. ***Flat panel antenna incorporating an electronically tuned variable impedance surface***
   In this group of antenna arrays, the FPA is made from a tunable holographic impedance surface consisting of a large matrix of metamaterial units that are digitally controlled. The solutions in this category promise to reduce the FPA manufacturing cost compared with phased array antennas, but are faced with challenging compromises between antenna radiation performance, resolution and accuracy of steering, and sidelobe levels, as well as limited bandwidth due to the inherent narrowband properties of metamaterials.

4. ***Flat antenna made using sliding mechanical structures to achieve two-dimensional steering***
   In this group, the FPA is designed as a surface-wave generator by using the same theoretical framework once widely employed in optical science. A sliding mechanical structure within the FPA is used to steer the beam along the elevation angle, while a separate mechanical subsystem is required to rotate the entire antenna body horizontally to change the

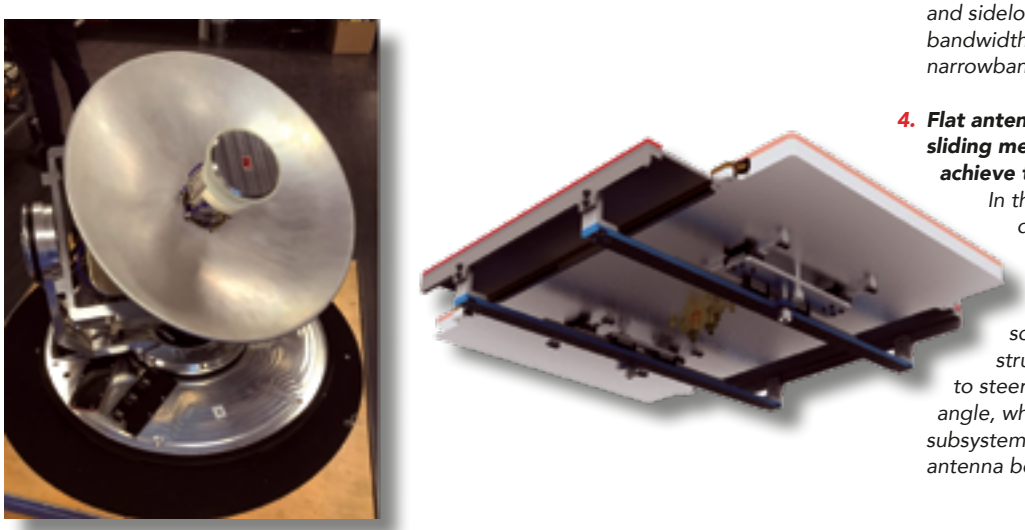


Figure 1: An EM Solutions X-band Taipan terminal (left) and flat panel prototype (right). The parabolic antenna has optimum performance in all respects if its height profile can be accommodated…but the FPA sits only a few inches high

beam direction in the azimuthal plane. Such a design approach has the potential to reduce the manufacturing cost of the FPA, while maintaining a high-quality radiation pattern. However, the FPA will suffer degradation in its radiation efficiency as it is steered, with fluctuating antenna gain in different beam directions, and limited working bandwidth (See Figure 1 on the preceding page)

With its Cobra and Taipan OTM terminal portfolios that use steered parabolic antennas, EM Solutions has traditionally valued high antenna gain rather than low profile, and sweetened the choice by offering monopulse tracking for very robust performance over rough terrain, as well as coverage of multiple operating bands for assured communications, two advantages not yet achievable with an FPA approach.

How can these two advantages be retained in the FPA approach? At EM Solutions, we have established a long-term research collaboration with the University of Queensland (UQ) that is now beginning to bear fruit.

The EM Solutions flat panel antenna uses the fourth approach above, but attempts to retain some of the classical parabolic advantages, such as broad operating bandwidth and monopulse tracking. This flat panel might be considered a mechanically-tuned leaky wave antenna. By launching a surface wave into a flat panel dielectric waveguide, and changing a reconfigurable pattern on its top surface by mechanically shifting two patterns relative to each other, the leaky wave that radiates from the panel can be steered in any desired direction. Because the patterns themselves are etched into dielectric surfaces, the leakage can be accurately controlled. In addition, calibration of the surface can be easily accomplished and beam sidelobes well simulated and controlled. Most importantly, the panel surface itself is completely flat and inexpensive to manufacture.

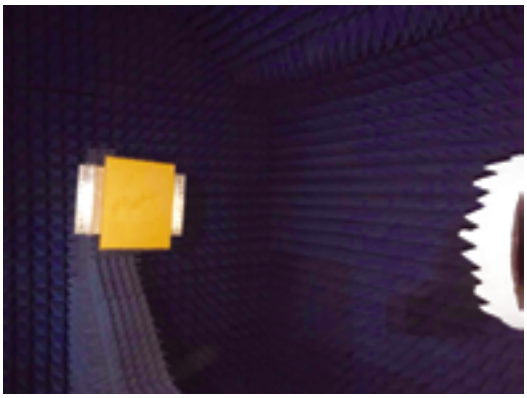


Figure 2: The EM Solutions flat panel antenna in the near field measurement chamber

The modeling of the FPA is a complex task and it is necessary to verify that the model describes the antenna pattern in space quite accurately (***see Figure 2 above***). The parameters to check are:

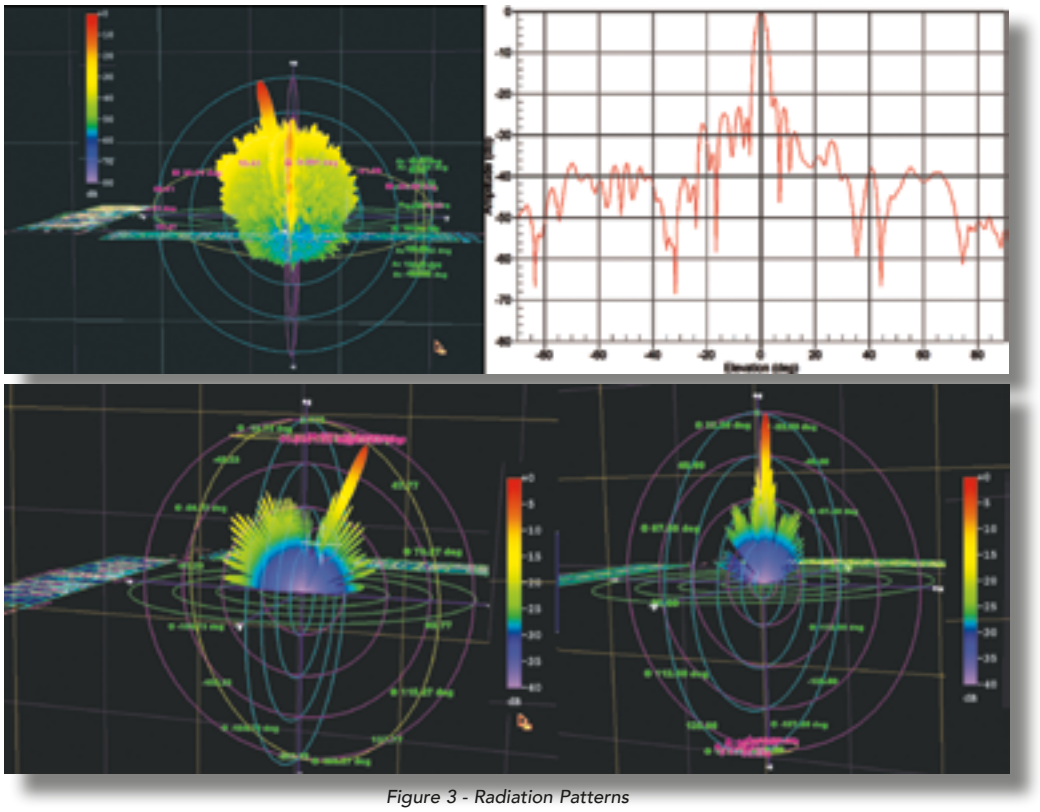


Figure 3 - Radiation Patterns
Upper: The normalized 3D radiation pattern shows the front-to-back ratios (20dB/div)
Lower: The normalized 3D radiation pattern of different beam steering directions, co-polarized LP plot (10dB/div)

- *That the actual antenna beam points in the direction determined from the model.*
- *That the antenna gain and pattern including cross polar levels are accurately predicted by the model.*
- *That the pointing as a function of leaky wave pattern displacements is correct.*
- *That the pointing and patterns as functions of frequency are correct and that beam squinting can be well predicted.*
- *That the limits to the pointing direction are approximately correct.*

Following simulation, a variety of measurements were taken to verify performance against simulation. These include:

Radiation Efficiency
This is measured by calibrating the loss in the dielectric material itself without the patterned radiator surface that creates leakage into space, and comparing it with the loss when the leaky wave patterned surface is placed over the dielectric waveguide.

