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MilsatMagazine

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Avoiding Fair Fights
DoD as a Space Innovator?

Changing Gears in UAS

Saving Time and Resources
Mesh Space and Ground Network

New Partnership = Greater Coverage
Offering a Helping Hand to Canada

The launch of the NRO's NROL-76 aboard a SpaceX Falcon 9 launch vehicle. Photo is courtesy of SpaceX.

MilsatMagazine

May 2017

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NROL-76 awaiting launch aboard a ULA Atlas V at Cape Canaveral. Photo is courtesy of United Launch Alliance.

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DISPATCHES

TWO NRO LAUNCH SUCCESSES IN TWO MONTHS

A National Reconnaissance Office (NRO) payload — NROL-76 — was successfully launched aboard a SpaceX Falcon 9 rocket from Launch Complex 39A (LC-39A), Kennedy Space Center (KSC), Florida , at 7:15 a.m. EDT, on May 1, 2017.

"*Thanks to the SpaceX team for the great ride, and for the terrific teamwork and commitment they demonstrated throughout. They were an integral part of our government/ industry team for this mission, and proved themselves to be a great partner,*" said Betty Sapp, Director of the National Reconnaissance Office.

LC-39A, located at NASA's Kennedy Space Center, is historical for launches dating back to the early 1960s.

Originally built to host the Apollo program, LC-39A supported Apollo 4— the first Saturn V launch, and subsequent Apollo missions including Apollo 11, in July 1969.

In the late 1970s, LC-39A was modified to support Space Shuttle launches, hosting the initial shuttle mission in 1981 and concluding with the final shuttle mission in 2011.

NROL-76 is the second of five launches slated for the NRO in 2017.

A United Launch Alliance (ULA) Atlas V rocket carrying a payload for the NRO lifted off from Space Launch Complex-3 on March 1 at 9:50 a.m. PST. Designated NROL-79, the mission is in support of US national defense.

"*I am so impressed by the incredible teamwork between the NRO, US Air Force our industry partners and the ULA team that resulted in today's successful launch. The integrated mission team overcame many challenges this flow including delays associated with the Vandenberg Canyon Fire last year,*" said Laura Maginnis,Vice President, Government Satellite Launch.

Photo, courtesy of SpaceX, is of Launch Complex 39A and the SpaceX hanger at the Kennedy Space Center.

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"*Tragically, Ventura County firefighter Ryan Osler lost his life en route to assist in fighting the fire. We are honored to dedicate today's mission to Ryan and his family. Thank you to all of the men and women who worked to deliver this critical asset for our nation's security.*"

This mission was launched aboard an Atlas V Evolved Expendable Launch Vehicle (EELV) 401 configuration vehicle, which includes a 4 meter diameter extended payload fairing.

The Atlas booster for this mission was powered by the RD AMROSS RD-180 engine and the Centaur upper stage was powered by the Aerojet Rocketdyne RL10C-1 engine.

This was ULA's second launch in 2017 and the 117th successful launch since the company was formed in December of 2006.

The EELV program was established by the US Air Force to provide assured access to space for Department of Defense and other government payloads.

The commercially developed EELV program supports the full range of government mission requirements, while delivering on schedule and providing significant cost savings over the heritage launch systems.

ULA has successfully delivered more than 115 satellites to orbit that provide critical capabilities for troops in the field, aid meteorologists in tracking severe weather, enable personal device-based GPS navigation and unlock the mysteries of our solar system.

"I *congratulate everyone who made this morning 's launch a success. Without the dedicated commitment from our government and industry teams, working together as one, it would not have been possible. All their hard work has contributed to providing superior vigilance from above for the Nation*," said Colonel Matthew Skeen, USAF, Director, NRO Office of Space Launch.

The next NRO launch is on schedule for August 14 from Vandenberg Air Force Base (VAFB), California.

The NRO is a joint Department of Defense – Intelligence Community organization responsible for developing, launching, and operating America's intelligence satellites to meet the national security needs of our nation.