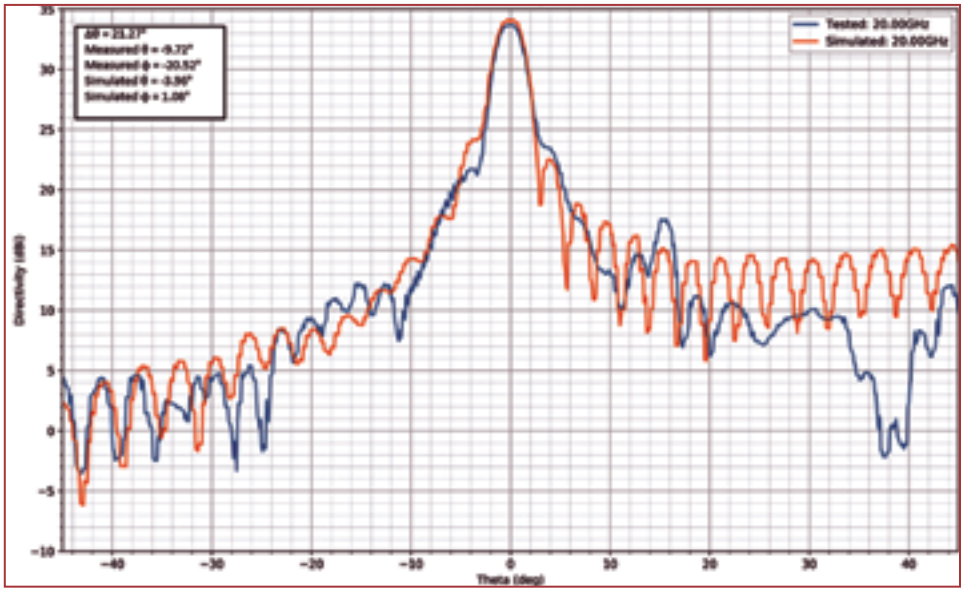


Figure 4: (X = 0mm, Y = 0mm) Measured and Simulated Antenna Pattern plots at 20GHz.

The increase in loss is due to the power that is radiated into space.

We found a nominal insertion loss of 3dB without the pattern and an insertion loss of 7.5 to 10.5dB across the 18.5-21GHz band width with the pattern, so the power 'lost' in space varies from 4.5dB to 7.5dB. This means that 65 to 82 percent of the power is radiated.

Because the antenna directivity can also be measured in the near field measurement chamber, the resulting antenna efficiency varies from between 53 to 67 percent over the 18.5 to 21GHz frequency band. This directly determines the G/T of the antenna, and is a good result compared with most competing technologies.

Static Radiation Patterns

As a check on the modeling a fixed leaky wave pattern was initially used. This does not require precise positioning of the pattern on the dielectric waveguide, nor are there any problems associated with the alignment between patterns or with possible airgaps.

The fixed pattern approach was also used to determine the efficiency of the antenna. Other parameters such as beam squinting, frequency variation in gain and efficiency can also be more accurately determined with fixed patterns.

The zero-point radiation patterns were measured in the near field range at the University of Queensland across the entire receive Ka-band. By further optimization of the feed structure and the leaky wave patterns, we expect that the sidelobe level in the transverse direction can be suppressed to more than 20dB as a result of the tapered amplitude profile realized by the feeding structure.

The side lobe level in the longitudinal direction is around 13dB, since there is no window function applied to that direction (at this point in the project — see Figures 3 and Figure 4 on the previous page).

Steered Antenna Patterns

After the initial antenna pattern was measured at its static zero point, the leaky wave pattern was then moved a known amount to point the generated beam in a new location where the antenna pattern was again measured. This step was repeated at a number of data points.

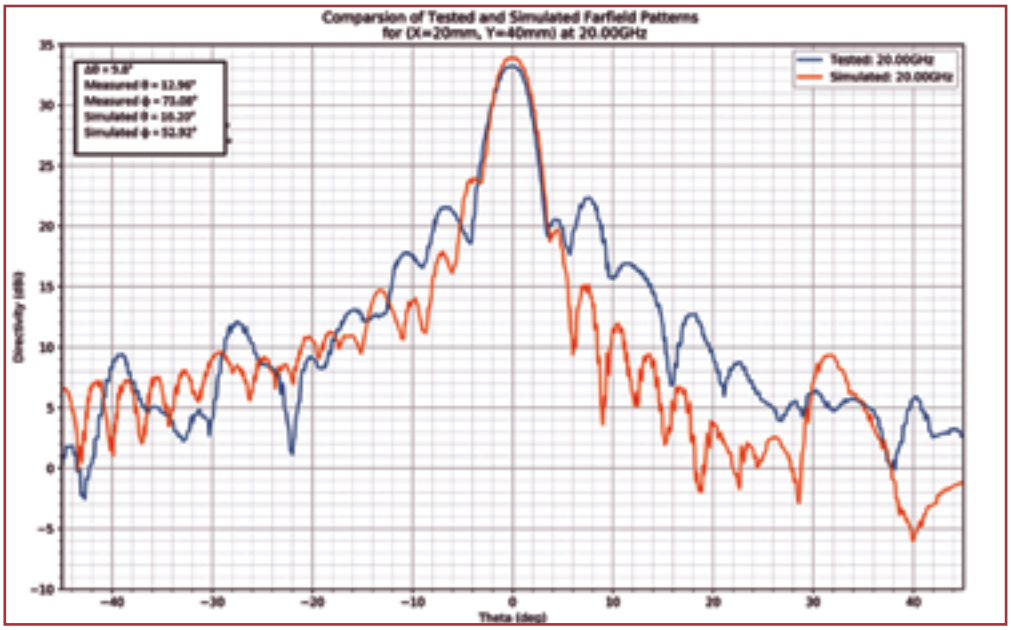


Figure 5: Measured and Simulated Antenna Pattern plots at 20GHz with a reconfigured beam steered 15 degrees off boresight.

Figure 5 compares the measured and simulated antenna patterns for one translation of the etched leaky wave pattern, and shows how the beamwidth and shape is relatively insensitive to the shift.

However, the peak amplitude is now 15 degrees offset with respect to Figure 5.

Holographic Mapping

A holographic mapping produced from the near-field scanning system can visualize the electromagnetic field distribution across the FPA aperture, which is a useful tool to diagnose any defect of the FPA and to analyze its radiation characteristics.

Figure 6 shows this mapping, and the reduction in leaky wave intensity as the incident wave travels across its surface (from left to right). It is through control of this radiation intensity and phase that a focused beam can be produced with desired sidelobe levels.

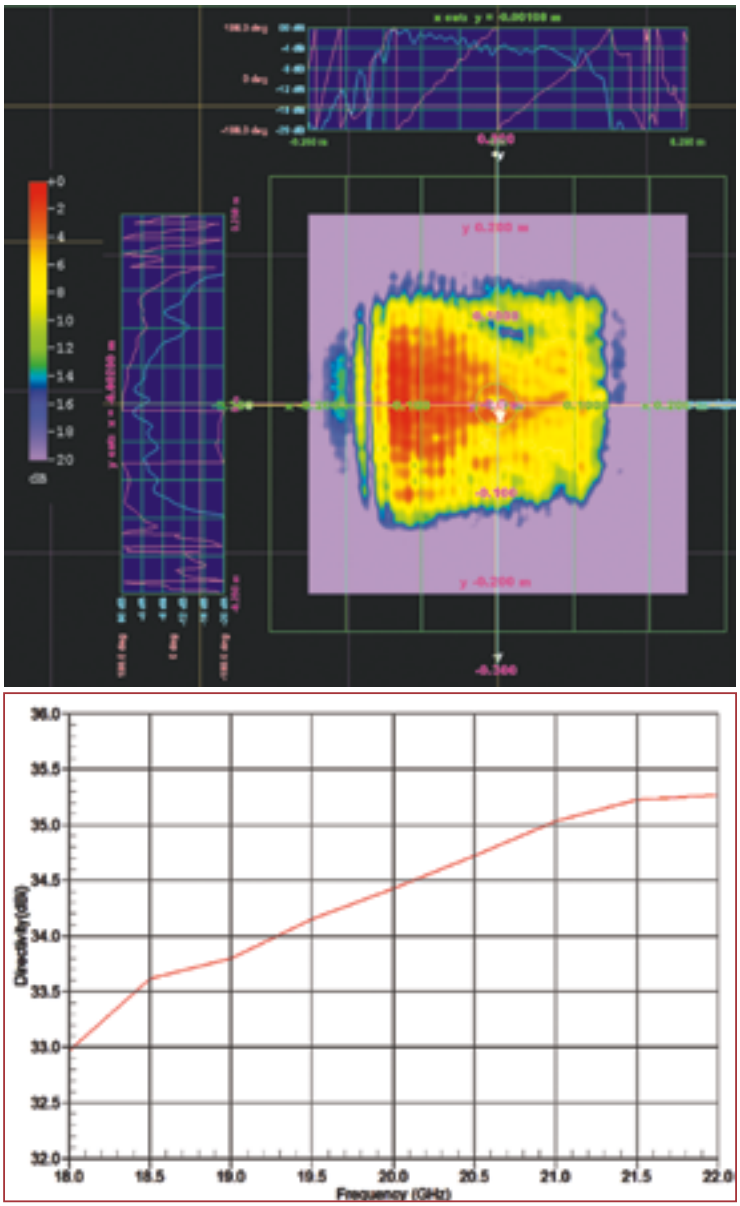


Figure 6 - Holographic Mapping of Gain vs Frequency.

The bottom part of Figure 6 shows the increase in antenna gain with frequency, as would be expected.

Test Results Monopulse Measurements

Monopulse tracking has been used with parabolic antennas for radar and satellite terminals for over 50 years. There are various implementations of this method but the common objective is to generate what is referred to as a 'difference' pattern which has a null along the antenna boresight, so that the antenna can be steered by searching for the location of an exact monopulse-generated null, to indicate true boresight.

By comparing this difference pattern with the main beam, often referred to as the 'sum' signal, precise alignment is possible by comparing the difference to the sum, and minimizing this ratio. Additional information about how far the antenna is pointing off boresight can be extracted from the amplitude and phase of the difference signal with respect to the sum signal.

This means that the antenna pointing can be corrected virtually in one step. With circularly symmetrical antennas, it is comparatively easy to derive tracking signals along orthogonal axes. With the FPA this is not so straightforward. The monopulse circuit implemented for this version of the prototype antenna was tested for tracking along only one axis initially.

The preliminary tests verify that the monopulse approach is capable of achieving quite good tracking in one plane.

Figure 7 (below) shows the sum (left) and difference (right) patterns that can be generated by the FPA and used for locating true boresight. The SUM is a maximum along the main axis and the DIFF is a relatively sharp minimum along that axis. This shows that the monopulse circuit works well along that axis.

In Summary

EM Solutions is developing a true flat panel antenna with reconfigurable beam steering, initially to cover Ka-band frequencies.

The company has been able to confirm that an acceptable pattern can be produced using the antenna, and that the pattern can be steered by shifting the leaky wave surface.

Furthermore, the patterns can be achieved across a broad bandwidth, and match the simulated patterns well. A way to achieve monopulse pointing has also been demonstrated.

In short, EM Solutions has found a pathway to duplicate the competitive advantages of the company's parabolic antennas — broad bandwidth across an entire band, and highly accurate and responsive monopulse tracking in a totally flat configuration.

All the while remembering that it's horses for courses...

www.emsolutions.com.au

Dr. 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.

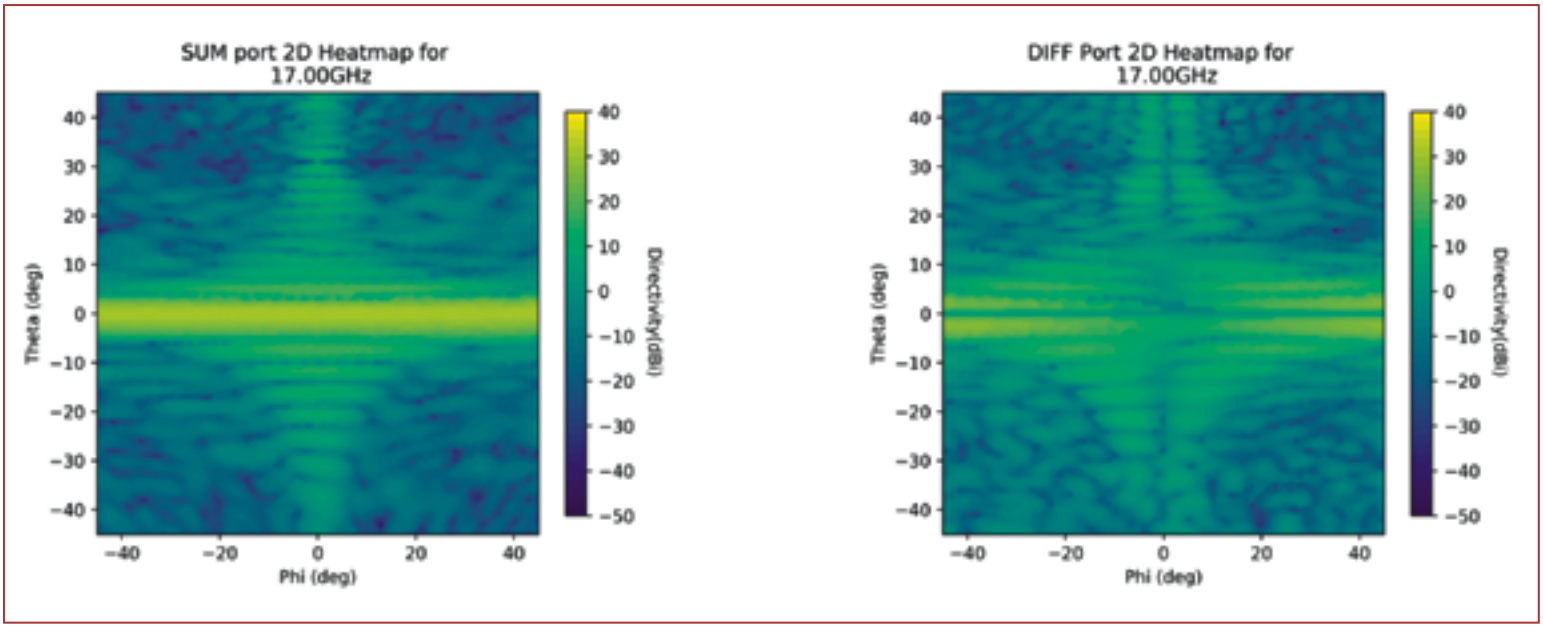


Figure 7 – "Sum" (right) and "Difference" (left) Power Levels Generated by the Monopulse Circuit.

COMING TO A MILITARY MISSION SOON…

Switching between MILSATCOM and COMSATCOM on the fly

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

This is a Satellite Transportable Terminal (STT), used by the Project Manager (PM) Tactical Network program. STTs, which provide critical infrastructure in the U.S. Army's Tactical SATCOM network, are good candidates for the EM&C architecture. Photo is by Staff Sgt. Rubin Tan, 1st Marine Logistics Group.

Roaming capability to provide U.S. Warfighters with path diversity for more resilient satellite communications

Operating in a connected world, Warfighters and consumers have something in common: little tolerance for disrupted communications. But whereas a teen's cell phone can seamlessly roam a grid of networks, staying connected while video chatting with friends, the Special Ops team sharing critical intel is tied to a single SATCOM link, which if compromised, could take weeks or months to change out.

That inability to quickly switch to an alternative SATCOM service in the face of what are expected to be increasing attacks on satellite communications created an untenable scenario, one that led the U.S. Air Force (USAF) to pursue a new SATCOM model known as Enterprise Management and Control (EM&C).

EM&C is addressing numerous shortcomings and concerns identified by the government and military leaders who have cited the need for more agile, resilient, and secure SATCOM as adversaries step up their disruptive capabilities and intent.

Initiated as a pilot program between the USAF and industry, EMC is leveraging commercial innovation to create an open architecture that will unify and automate many new SATCOM functions that simply aren't possible given today's largely inefficient, stove-piped systems and manual processes.

One of EM&C breakthrough features is an automated roaming capability that can dynamically switch among MILSATCOM and commercial SATCOM networks (COMSATCOM) to keep warfighters connected in the face of interference, network outages, or other disruptions and threats.

For the tactical warfighter on the move, whose network is being denied or degraded, EMC will find, configure, and connect to alternative SATCOM resources on the fly. Akin to our experience and expectations with cellphones, this re-provisioning will occur nearly as quickly and easily as connecting to a WiFi network at the airport.

And it will provide this near instant path diversity without intensive capital replacement or acquisition. Rather, EM&C's software-defined architecture will allow the Department of Defense (DoD) to update the vast majority of its current wideband infrastructure using

EM&C's open architecture and software can be mostly layered on top of existing DoD systems and equipment, providing an interoperable and flexible way to utilize current and future SATCOM assets.

Image of current RF COP developed as a tool for Kratos' RF and Network monitoring capabilities. Image is courtesy of Kratos Defense.

inexpensive software upgrades or hardware integration into existing terminals rather than wholesale replacement.

Intelligent Awareness & Automation

While simple in concept, EMC's under-the-hood intricacies are substantial. EMC works by combining flexibility embedded at the terminal level with enterprise components that manage and control why, when, and how the system should roam and transition.

This is made possible, by the system's "Satellite Situational Awareness — Common Operating Picture" (SA-COP), a capability that is a current focus area in EM&C's latest phase of development. The SA-COP provides the enterprise-wide view of all SATCOM resources, including the health, availability, and status of all satellites, gateways, and terminals, including cybersecurity alerts and RF interference detection.

For the deployed unit whose SATCOM connection was disrupted, the SA-COP intelligence will identify the cause of the outage and accordingly select the optimal service path or equipment to circumvent the issue and reestablish connectivity, whether from adversarial interference, network congestion, or equipment failure. EM&C's orchestration tools will then execute all the pieces of the service plan to make the transition, doing so automatically, or alternately, supervised by the human operator.

For warfighters with limited time and expertise to troubleshoot an outage in midst of a SATCOM-dependent mission, this near instant re-provisioning is no small matter. The smart automated switchover occurs in only seconds to minutes versus what otherwise would take weeks or months.

From Concept to Reality

These recent SA-COP and orchestration capabilities expand on EM&C functions developed under previous Pilot I and II programs.

Earlier this year, EM&C prototypes successful demonstrated the ability to roam among heterogeneous networks, enabling secure SATCOM across multiple operator networks.

The demo used a Special Operations Forces Deployable Node terminal (embedded with EM&C software) to transition across three different satellites (Intelsat Galaxy-16, Intelsat Galaxy-18, and SES-1), and connect to three separate, geographically diverse teleport locations. This prototype showed the ability to automatically reconfigure a government multi-band terminal and network in response to interference, congestion, or changing mission needs in minutes, using equipment representative of current infrastructure.

While the tactical advantages to the soldier in the field are obvious, DoD will also benefit from enterprise-wide efficiencies. With EM&C scaling to DoD's global network of satellites, gateways, and terminals, it will be able to manage and optimize utilization of its SATCOM resources and bandwidth, from its fully owned Wideband Global SATCOM system (WGS) to the capacity it leases from 3rd party operators.

Modify vs. Replace

While other concepts for enterprise management and control of SATCOM exist, they come with trade-offs in terms of costs, flexibility, and control.

For example, vertically integrated solutions based on proprietary technologies would require the DoD to replace or radically modify existing equipment to include proprietary systems, effectively causing the DoD to abandon a significant amount of infrastructure it has already invested in and fielded.