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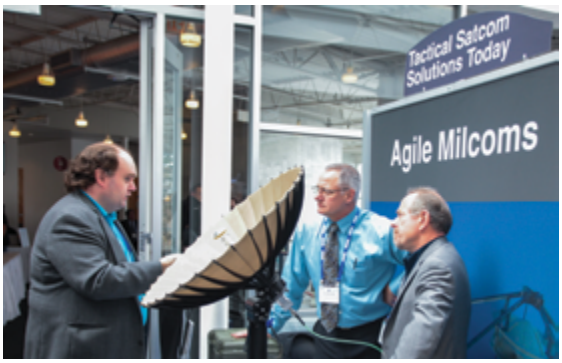

Bridging Innovation and Market Dynamics

Hosted By satnews

Rapidly evolving technology coupled with mergers and acquisitions are changing satellite market dynamics at an accelerating pace. The 2017 Satellite Innovation Symposium aims to pinpoint key imminent market changes that will become obvious in years to come. While infrastructure and capital status have dominated for decades, key innovations will continue to cause major disruptions to the established marketplace. *What innovations will define the satellite communications industry going forward?*

Sessions To Date

- New Horizons in Space: The Innovation Landscape of the Future
- Manufacture and Servicing in Space: New Solutions for What is Needed
- Staying Ahead of Technology: Robotics, AI, 3D, Big Data Analytics and More
- Ground-Based Ecosystems of the Future
- Satellite Constellations – The New Roles of LEO & MEO
- Contemporary Financial Modeling
- Government as Innovators: Incubators, Investors & Customers
- Digesting Software's New Role
- Alternatives to RF and the State of Spectrum
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- Cyber Security - Secure Satellite Systems of the Future

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DISPATCHES

AT THE TRANSFORM AFRICA SUMMIT 2017, INMARSAT'S PLAN

Inmarsat is showcasing how satellite communications can be deployed to deliver unified mission critical data and voice communications at the Transform Africa Summit (May 10th through 12th) in Kigali, Rwanda.

The summit, organized by the Smart Africa Alliance, brings together Presidents and senior government officials from 18 African nations, alongside leading technology innovators, such as Inmarsat.

The purpose of the summit is to discuss and demonstrate how key technologies, including satellite communications, could be deployed in Africa to accelerate socio-economic development. The theme of this summit is Smart Cities and one of the critical developmental areas on the agenda is how technology can be deployed to enhance the safety and security of citizens.

Inmarsat's goal is to demonstrate how SATCOM can enable first responders and other relevant government departments to coordinate security and relief efforts more effectively and operate jointly in ways that were not possible just a few years ago.

Until recently, many security and safety agencies, such as emergency services, defence and intelligence, have operated independently of one another, procuring and deploying their own unique communications solutions to meet individual operational objectives. However, the Internet of Everywhere, Everything and Everyone has transformed how individuals, organized social groups, and commercial companies now communicate and organize themselves, and this transformation has also been embraced rapidly and effectively by criminals and terrorists alike.

The need for responsive and effective joint operations among the security and safety agencies has never been greater and Inmarsat has responded with the rapid innovation of a number of data, video and voice solutions, which integrate terrestrial and satellite communications services in a secure, resilient and cost effective manner.

Inmarsat's Global Government team will be demonstrating a range of mission critical unified communications solutions at the Transform Africa event, which will enable Government officials to see very directly how their security agencies and disaster response organizations can benefit from access to real-time video surveillance, integrated push-to-talk radio networks, and enhanced command and control, and situational awareness, linking their mobile and remotely deployed personnel back to the operational HQ.

Andy Start, President, Inmarsat Global Government, said that the President of Rwanda, H.E. Paul Kagame, recognizes the vital contribution of ICT to the development of African nations and took the lead in establishing the Smart Africa initiative, which many other African nations quickly embraced. Inmarsat was the first private sector partner to join Smart Africa, and we are very excited at the prospect of being able to contribute practically to the objectives of the alliance. The Transform Africa Summit in Kigali provides an unrivaled opportunity to showcase Inmarsat's innovative and compelling solutions designed specifically to address the unique operational challenges faced by security and safety agencies. This all adds up to fewer lives lost to security and disaster incidents and to citizens feeling, and being, safer; to creating a protected environment where commerce and leisure activities can flourish.