In contrast to the closed system approach, EM&C's open architecture and software can be mostly layered on top of existing DoD systems and equipment, providing an interoperable and flexible way to utilize current and future SATCOM assets.

This straightforward upgrade/modification will allow DoD to unlock new capabilities, value, and future potential from current infrastructure. Which means, most of DoD's approximately 17,000 user terminals can be easily modified with EM&C capabilities to support an open, multi-vendor architecture, with open standard M&C interfaces to communicate with other terminals or SATCOM gateways.

EM&C's proposed architecture has shown that this vision to access diverse commercial and DoD MILSATCOM resources is attainable with minor modifications to existing equipment and systems. By leveraging this innovation, the U.S. military can realize the all-important objectives of more resilient, flexible, and secure SATCOM, along with gaining commercial benefits such as ease-of-use at the point of need and enterprise-wide efficiency.

Features of Enterprise Management and Control for Satellite Communications (EM&C)

1. Centralized configuration, provisioning, and positive control enabling diverse terminals and architectures to span network stovepipes.

2. Comprehensive centralized Situational Awareness.

3. Significantly reduces time required to provision SATCOM services from weeks/months to minutes.

4. More efficient use of satellite network resources, increasing capacity and/or reducing costs

5. Enhanced resiliency through path diversity enabled by automated roaming.

6. Support for open, multi-vendor architecture and open standard management and control interfaces.

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.

CUBESAT-BASED ISR

Will it fulfill its promise?

By John Beckner, Chief Executive Officer, Horizon Technologies

In the Strait of Hormuz (which one retired Royal Navy Admiral referred to as similar to a "crowded highway"), Iran depends on asymmetrical methods to promote their current political aims and cause trouble for their enemies. That nation does not deploy it's regular Navy conventional vessels to confront the U.S. and its Allies; instead, Iran uses commercial high speed, small naval craft with no AIS and RF emissions cut to a minimum. They prey upon Allied shipping in groups, whether in convoy or not, and are fully cognizant on where U.S./NATO SIGINT assets are located, and their coverage at any given moment. Some call it, "'little green' men on the open seas."

In July of 2019, the Islamic Revolutionary Guard Corps (IRGC) was able to capture the British flagged Stena Impero, despite the presence of British Royal Navy frigates protecting the convoy. Their nighttime helo insertion of special forces raised eyebrows in the region for its sophistication. It is rumored that the insertion of IRGC forces was observed by a lightly-armed RN Lynx helicopter (with orders not to escalate).

Could asymmetrical ISR assets such as cubesats be used in the near future to provide more persistent and flexible ISR? Can the companies moving into this market provide actual solutions to the warfighter, and not just offer maritime "*dark target detection*" (via AIS correlation), and "*AIS-based analytical data for maritime users for ship tracking?*"

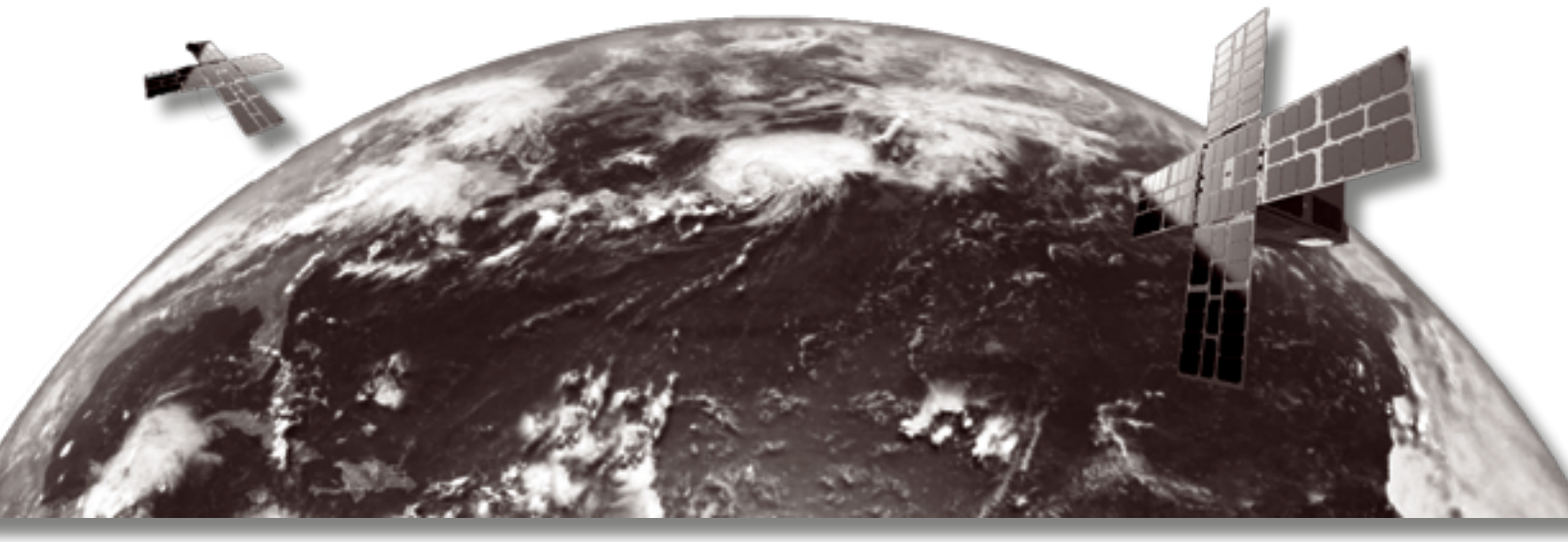
Certainly, cubesat-based AIS tracking has been proven by Spire Global, and there seems to be a solid market for this data, especially when combined with analytics and cued SAR imagery (IceEye, Capella, and NovaSar). The question to ask today is, will these emerging "New Space" technologies actually play a role in military (tactical) ISR?

The subject is complex and the ISR assets required to support peacetime operations such as those operating today in the Persian Gulf are far different than those requested in an actual wartime environment. To those who have participated in NATO wargames, it is well known that the first assets "*swept from the board*" are larger, manned and unmanned SIGINT/ISR assets like Rivet Joint/ Air Seeker, Global Hawk, etc. These assets are clearly vulnerable today and their vulnerability will only increase with new Russian and Chinese missile technology.

In July of 2019, the Royal Air Force (RAF) announced it was going to buy a "*quick reaction capability*" of small Earth Observation (EO) sats from SSTL (Airbus) under the ARTEMIS program. They will be launched by Virgin Orbit's innovative horizontal launch vehicle, which has major advantages over traditional horizontal launchers; different, optimal orbits can be obtained due to the flexibility in using runways around the world as space launch sites. Once this capability is operational, the question is: Will the refresh rates/ persistence be adequate to image the required target sets with a small number of EO satellites.

In December of 2018, the U.S. company HawkEye 360 (HE360) launched their first constellation of three (3) formation-flying RF SIGINT smallsats (12U) using traditional Direction Finding/TOA ESM techniques. According to the data presented at conferences by HE360, their performance has been impressive with detection geolocation of maritime radar emitters, AIS, and VHF transmissions.

In order to be of real value to national government end-users, the data needs to be a level of sophistication higher than needed by the maritime commercial/ fleet management market.



According to HE360, they will need six (6) constellations for adequate refresh rates for worldwide coverage. To meet this not trivial financial expense, Airbus recently announced they were investing $70 million in HE360. Airbus claims that they can offer HE360's RF SIGINT data — together with their own Geospatial data package/ service. While this certainly gives HE360 a path to the international market, one wonders about the ITAR constraints which will be put on this data.

Other players entering this market are the Luxembourg-based / Australian-listed KLEOS Space which plans to eventually launch groups of four (4) cubesats (similar to the HE360 concept) to retrieve VHF radio signals from space and offer that as RF reconnaissance data for maritime tracking.

SIGINT OEM Horizon Technologies of the UK was recently awarded a contract by the UK Government for their Amber SIGINT cubesats that will pick up a variety of signals, including Sat Phones, AIS and radars, starting in 2020. In Australia, DEWC Systems has announced plans to launch SIGINT smallsats in 2021.

In order to be of real value to national government end-users, the data needs to be a level of sophistication higher than needed by the maritime commercial/fleet management market.

The imagery must produce 1 meter resolution and the RF SIGINT data needs to geolocate the threat emitters (to a high degree of accuracy), it needs to fingerprint the radars for inclusion in national EW databases, as well as be able to capture other emissions, like Sat Phones, radios and Sat-based datalinks.

The content and metadata captured needs to be decrypted by national governments. Refresh rates of less than 60 minutes are desired as well as geolocation of less than one (1) km.

While maritime X-/S-band radar data is of interest, and can help immensely for certain missions, the full SIGINT spectrum of 2 to 18 GHz is clearly the goal of many governments. Naturally, this is not a commercial system, but an export-controlled military ISR capability.

If a full spectrum, robust, and rapidly refreshed SIGINT cubesat constellation can be launched and supported, the data provided by this system would be "*gold dust,*" according to one UK MoD user.

Perhaps in the next few years, hot spots such as the Strait of Hormuz will be covered by EO, SAR, and SIGINT smallsat constellations with their collected data fed into the Joint HQ in Bahrain.

Large amounts of data on an opposing force (OPFOR) "*pattern of life*" will be collected and hourly updates of OPFOR movement will be added to the existing manned and unmanned ISR assets in the region.