Additionally, during this event, Inmarsat announced that, in conjunction with the government of the Republic of Rwanda, the company is launching a series of digital service initiatives across the capital, Kigali, a city of more than one million people.

As part of the digital services initiatives, Inmarsat also signed a Memorandum of Understanding (MOU) with Rwanda's Ministry of Youth and ICT, which will facilitate closer cooperation and coordination between the Government of Rwanda and Inmarsat. The objective of the MoU is to develop a number of key ICT projects aligned with the Rwandan National ICT strategy. That announcement was made by Inmarsat's CEO, Rupert Pearce, at the opening ceremony of the Transform Africa Summit in Kigali (10-12 May 2017), hosted by HE Paul Kagame, President of the Republic of Rwanda.

Under the Smart Africa Alliance, Rwanda is spearheading the smart cities agenda and will showcase the components of the smart city to over 300 city mayors from across Africa. The digital service pilots, which will be enabled through Inmarsat's world-leading satellite communications network, are scheduled to last up to 12-months in Kigali. The results of the lessons learned during the pilots will be used to develop blueprints for a range of digital services initiatives that can be applied more broadly across Rwanda and in other African nations, in conjunction with the Smart Africa Alliance.

The Smart Africa Alliance is a partnership bringing together all African countries committed to the Smart Africa Manifesto and is supported by regional and global bodies including the African Union, the International Telecommunication Union, World Bank and The African Development Bank. Inmarsat was the first commercial company to join the Alliance, becoming a platinum member in 2016.

www.inmarsat.com
www.smartafrica.org/tas17/

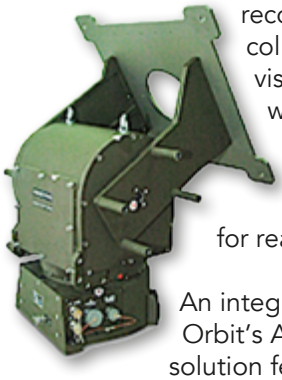
DISPATCHES

ORBIT COMMUNICATIONS RECRUITED

Orbit Communications Systems Ltd.'s expertise has been recruited by a global defense systems provider who has ordered several AL-4012 digital tracking pedestal systems and control units for a leading air force.

The transaction totals US$700,000 and the product will be delivered in 2018 bringing a total of more than 100 units ordered, to date, by this customer.

The mechanics of the AL-4012 digital tracking pedestal systems engage as the tactical reconnaissance pod simultaneously collects high resolution infrared and visual digital images within a very wide field of view. The images and data annotation are recorded on a solid-state recorder and transmitted to the ground station for real-time interpretation.



An integral part of the ground station, Orbit's AL-4012 digital tracking pedestal solution features:

» *Elevation-over-azimuth axes configuration with optional stabilization*

» *A digital servo amplifier to control antenna motion*

» *Highly dynamic, low-backlash motion capabilities for outstanding accuracy*

» *Brushless motor and planetary gear assembly for easy maintenance and high reliability*

» *Modular and easily maintainable*

» *Robust, reliable and environmentally durable*

The AL-4012 is Orbit's most compact, portable and light-weight solution for field-based applications that require accurate tracking capabilities, such as UAS command and control, telemetry and stabilized point-to-point RF communications. The AL-4012 is a self-contained elevation-over-azimuth tracking positioner that delivers high performance under demanding field conditions. Easy to deploy, it may be ground-based, transportable or shipboard (with additional stabilization) to fit specific needs.

orbit-cs-usa.com/?product=al-4012s

DISPATCHES

LAW ENFORCEMENT PIONEER USE OF LOCKHEED MARTIN INDAGO UAS

Sheriff's agencies are poised to use the Lockheed Martin Indago quadrotor small unmanned aerial system (UAS) to perform search and rescue operations as part of the Project Lifesaver International (PLI) program that supports clients with autism, Down syndrome and dementia.

Indago is paired with Project Lifesaver's electronic location equipment used by first responders to find special needs individuals who may wander. Upon receiving a distress call, operators can rapidly deploy Indago to locate missing individuals. Sheriff's offices in New Jersey and Virginia have added the PLI Indago to their inventories, with additional first response agencies soon to join the ranks.

"*The Indago UAS will allow us to increase our capabilities in locating a client who has wandered. This new asset will give us the ability to search even more efficiently over a broader area and will increase the probability of a successful recovery*," Somerset County New Jersey Sheriff Frank J. Provenzano, who oversees the first sheriff's office in the country to adopt the Indago system. Somerset County has 40 clients enrolled in Project Lifesaver: 23 children who have autism or Down syndrome and 17 adults who have dementia.

"*The Indago will give Project Lifesaver agency members the ability to have an airborne asset available quickly to enhance their search capability in bringing loved ones home*," said Gene Saunders, Founder and CEO of Project Lifesaver.

First responders have relied on manned aircraft to conduct aerial search and rescue operations. Indago reduces the response time and increases the efficiency of search efforts when time is critical.

The 5 lb., collapsible Indago system can be stored in the trunk of any squad car and deployed within a matter of minutes.

"*Coupling the Project Lifesaver antenna and control elements with the Indago system expands signal detectability, serves as an airborne relay, and greatly improves the probability of location success across broad search areas*," said Rich Bonnett, Indago program manager, Lockheed Martin unmanned systems. "*This innovative technology is available for Project Lifesaver agents to further their important public safety mission, and more importantly, to reunite individuals with their families and caretakers.*"

Indago is used in tasks spanning firefighting, disaster relief, precision agriculture and coastal erosion monitoring. The proven and reliable system has an industry-leading flight time surpassing 45 minutes, and provides high quality data with an electro-optic infrared gimbaled imager to enhance situational awareness and enable real-time decision-making.

Lockheed Martin has five decades of experience in unmanned and autonomous systems for air, land and sea. From the depths of the ocean to the rarified air of the stratosphere, Lockheed Martin's unmanned systems help our military, civil and commercial customers accomplish their most difficult challenges.

Project Lifesaver International (PLI) is a 501 (C) (3) community based, public safety, non-profit organization that provides law enforcement, fire/rescue, other first responders and caregivers with equipment and training to quickly locate and rescue individuals with cognitive disorders who are prone to the life threatening behavior of wandering, including those with Alzheimer's disease, Autism, and Down syndrome.

To date Project Lifesaver agencies have conducted over 3,254 successful rescues. Most who wander are found within a few miles from home, and search times have been reduced from hours and days to minutes. Recovery times for PLI clients average 30 minutes—95 percent less time than standard operations. Visit

www.lockheedmartin.com/us/products/procerus/indago-uas.html

www.projectlifesaver.org

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DISPATCHES

US SPECIAL OPERATIONS COMMAND PRESOLICITATION FOR 809 SDN-LITES

The United States Special Operations Command (USSOCOM), Directorate of Procurement has a requirement to purchase the next generation of Satellite Deployable Node - Family of Systems (SDN-FoS) Sub One-Meter Variant (SDN-Lite).

The attached Draft Request for Proposal (RFP) documents (Performance Specification, Statement of Work, CDRLs) for the SDN-Lite is to provide Industry with the most current information as well as gather feedback and address any questions and comments.

The Government is still in the process of drafting Sections L & M and getting the final acquisition plan approved; however, the team anticipates issuing a Final RFP using full and open competition with no exclusions/set-asides which may result in a single award of a commercial, Indefinite Delivery Indefinite Quantity (IDIQ) contract issuing Firm Fixed Price (FFP) delivery orders with an ordering period of five years, a guaranteed contract minimum of $2,500.00 and contract maximum of $75,000,000.00.

The Government anticipates ordering approximately a total of 809 SDN-Lites during the life of this contract.

A Final RFP, which will be posted on Federal Business Opportunities website under solicitation number H92222-17-R-0004, is anticipated to be released in Q4 FY17.

Companies interested in providing this capability and desiring to provide value added feedback on the Draft RFP documents must email their questions and comments in writing to Mr. Jonathan Katz, Contracting Officer, ***jonathan.katz@socom.mil*** and Mr. Phillip Sabo, Contracting Officer, ***phillip.sabo@socom.mil*** no later than May 24, 2017, 1200 hours, eastern time. Please provide suggested edits and comments utilizing the track changes and review features via Microsoft Word directly in the Draft RFP documents where possible.