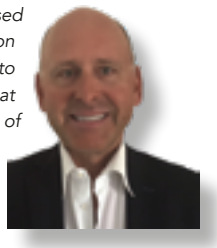
Looking into the mid-'20s, these constellations could be closely tracking Russian and Chinese military emitters all over the planet. The world has the potential to become a much more opaque, and thereby a safer place as any large-scale terrestrial or naval movements would be quickly spotted and made public.

The U.S., UK, France, Australians, and other nations, are actively promoting smallsat development in this field. Good examples are the UK, via their Satellite Applications Catapult, and the U.S. with its USAF Catalyst program.

The jury is still out as to whether the current generation of cubesat constellations can fulfill their promise and "jump" from the commercial geolocation/EO market into the military ISR market where their value can be extensively utilized. The next few years will be decisive.

www.horizontechnologies.eu

John Beckner is the CEO of UK-based Horizon Technologies. Horizon Technologies is under contract to launch the UK's first SIGINT CubeSat constellation, Amber, as part of a public/private partnership sponsored by Innovate UK and the Satellite Applications Catapult.



PROPULSION COMPONENT QUALIFICATION AND PRODUCTION TESTING

By Chris Johnson, Project Engineer, Experior Laboratories

Recent advancements in small satellite technologies are transforming the commercial space industry. Space flight is getting cheaper and payloads are getting smaller.

This has spawned new market segments, including small payload launch vehicles and micro-satellite propulsion systems. This has also resulted in a substantially lower barrier to entry and created an opportunity for tech startups to flourish.

This modern-day space race is driving competition and ultimately shortening the time to market.

This article offers a high-level overview of the major challenges associated with executing an expedited propulsion component qualification test program and to offer valuable industry insight on steps that can be taken both in the test planning and design phases to optimize test flow execution and mitigate schedule delay risks

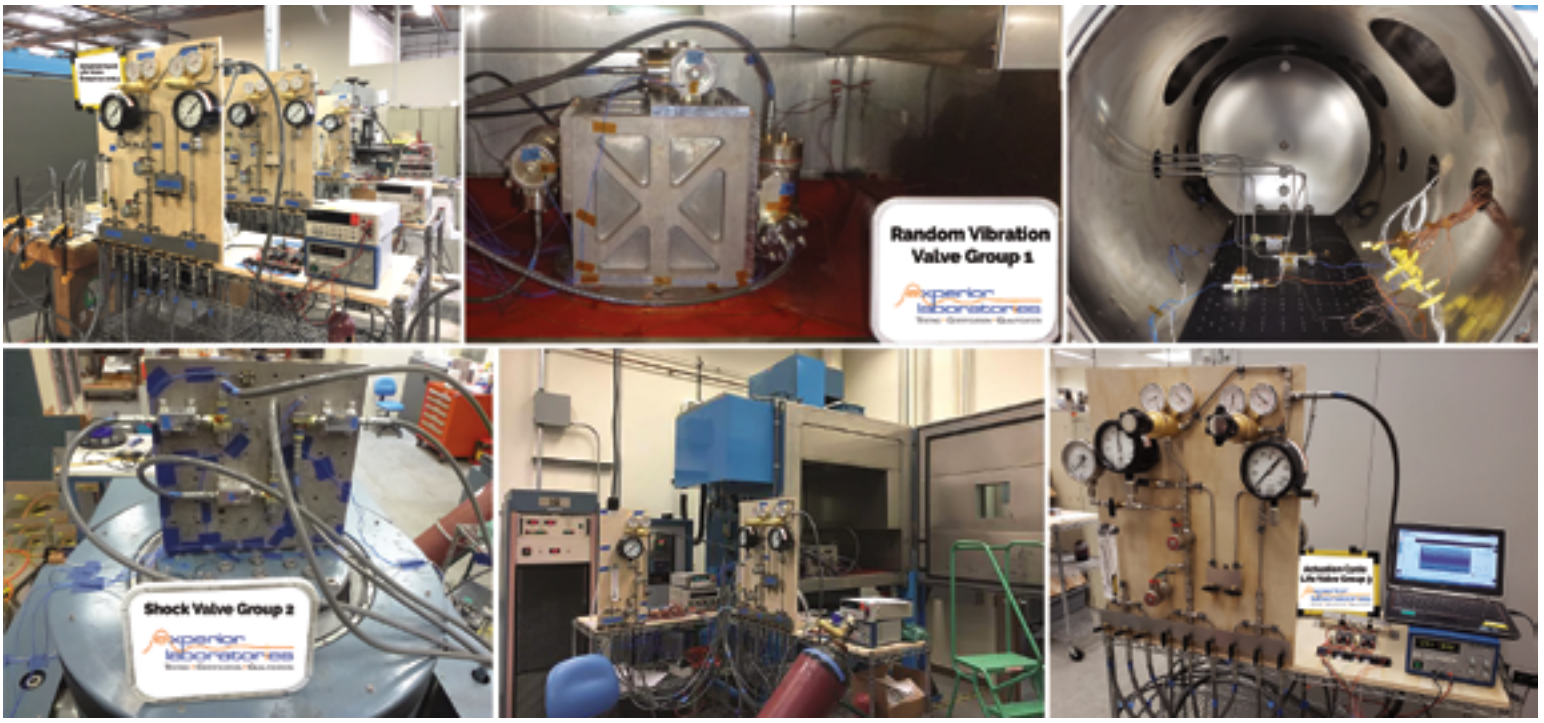
To do so, various elements of a previous propulsion component qualification test program will be examined to highlight the key take-aways that led to a successful test campaign. In this program, three pneumatic valves — serving as key components of a launch vehicle propulsion system — were qualified for flight in conformance with Flight Terminations Systems Commonality Standard RCC 319-14, FAA Title 14, MIL-STD-461 and MIL-PRF-27401.

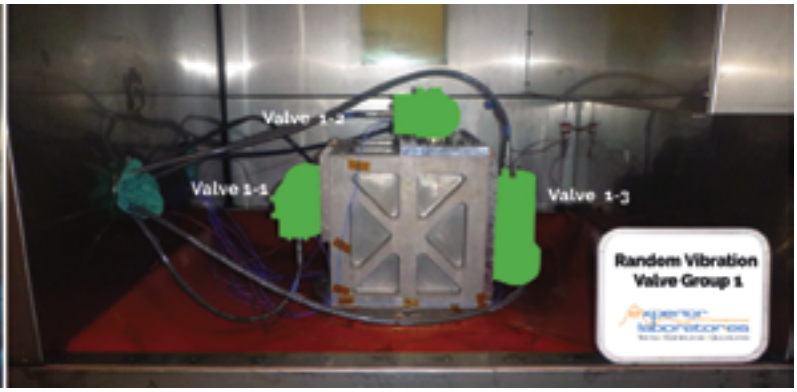
The customer supplied three identical qualification test articles for each valve group to move through the full test sequence, including Bench Handling Shock, Transportation Shock, Transportation Vibration, Random Vibration, SRS Shock, Thermal Vacuum, Thermal Cycling, EMI/EMC, Actuation Life Cycle and Extended Stall.

The crucial first step in the program planning phase was to build an accurate schedule forecast to confidently identify key program drivers and possible bottlenecks that could be optimized to satisfy the customer's strict timeline requirements needed to receive FAA approval.

From here, the team at Experior Laboratories was able to leverage their facilities' environmental and dynamic test system resources to parallelize Vibration, Shock, Thermal Cycling and Thermal Vacuum Tests while still being cost-effective.

Rapid hardware development is quickly becoming the status quo in the commercial space market and it's clear that the supporting qualification test programs will have to adapt to this agile approach in a similar fashion to facilitate the needs of the expanding modern space market.





This ultimately drove the decision to build three separate mobile pneumatic test setups and dynamic test fixtures to accommodate the parallel test flow approach and customize each setup to its respective valve group.

All qualification test units underwent functional actuation and external leak tests before and after vibration and shock testing to verify no damage occurred as a result of simulated dynamic or climatic stress.

Random Vibration

All three test article groups were required to meet the RCC 319-14 specifications for Random Vibration. The Valve Groups 2 and 3 were mounted to a single vibe fixture. The Valve Group 1 test articles were significantly heavier and as a result utilized their own vibe fixture.

A low-level resonance sweep was performed before and after Random Vibration as a full system checkout to verify the induced dynamic loads did not augment the test articles' structural modes. The units were pressurized to their respective maximum system operating pressure (MEOP) and ramped up to the maximum predicted environment (MPE) temperature until stabilized.

Shock

Electrodynamic shakers were used for vibration to meet the RCC 319-14 shock specifications for both Valve Groups 2 and 3. This greatly reduced setup efforts which is often the most time-consuming element of any dynamics test.

The Kinetic Impact Pyrotechnic Simulation (KIPS) – developed at Experior Labs – was used to meet the shock requirements for Valve Group 1 and was performed in parallel with the other test groups.

Thermal Cycling

Thermal cycling was required for Valve Groups 1 and 3. All test articles were pressurized to MEOP and two separate thermal chambers were used in parallel to simulate RCC 319-14 required specifications for Thermal Cycling.

Thermal Vacuum

The electromechanical Valve Group 2 required Thermal Vacuum testing per RCC 319-14 specification. The test articles were pressurized before the chamber was pumped down. Once stable chamber pressure was achieved, temperature was ramped to the Upper and Lower MPE specifications and Actuation Tests were performed on all test articles to verify performance in their maximum predicted environment (MPE).

Actuation Life Cycle

To further optimize the schedule, the team was able to implement automation capabilities into the pneumatic test setups.

All test articles were required to undergo Actuation Cycle Life tests in compliance with RCC 319-14 4.20.13 specification for pneumatic components. This required all pneumatic test articles to undergo 500 actuation cycles at MEOP to satisfy performance requirements.