Oral requests (*e.g.*, phone call) for information will be re-directed to provide email correspondence for documentation purposes. Individual responses to inquiries will not be provided. Do not include any proprietary information when responding back to the Government unless properly marked.

Questions to Industry -

1. Can you provide a terminal which immediately satisfies all the Threshold (Th) requirements in the Government's Performance Specification and SOW?

2. If yes, does this proposed terminal also currently meet any Objective (Obj) requirements outlined in the performance specification? If yes, please identify all Objectives.

3. If your proposed terminal does not currently meet all Threshold requirements, state specifically which Thresholds are not met, when you anticipate being able to meet them, and what is your implementation plan?

4. Do you currently possess the capability to deliver a fully certified terminal which meets all Threshold requirements outlined in the Government's Performance Specification and SOW within the required initial delivery schedule (at the production capacity outlined) requirements defined in SOW para. 6.11?

5. Describe your approach to address the test and certification requirements in paragraph 5 of the SOW.

Specifically:

What is your current certification status is for Wideband Global SATCOM (WGS) and commercial bands as defined in SOW Section 5.4? If certified, provide ARSTRAT certification numbers and commercial service provider certification letters.

If not currently certified, where are you at in the process (Specific Phase) for certification and will you have certifications in order to meet the schedule timeframe in SOW 6.11 (90 days ARO in Nov 2017). Message traffic from ARSTRAT should be provided to verify WGS certification test phase status. Similarly, message traffic from commercial service providers should be provided to verify in-process status of those certifications.

Have your proposed terminal offerings already undergone the required MIL-STD-810G testing defined in SOW paragraph 5.2.1? If, so when was testing conducted and by which laboratory? A summary report from the independent laboratory test report should be submitted.

If terminals have not undergone the required MIL-STD-810G testing discuss how that will be satisfied within the required initial delivery schedule (at the production capacity outlined) requirements defined in SOW paragraph 6.11.

Notes/Information before providing comments:

1. A complete scrub and/or peer and policy review of the Draft RFP documents has not yet been accomplished but will be accomplished prior to the Final RFP release.

2. All Attachments to the RFP have not been finalized.

FedBizOps.gov

DISPATCHES

THE TACTICAL SIGNAL ELEMENTS (SIGINT) COLLECTION SYSTEM (TSCS) FOR THE USMC

The Tactical SIGINT Collection System (TSCS) family of systems (FoS) is a modular, semi-automated, multi-platform transportable and man packable system capable of conducting signals intercept, collection, exploitation, direction finding, and precision geo-location against threat communications.

The TSCS FoS is comprised of the Team Portable Collection System Multi-Platform Capable (TPCS-MPC) and the Radio Reconnaissance Equipment Program (RREP).

TPCS-MPC is employed by SIGINT Support Teams (SST) and provides Marine Corps Radio Battalions with a semi-automated, team transportable SIGINT collection capability supporting the MAGTF and Marine Corps Forces Special Operations Command (MARSOC).

RREP provides a man-packable, modular, and scalable SIGINT capability to support the MAGTF and MARSOC.

TPCS Mods is currently executing engineering change proposals and is in the Operations and Support phase. PB16 will allow for the sustainment of the program and execution of a Special Purpose Receiver Refresh and Modular Case Refresh.

TPCS is currently executing an FY14 Technical Refresh that is designated as an AAP and is in the Production and Deployment phase.

Current funding does not allow for the execution of Dual Receiver, Server Sleeve, and Legacy SOIs. PB16 will allow for the procurement and delivery of a common TSCS Workstation.

RREP Mods is currently executing engineering change proposals and is in the Production and Deployment phase. PB16 will allow for the sustainment of the program and execution of a Special Purpose Receiver and TSCS Workstation Refresh.
RREP is currently executing an FY14 Technical Refresh that is designated as an AAP and is in the Production and Deployment phase.