A customized control and data acquisition system was implemented into the test setup to automate this test for overnight operation and eliminate the need for manual valve actuation.

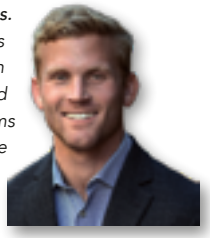
The team identified that the equipment procurement, fabrication, assembly and validation of the pneumatic test setups was an obvious bottleneck in the program, early in the design phase.

Off-the- shelf solenoid valves, used as actuators to regulate pressure, and external electronics were selected to ensure on-time delivery. Experior Labs leveraged its expertise in pneumatic setup design to select reliable and short lead-time, cost-effective components to satisfy test specifications.

Conclusion

Through diligent planning, experienced design choices and outstanding project management, the Experior team was able to endure a demanding test campaign and maintain an on-time trajectory to meet customer schedule requirements. Rapid hardware development is quickly becoming the status quo in the commercial space market and it's clear that the supporting qualification test programs will have to adapt to this agile approach in a similar fashion to facilitate the needs of the expanding modern space market.

www.ExperiorLabs.com/Propulsion



*Chris Johnson (**cjohnson@experiorlabs.com**) joined Experior Laboratories as an Instrumentation Engineer in 2017. He has worked on a broad range of environmental test programs requiring reliable custom software solutions for control, automation, and data acquisition applications ranging from long duration control, to mission critical transient capture events. He graduated from University of California, Santa Barbara in 2016 with a BS in Electrical Engineering and is now developing his skills as a Project Engineer for the environmental/dynamics team at Experior Laboratories.*

Experior Labs is a southern California based, third-party test laboratory providing independent design verification and qualification testing services to component and system manufacturers, military contractors, integrators and system providers within the military, aerospace and space industries.

To facilitate the expansion, Experior Laboratories raised the roof on an 11,000-square-foot industrial space to 33 feet and included a 15-ton bridge-crane and two Unholtz-Dickie T4000 electrodynamic vibration systems that together produce 80,000 pound-force for testing heavy-duty equipment used on rockets, missile systems, satellites and the like.

CAN THE NEW SPACE SUPPLY CHAIN PRODUCE NEW NATIONAL SPACE ASSETS?

By Will Francis, Chief Products Officer, Roccor

At a recent forum convened by Aerospace Corporation to discuss U.S. national space assets, Lt Gen. John "JT" Thompson, Commander of the Air Force Space and Missile Systems Center (SMC), said: "We must change our acquisition approach to stay ahead of our adversaries in space and to provide more capability for all our warfighters."[1]

As an illustrative example: cell phones and tactical military radios work when they have "*line of sight*" to the receiving station. If you are over a hilltop or behind an obstruction, the radio waves are blocked.

A decade ago, the U.S. Marine Corps (USMC) started equipping their expeditionary forces with Iridium satellite phones as a stop-gap solution to the problem. However, the Iridium satellite constellation isn't well designed to handle the load of encrypted and secured military communications. As sergeant ***Reggie Dela Cruz*** found on deployment with Marine Corps squadron VMM-263, talking over the Iridium phones in theater was like "*talking between two tin cans.*"

A decade later, the former Marine sergeant is now a composite fabrication technician at Roccor responsible for building key parts of a small satellite radio antenna that will fly on a pathfinding mission for prime-contractor Viasat. According to Viasat, the spacecraft is "*intended to enhance warfighters' situational awareness by extending the range of Link 16 networks — using a constellation of satellites to provide greater access to Link 16 capabilities in contested or congested environments (and) significantly enhancing mission effectiveness.*"

In less than two years from start to finish, the mission is designed to demonstrate that a smallsat constellation can eliminate blind spots and drop-out zones for military tactical communications networks. If the system works, troops won't have to carry a second "*cranky*" phone or worry about whether their primary field radio will maintain a temperamental line of sight connection — a capability that doesn't exist at present.

Proving such a system can work in a very short timeframe is one thing. Making such a system attractive to military acquisition programs is another thing altogether.

For the most part, these commercial prime contractors have become comfortable managing the supply chain through performance-based specifications rather than strict engineering oversight.

[1] *https://aerospace.org/press-release/aerospace-industry-takes-action-outpace-threat-space*

In order for these pathfinding missions to influence the conversation over next-generation national space assets, it is critical that they prove both technical feasibility and viability of an emerging new space supply chain that can deliver needed capability affordably and responsibly.

Just as Toyota proved to the automotive industry in the 1980s, changing paradigms of satellite design and performance requires changes in supply chain management.

America's national space asset Tier 1 contractors are learning that meeting the Department of Defense's (DoD) evolving affordability and resiliency goals demands an agile supply chain of Tier 2 and 3 subcontractors capable of producing component designs that can deliver unprecedented performance to vanishingly small satellite platforms.

Moreover, these subcontractors must be organized to execute development programs cost-effectively without a standing engineering army that feeds on design change orders and encourages the schedule to "*push right*" for reasons of self-preservation.

While national security may restrict disclosure of mission details, two-way transparency is critical between the prime contractors' engineering teams and those of the Tier 2 and 3 subcontractors. Becoming a "bonded" supplier to this elite mission community requires a passion for fast product development cycles and a commitment to delivering on time and on budget.

While the business long game is in the recurring orders for second, third, and fourth-generation constellations launched by these companies, the important starting point is ensuring the first-generation systems work.

At the recent Small Satellite 2019 Conference, Colonel ***Russell Teehan***, the SMC Portfolio Architect, stated that a modern and resilient space architecture will require us to *"enhance (the) rate of production via development, partnership and business practice improvements."*

During the past five years, commercial constellation providers such as OneWeb, SpaceX, and a myriad of smaller space 2.0 suppliers, have begun building a rapidly growing supply chain for whom "*smaller, cheaper, and faster*" are standard engineering specifications.

For the most part, these commercial prime contractors have become comfortable managing the supply chain through performance-based specifications rather than strict engineering oversight. Now, this commercial resource is poised to help the DoD achieve new goals of resiliency and agility in the high ground of national space assets.

The key to achieving this vision, as Lieutenant General Thompson recently intimated, is in evolving the acquisition paradigm for national space assets in a way that allows the agility and responsiveness of this supply chain to prevail.

roccor.com

Will Francis is the Co-Founder and Chief Products Officer of Roccor with more than 15 years of experience in developing emerging technologies and flight qualified subsystems for satellites. Roccor is a world leader in low-cost composite deployment systems, power systems, and thermal management devices for commercial and military satellites.

FOCUS: VIASAT'S UK BUSINESS

Protecting the nation and boosting Britain's economy

By Kim Hampson, Marketing Director, Viasat

Viasat is beefing up its UK operations with new projects that support British defense capabilities as well as boost the nation's economy. In addition to offering numerous interoperable defense capabilities, Viasat's UK business is expanding locations, hiring local defense and technology experts and developing a range of sovereign British-designed solutions that will help move and support the MoD into the new age of technology driven deterrence.

"*Over the past two decades, Viasat's UK defense business has expanded to new strategic locations and developed an expansive portfolio of expertise and technology capabilities across tactical networking, information assurance, cybersecurity and satellite communications market segments,*" said ***Ken Peterman***, Viasat's President of Government Systems.

Ken Peterman.

"*We see a significant growth opportunity in the UK defense market,*" Peterman recently told the ***San Diego Business Journal***. "*We are committed to working with the Ministry of Defence (MoD) to rapidly and affordably bring forward game-changing technology capabilities for UK warfighters operating across the battlespace.*"

Viasat's UK operation dates back to 2000. The company's security and next-generation tactical data links presence already extends across multiple defense programs, from the Royal Air Force's new F-35 stealth fighter to Royal Navy warships.

Viasat's broad portfolio of industry-leading tactical networking products such as the company's ***Battlefield Awareness Targeting System-Dismounted (BATS-D)***, the world's first handheld Link 16 tactical radio, are available to help the MoD modernize its forces today.

Viasat's UK growth plans come at an opportune time, as the British government and MoD look to modernize forces and expand capabilities across the battlespace.

Using the BATS-D device, a soldier on the ground has a much better connection to aircraft for close air support. Image is courtesy of Viasat.

In addition, Viasat's Multi-Mission Terminal (MMT) offers the MoD's small teams and HQs a man-portable terminal for secure SATCOM.

"*It's taking high-throughput SATCOM capabilities into a manpack-sized unit, instead of the large mobile antennas the MoD tends to currently use*," said ***Steve Beeching***, Managing Director of Viasat's UK business. "*It's enabling access to high-capacity SATCOM to deliver high speed, secure capabilities in a small form factor, which is particularly useful for small team deployments.*"

Future Plans

Viasat has even bigger plans for the future of its UK defense business. Viasat's UK growth plans come at an opportune time, as the British government and MoD look to modernize forces and expand capabilities across the battlespace.

While several major MoD acquisition programs — such as aircraft carriers, Ajax armored vehicle and F35 jet fighters — are already underway, there is an overwhelming need to develop new technology capabilities to better enable and connect these capabilities and wider users.

Viasat is already engaged in some of the most high-profile UK MoD initiatives expected to launch over the next few years — including the Skynet 6 satellite communications (SATCOM) program; the TRINITY "broadband in the battlespace" initiative; and the Morpheus next-generation of battlefield communications. Over the next 18 months, Viasat's UK presence is expected to continue to grow, creating jobs and generating investment in local economies.

During a recent visit to Viasat's Aldershot campus, ***Leo Docherty***, a Member of Parliament, echoed the positive impact Viasat can make to the UK economy and the importance of the MoD defense capabilities the company is bringing forward.

"*It was great to visit Viasat's UK headquarters, a growing and innovative global communications and security company within my constituency*," said Mr. Docherty. "*I'm excited to support Viasat's investment in the UK and the value the company can bring to the nation.*"

New HQ in the UK

As part of Viasat's strategic growth plan, the company recently moved its UK defense headquarters to the M-3 high-tech corridor, closer to both customers and research centers. Today, Viasat's Aldershot campus is making significant advancements in the areas of security, tactical communications and satellite communications.

"*We are using our skills, expertise and expansive network in the UK to rapidly enable growth and bring forward new technology capabilities in the market*," Peterman said.

Particularly significant is Viasat's June 2018 acquisition of a well-known ground networks company based near Cheltenham, home to government agencies, including the Government Communications Headquarters signals intelligence organization.

Coupled with Viasat's existing network of defense experts and in-depth cybersecurity capabilities, the addition of the Cheltenham company's strong reputation of delivering integrated communications will allow Viasat to offer a suite of advanced services for government missions.

Today, Viasat's Cheltenham office is working on a range of cybersecurity, Internet of Battlefield Things and secure in-car connected technology programs. In fact, Viasat partnered with Bentley Motors last year to develop the first-ever advanced in-car connectivity system with military grade security features that will be rolled out later this year.

"*We implemented the world's first high-speed in-car connectivity and security system that fits in a commercial vehicle*," Beeching said. "*It's a bonded solution that is designed to keep users securely connected — no matter the location.*"

Hybrid Networking

As in the U.S., the British government is also looking to the high-speed, secure, resilient connectivity and cutting-edge technology capabilities of private sector SATCOM providers.

Thus, Viasat is developing Hybrid Adaptive Networking — which combines military and commercial satellite networks — specifically tailored for British defense and government customers.

As part of this effort, Viasat has worked with the UK Space Agency and ESA to connect ambulances operating in rural areas, as well as unmanned systems for both commercial and government missions.

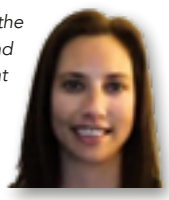
Viasat's UK business is also working to further develop a concept that would connect Low Earth Orbit (LEO) to Geostationary Orbit (GEO) satellites to deliver real-time imagery.

"*Viasat's UK business is already working with the MoD and UK government on a range of initiatives and programs*," Beeching said. "*We are poised to be a national asset to the UK government — ready to address emerging threats from adversaries and help the MoD better connect its forces across today's rapidly evolving battlespace.*"

"*We have quite an aggressive roadmap and we're looking forward to what the future holds for our UK Government Systems business*," Peterman added.

www.viasat.com/industries-applications/defense

Kim Hampson has been tracking the defense industry for over 10 years, and serves as Marketing Director for Viasat Government Systems.



SLINGSHOT SUCCESS

At the U.S. Army's Expeditionary Warrior Experiments

In the wake of escalating global interest in and sales of their game-changing SlingShot communications system, Spectra Group (UK) Ltd. was selected to take part in the 2019 series of U.S. Army Expeditionary Warrior Experiments (AEWE 2019). AEWE, fielded by the U.S. Army Maneuver Battle Lab (MBL) at Fort Benning, Georgia. The exercise focused on small unit modernization, providing capability developers, the Science and Technology (S&T) community, and industry with a repeatable, credible, rigorous, and validated operational experiment, supporting both concept and material development.

Spectra's SlingShot is a unique, lightweight, low-power system that enables existing, in-service tactical military and commercial VHF/UHF radios to utilize commercial L-band satellite coverage (L-Band ComSatCom). The technology delivers Beyond Line of Sight (BLOS) and Comms-on-the-Move (COTM) with low-latency voice and data connectivity to radio networks for ground, vehicle, maritime or airborne platforms, with or without encryption. SlingShot's unique capability provides reliable, secure communications between widely dispersed military forces and/or civilian agencies operating in austere and hostile environments, without the delay or logistical challenges of deploying additional infrastructure.

SlingShot was invited to take part in AEWE 2019 by the U.S. Army Training and Doctrine Command (TRADOC), selected alongside a number of emerging technologies identified for integration into the U.S. Army to gap future battlefield capability shortfalls. Extensive planning, testing and evaluation was conducted throughout 2018/9, including SlingShot achieving safety accreditation from the U.S. Army Test and Evaluation Command, and culminating in an Army War Gaming Force on Force (FoF) Exercise conducted in February and March 2019.

The analysis team collected data through various methodologies including observations from SMEs and user surveys.

During AEWE, soldiers using Slingshot at the pause.

Rigorous Testing and Evaluation

The exercise consisted of U.S., UK and Australian military units operating in a wide range of squad, platoon and company level operational scenarios. These scenarios included movement to contact, offensive and defensive kinetic operations.

During the scenarios, the SlingShot system was evaluated extensively alongside various industry technologies, providing BLOS voice and data connectivity from tactical manpack recce sections to vehicle-borne forward observers and battalion level headquarters tactical operations centers.

The evaluation was conducted throughout by the Mission Battle Lab (MBL) analysis team, who led, coordinated and managed all aspects of data collection during the Networked Assessment and FoF Phases of the Exercise. This team included members from multiple participating agencies including the Cyber Center of Excellence (CCoE), the Maneuver Center of Excellence (MCoE), and the British and Australian Armies.

The analysis team collected data through various methodologies including observations from SMEs and user surveys. MBL personnel conducted focused interviews throughout the exercise, administering surveys at the conclusion of the experiment, focusing on the effectiveness and suitability of the system.

Four Soldiers from an Australian reconnaissance section employed SlingShot during the squad, platoon and company Situational Training Exercise (STX) phases of the FoF exercise. Vital system interoperability between commercial and military radios, UHF to VHF and vice versa, was proven in a number of operationally challenging scenarios using all three variants being evaluated — manpack, vehicle and operations room.

Reliable, responsive BLOS COTM were maintained with all the SlingShot systems, including in vehicles traveling at 80 mph and throughout the extensive Fort Benning training area and to a distance of approximately 40 miles North of Fort Benning where LoS communications failed.

That distance could well have been many hundreds of miles more, had it been required. During AEWE 2019, SlingShot further proved its ability to remove the necessity for hill-top repeater sites to extend radio communications, thereby negating the associated manning and logistic requirement for the provision of power, force protection and resupply.

Ease of Use, Utility and Effectiveness

The AEWE 2019 findings stated "*SlingShot performed as intended enabling the reconnaissance section to maintain communications with the battalion throughout the experiment. During the excursion, soldiers had no issues transmitting both data and voice transmissions, while stationary and on the move, from approximately 40 miles away. In addition, the system enabled interoperable communications between soldiers using various frequency bands and radio types. All four soldiers felt the SlingShot greatly increased their ability to communicate when terrestrial networks were not available. When asked to rate the effectiveness of the system for maintaining communications and position location information when terrestrial networks were not available, all four soldiers rated the system as effective or very effective.*"

In terms of use, rather than capability, it was found that "*SlingShot was easy to employ and soldiers reported no issues when connecting the system. When asked to rate the acceptability of the size and weight of the system, considering the capability it provides, all four soldiers rated the system as very acceptable for both. The soldiers reported no compatibility issues during the experiment.*"

Summarizing, AEWE reported that "*Slingshot performed as intended, enabling the reconnaissance section to maintain communications when terrestrial networks were not available. The system proved easy to use, allowing Soldiers to rapidly connect and communicate without interfering with operations.*"

Although aircraft and maritime assets were not available for AEWE 2019, SlingShot was used successfully in all the operationally challenging situations in which it was involved, in the manpack and vehicle roles. SlingShot is also able to provide BLOS COTM and interoperability on fixed/rotary wing aircraft and maritime platforms.

https://www.spectra-group.us

Spectra Group (UK) Ltd is an internationally renowned specialist provider of secure voice, data and satellite communications systems, specifically optimized for use in remote and challenging environments. They are a world-leading solutions provider of high-grade information security and communication capabilities, with over 15 years of experience in delivering solutions for governments around the globe, elite militaries, Special Forces and private enterprises of all sizes. They were recently awarded the prestigious Queen's Award for Enterprise in the Innovation Category for SlingShot.

Launched in 2013, more than 3,500 SlingShot systems are now in operation world-wide. The system is used by over 20 different organisations, in mostly NATO countries. Spectra continues to expand its SlingShot business into new markets. In October of 2018, following contract successes in North America, Spectra Group (UK) Ltd established new offices in Fairfax County, Virginia, with Spectra Group (US) Inc. Spectra Group's permanent presence in the USA enables them to guarantee closer product support to their existing partners in North America, as well as dedicated product and service support directly to the end-user.

As a dynamic, agile, security accredited organisation, Spectra can leverage their international delivery experience to also provide Cyber Advisory and secure Hosted and Managed Solutions on time, to spec and on budget, ensuring compliance with industry standards and best practices.