DISPATCHES

ALASKA AIRBORNE BDE CONDUCTS SATCOM TEST WHILE PREPARING FOR CTC

Soldiers from the 4th Infantry Brigade Combat Team (Airborne) 25th Infantry Division at Joint Base Elmendorf-Richardson, Alaska set up two "Heavy" systems on the left, and two "Lite" systems on the right, of the Transportable Tactical Command Communications (T2C2) system during new equipment training. Photo Credit: Staff Sgt. Pedro Garcia Bibian, 55th Signal Company, Combat Camera.

The Army's only airborne infantry brigade combat team in the Pacific theater is supporting an Initial Operational Test here before heading off to a combat training center rotation.

When the 4th Brigade Combat Team (Airborne), 25th Infantry Division saw the opportunity to test and field the new Transportable Tactical Command Communications (T2C2), unit leadership jumped at the chance.

"*Right after the unit volunteered to test this new gear, they also received word they'd be heading to the Joint Readiness Training Center (JRTC) in Fort Polk, Louisiana during June*," said Keith West, Test Officer with the US Army Operational Test Command's (USAOTC) Mission Command Test Directorate.

In a nutshell, T2C2 uses proven commercially-available components that will allow Soldiers and their commanders increased situational awareness to ensure the best outcomes as they apply more effective combat power.

With its timeline suddenly compressed, the Infantry Soldiers were faced with upgrades of their command systems, and firing exercises like gunnery qualifications —all while wrapping an operational test of the T2C2 into the mix.

About 40 Soldiers were hand-picked to train on and test the T2C2 March 15 to 26, allowing the rest of the brigade to focus on ongoing operations. "*Given the limited signal experience of the system operators, it is unbelievable that non-signal Soldiers with only two weeks of training are able to acquire the satellite, put them into operation quickly, and make mission*," said Chief Warrant Officer 3 Woody Scott, the 4th Brigade's network operations officer-in-charge.

"*That says something incredible about how these systems are designed in their simplicity.*"

"*The systems and Soldiers have proven to be equally resilient*," added Capt. Daniel L. Standridge, the 4th Brigade's chemical, biological, radiological, and nuclear defense officer.

Scott said T2C2 could become an advantage for all Airborne brigades.

"*During Arctic operations, the Air Force trying to land their aircraft has to be de-conflicted with Army Aviation assets*," he said. "*We can't get other assets on the ground until someone has been able to clear the drop zone and communicate back.*"

As USAOTC's test non-commissioned officer-in-charge for his first initial operational test, Sgt. 1st Class Shelby R. Schoolcraft said, "*Participating in this operational test opened my eyes to how important it is to test equipment before putting it in the hands of Soldiers," noting the innovative ways the Soldiers discovered to use the systems.*

"*T2C2 brings greater throughput and a higher quality network that comes on-line quickly and can operate at much lower temperatures*," said Scott.

"*Early entry packages like the T2C2 Lite, and now with a drop-capable T2C2 Heavy, make an Arctic mission safer for our brigade.*"

USAOTC's mission is about making sure that systems developed are effective in a Soldier's hands and suitable for the environments in which Soldiers train and fight.

Test units and their Soldiers offer their feedback, which influences the future by offering input to improve upon existing and future systems that Soldiers will ultimately use to train and fight with.

Story by Capt. James K. Mayberry, Mission Command Test Directorate, US Army Operational Test Command

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STEPPING UP THE BATTLE AGAINST CYBER-ATTACKERS

A SPECTRA PERSPECTIVE

By Simon Davies, Chief Executive Officer, Spectra Group (UK) Ltd. and Senior Contributor

Cyber-attack has been identified as one of the four highest priority and most pervasive of risks faced by the UK — the others being international terrorism, international military crises and major accidents or natural hazards.

Data is now vital to everyday business operations and ensuring its confidentiality and security must be of paramount importance to any organization.

In the last year alone, some £1 billion[1] was lost to online crime (March 15 to March 16) with seven in ten[2] business leaders admitting that they have not taken any action to protect their business and employees from financial fraud. From a SATCOM perspective, the subject of cyber threat and cyber security related to satellite communications has been a hot topic for a while and is very much a focus of concern for the satellite market.

When using satellite connectivity, generally data has to pass through public and private terrestrial networks and the security focus shifts to ensuring end-to-end data integrity. The satellite link can often be most at risk and vulnerabilities in a network must be identified and rapidly rectified.

According to a report by *IOActive* called '***Wake-up Call for SATCOM Security***' in 2014, there were a number of commercial SATCOM terminals with various vulnerabilities.

While these vulnerabilities will have since been mitigated, the report demonstrates the potential threats by cyber-attackers to this industry, whether from an e-crime state or industrial espionage.

Last year, the UK Government unveiled a five-year National Cyber Security Strategy and announced the nation was investing £1.9 billion in defending its systems and infrastructure.

The organization has also established a new National Cyber Security Centre that will provide a hub of world-class, user-friendly expertise for businesses and individuals, as well as rapid response to major incidents.

The urgency shown by other governments worldwide in unveiling similar strategies emphasizes the growing menace posed by cyber-attackers both on the battlefield and in the corporate world. Spectra now has an in-house team of experts who can react to this threat and play their part in the battle against cyber warfare.

Spectra Group (UK) Ltd — which was launched in 2002 — has established itself as a leading international provider to defence and security, aid and emergency and commercial organizations of secure voice, data and satellite communications in locations with limited or compromised infrastructure.

The company is probably best known for the ground-breaking SlingShot® system, which is a straightforward and cost-effective way to achieve tactical, secure, beyond line of sight communications (BLOS) on the move (COTM), using UHF and VHF radios, currently exclusively using Inmarsat's L-TAC™ service.

Spectra is highly experienced and well-placed to provide advice and services to counter the increasing and alarming threat of cyber-attack. The company is already delivering cyber solutions through the firm's existing satellite and terrestrial networks business, so the launch in February in 2017 of **Spectra Cyber Security Solutions** is a natural progression for the company.

Spectra Cyber Security Solutions provides defence-in-depth, with proactive testing, in order to identify vulnerabilities in networks and procedures and protect data. It has the know-how and experience to deliver highly bespoke security solutions to protect against cyber-attacks.

It can also count on extensive experience successfully designing, delivering and maintaining networks for military organizations and government agencies. High-grade solutions are designed to integrate seamlessly with business architecture, minimizing downtime, ensuring data is available as and when required and is kept secure and protected from attacks throughout its lifecycle.

To enhance the firm's clients' security, Spectra operates a Security Operation Centre (SOC) which provides 24/7/365 network monitoring to immediately identify any breach — or potential breach — as well as providing a UK-based help desk. This enables clients to benefit from security monitoring and provides the user with a 24-hour contact if they have concerns or issues with their network.

Spectra is ISO 27001-accredited which, as an information security management standard, is clear and precise, listing 114 key security controls that should always be at the heart of any organization's approach to the security of its information assets.

Spectra is also fully compliant with the UK Government-backed Cyber Essentials Scheme.

Developed in conjunction with the Information Security Forum (ISF), Cyber Essentials forms a robust and stringent checklist that security companies must meet to be considered eligible to work with highly sensitive information and government-level security contracts. It is also a Cisco Partner – Cisco Select Certification recognizes and rewards partners that have achieved a Cisco specialization.

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www.spectra-group.co.uk

Simon Davies is the CEO of Spectra Group (UK) Ltd. Spectra is a leading provider of Voice and Data services into remote and hostile areas world-wide for defense, governmental and non-governmental sectors.

Upon leaving the Military in 2004, Simon established Spectra, which has achieved steady growth over the past 12 years through these difficult security and economic times. The company is fast becoming a leading service provider of reliable, robust, deployable communications.

Spectra's services are deployed worldwide in some of the harshest environments supporting the UK Military and European Union, Stabilization Unit to name a few.

AVOIDING FAIR FIGHTS, AND, DOD AS A SPACE INNOVATOR?

By Ryan Schradin, Executive Editor, GSR, and Senior Contributor

During March of this year, the *Government Satellite Report* team had the opportunity to attend the Washington D.C. satellite show.

The conference brought together satellite executives, aerospace thought leaders and end-users — including government and military satellite decision makers — to discuss advancements in satellite technology and share best practices.

However, even with a solid list of speakers and attendees, one of the most interesting and telling quotes I heard at this year's conference was spoken by someone that may not have even been in attendance – Tech Sergeant Justin Perran of the United States Air Force.