TAKING BANDWIDTH TO NEW PLACES

Resourceful Radomes

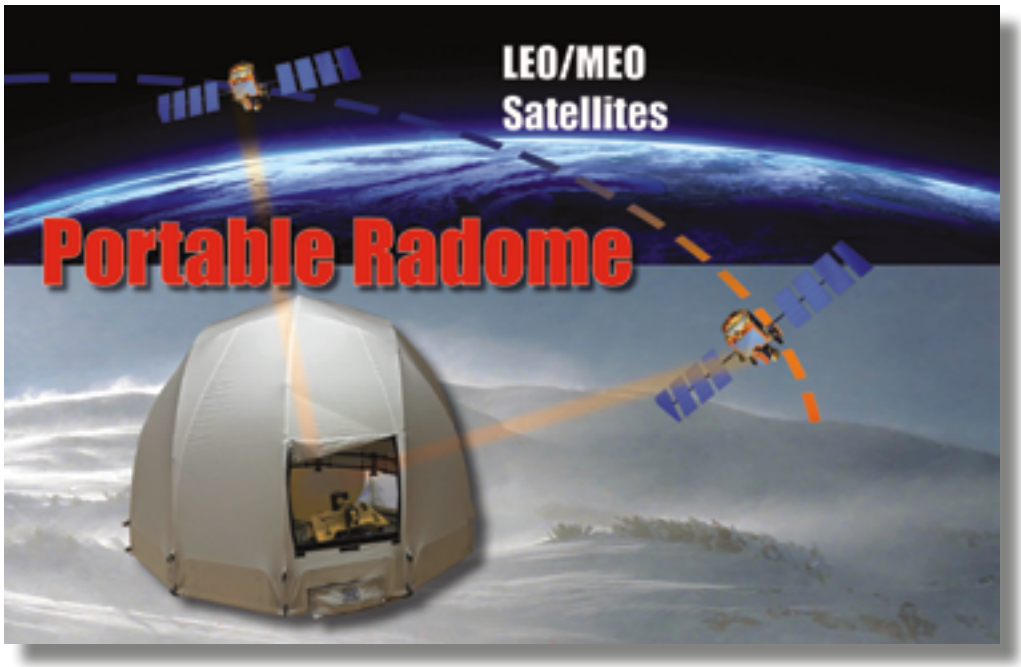
By David Walton, Vice President, Walton De-Ice

Battlefield tactical teams, mobile command posts and special operations units can have requirements for high bandwidth SATCOMS and use vehicle-mounted, VSAT, and handheld systems that need to be available in remote and harsh environments. These kinds of land SATCOM terminals can be subject to extreme weather conditions including snow, heavy rain and moisture, ice, wind and sandstorms, and intense heat.

Traditional Radomes

All-weather operations pose unique challenges in deployment of portable SATCOM terminals. For example, high winds can make it difficult to maintain antenna reflector pointing on the satellite, causing signal outages or interference. Snow and ice accumulation on antennas can cause signal problems and outages.

In sandstorms, antennas, feeds, auto-track drive systems and reflectors must be protected from dust and sand that can cause equipment malfunction or damage. In snowstorm, windstorm, rainstorm, and similar conditions, antenna feeds and reflectors must be protected from snow, ice, rain and winds.



Traditionally, radomes have been used to provide satellite earth station antenna protection from extreme elements. Another benefit is they can prevent hostile air or space reconnaissance forces from viewing the equipment underneath a radome. However, traditional antenna radomes are not built for easy transport.

The latest design of Portable Radome can protect tracking antennas of various sizes from harsh elements.

Transport and Rapid Deployment Challenges

The deployment of transportable SATCOM terminals into far-flung environments for land-based communications creates a new need for equally transportable radome solutions. Many of today's military and first-responder, applications on land require deployable systems where harsh elements demand radome-like protection.

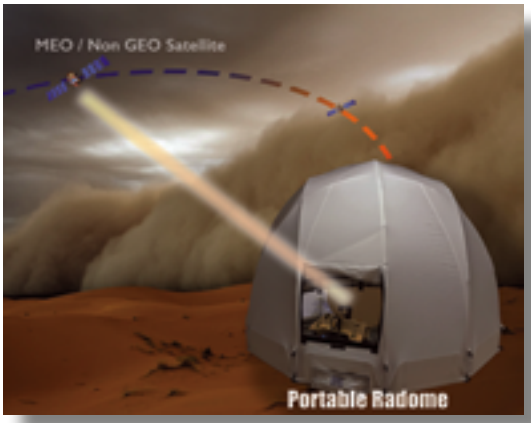
Examples employed by the U.S. military include:

- *Portable Fixed Satellite Services/ VSAT terminals, which can range from .45-meter man-packable systems to nearly 4-meter systems capable of rapid high-bandwidth service activation and use of DISC, WGS, and commercial satellite services*
- *Flyaway and transportable terminals of this type in the 0.5 to 2.5-meter reflector range*
- *The U.S. DOD has also invested in network services that leverage the low-latency, high-throughput MEO 03b commercial satellite constellation for applications. Several terminal manufacturers are supplying the antenna subsystems for terminals to operate on the 03b system. For example, transportable 03b terminal packages offered to U.S. DOD buyers include antennas from General Dynamics, AVL, from .85 to 2.4 meters in size.*

The Portable Radome

The Walton Portable Radome is a new solution for protecting deployable SATCOMS terminals from the elements. The Walton Portable Radome unleashes a whole new set of possibilities for operating Satellite Transportable Terminals (STT) and micro-VSATs in extreme and mobile conditions. This can support military requirements for high capacity data, voice and video capabilities worldwide. It provides a uniquely deployable weather protection solution for applications such as:

- *Military vehicular mount terminals "drive-aways"*
- *Comms-on-the-Pause (COTP) SATCOM antennas*



Artistic rendition of a Walton Portable Radome facing a sandstorm. Image is courtesy of the company.

- *VSATs*
- *Enterprise terminal antennas, and MEO field terminals, and LEO feeder/gateway antennas*

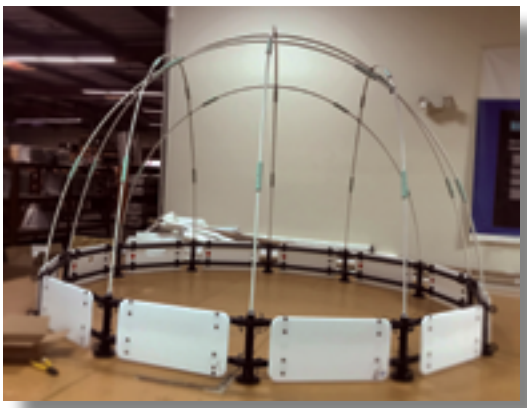
The lightweight, rapidly deployable solution protects antennas from rain, snow, ice, wind, sand, debris and heat. The Portable Radome helps make satellite networks more survivable and deployable into extreme or harsh environments, including windstorms, sandstorms, dust storms, blizzards, hail, torrential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

It also offers cost savings and other advantages compared to traditional Radomes. It can keep away ice and snow, and battle the effects of rainwater accumulation, and heavy winds. In the burning desert sun, the Portable Radome can keep antenna reflectors and outdoor electronic equipment cool — to prevent damage.

RF Transparency

The Walton Portable Radome employs rugged, RF-transparent, 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 station antennas from snow, ice, rain, and sun.

For example, field testing performed by performed by ACTIA Telecom Group, 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 Ministry of Defense of France.



A Walton LEO / MEO dome structure for the Portable Radome. Photo is courtesy of the company.

Protecting SATCOM Tactical 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. It can provide an "extra-ruggedness insurance policy" for the VSAT equipment when there is no way that a repair/replacement part could be fielded in time for a mission.

Highly ruggedized antenna terminals can be costly. Spares and repairs are not cheap. Transportable SATCOMs 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 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 items.

Portable Radome Benefits

Wind Resistance

Operational in an 85 mph (136 kph) constant wind load, the self-supporting structure requires no continuous power, unlike Inflatable SATCOM Antennas (ISA) antenna covers. A Portable Radome can operate at twice the wind load of some popular inflatable systems at sizes suitable for field deployable terminals. But unlike inflatable antenna covers that require a continuously powered blower to stay inflated, the Portable Radome structure is self-supporting.

Deploys Easily to Harsh Terrain/ Remote Sites

For many remote and deployed sites — installation with a crane is cost-prohibitive. For some sites, crane installation is simply not an option, but the Portable Radome can easily do the job, in effect "going where no radome has gone before."

Multi-Band

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

Heating and Cooling

In extremely hot environments, such as burning desert sun, 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 conserves energy. Other functions that can be remotely controlled and monitored include snow detection and precipitation sensing.

Speedy Setup

A single person can quickly and easily assemble the lightweight, rapidly deployable Portable Radome, with no tools.

Light and Airline Checkable

The small flyaway lightweight model (2.13m x 1.68m / 44.45 kg.) is airline baggage checkable. And yet, for all these benefits, it can also support permanent site requirements.

LEO and MEO Ground Cover

The latest design of Portable Radome can protect tracking antennas of various sizes from harsh elements. Walton Portable Radome units can be built to specifications for protecting 03b Dual Transportable Tracking Antennas. The latest design offers enhanced full-arc performance for protecting antennas that require the ability to track satellites at all elevation angels from horizon to horizon.

In addition to the interest in MEO services, U.S. Army battlefield communications leaders and U.S. Air Force leaders, among others, have said they are looking at more LEO commercial high throughput services and technologies for lower latency, high bandwidth battlefield communications in the future. LEO systems can have Feeder Link or Gateway Antenna with tracking antennas that are several meters in diameter. These can be cost-effectively protected as well using the Portable Radome, depending on the antenna size, which can extend up to a few meters.

The Portable Radome from Walton De-Ice creates completely new opportunities for rapid deployment and operation of high-bandwidth SATCOM terminals in harsh and remote environments. It also provides a practical solution for protecting transportable assets, extending the useful life of field terminals, potentially reducing maintenance and other costs, and providing insurance against equipment loss-of-use.

www.de-ice.com

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***

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