TSgt Perran is a Joint Tactical Air Controller, a position which requires him to use satellite capabilities to ensure that the actions of fixed and rotary wing support aircraft are as precise as possible.

Major General Thompson, Air Force Space Command.

As Major General David D. Thompson, the Vice Commander of Air Force Space Command, explained, "*[TSgt Perran's] job — in essence — is to be a scheduler. He schedules meetings between our enemies and American firepower. And he does it continuously. He is the most lethal person on a battlefield.*

"Our adversaries have been watching as well and they recognize now what space does for the American way of war — the precision, the lethality and the effectiveness — and they've decided that it's time to take that advantage away from the United States."

I can only speculate about TSgt Perran's whereabouts during the show as I never came face-to-face with him, or bumped into him. He wasn't a keynote speaker or — as far as I can tell — even a panelist during the event. But he was the star of a video package that was aired when General Thompson got up to speak.

What Tsgt Perran said in that video perfectly and beautifully encapsulated everything those listening will ever need to know about the importance of satellite to today's modern warfighter.

Speaking about GPS and satellite capabilities, TSgt Perran said, "*No, I don't want to be in a fair fight. The advantage is that America's military is so well trained and equipped that even if you took everything away, we're still better than [our potential adversaries]. But, when you add all of the capabilities that we have, and add all of the technology, and you get me down to that five minute window, that's absolutely what I'm going to prefer. That's because we're going to win that fight and we're going to win it so fast that you're not even going to know what happened. All of my guys are going to be safe and you're not going to send anymore because you know you're just going to lose them.*"

That's the kind of confidence that Maj. Gen. Thompson is looking to instill in the warfighter, which he refers to as his, "customer." That confidence comes from ensuring that space capabilities are there when they're needed for the soldiers in theater. According to the General, "*It's our job to ensure that those capabilities are there, on time every single time.*"

But Maj. Gen. Thompson's job — and the job of everyone in Air Force Space Command — is only getting harder. Ensuring space capabilities for the warfighter isn't as easy as it was in the past, when space was an uncontested domain that could be utilized to the advantage of the United States and few others.

Today, the space domain is changing, and that change was very well articulated by Maj. Gen. Thompson, when he said, "*Our adversaries have been watching as well and they recognize now what space does for the American way of war – the precision, the lethality and the effectiveness – and they've decided that it's time to take that advantage away from the United States. It's only recently that it's become obvious – not just to us but to the rest of the world – that others intend to deny us that capability in the future.*"

This shifting and changing threat environment in space is forcing the Air Force and Department of Defense to make changes as well — both as to how they operate in space, and how they construct their satellite architecture and infrastructure.

When it comes to operations and the command and control of space assets, the Air Force is fundamentally reevaluating the role of its airmen and examining what their highest priority and highest value tasks should be. In the past, this included the actual management and command of spacecraft in orbit, but there seems to a shift in that mindset.

Maj. Gen. David D. Thompson added, "*…we're going to increasingly look at the ability to bring commercial and contract operators online to do the routine day-to-day flying and operations for our satellite constellations while we focus on what we are truly commissioned and designed to do, which is fight [adversaries] through a contested environment.*"

As Robert Tarleton, Jr., the Director of the MILSATCOM Systems Directorate, Space and Missile Systems Center, Air Force Space Command, discussed in a previous post on the *Government Satellite Report*, there is an RFP that positions industry partners and contractors to take over the command and control of the military's WGS and DSCS satellite constellation. This step would free up existing airmen to focus on the higher value tasks increasing space situational awareness, understanding the threat environment and actually countering adversary attacks on space assets.

This shift in responsibility was well illustrated by Maj. Gen. Thompson, when he said the following, "*For years we have been focused on keeping the trains running on time. Our job now is to understand the threat environment and be able to react to it, and, in order to do that in this current environment, we will not get more uniformed or civilian airmen to do that. So, we're going to increasingly look at the ability to bring commercial and contract operators online to do the routine day-to-day flying and operations for our satellite constellations while we focus on what we are truly commissioned and designed to do, which is fight [adversaries] through a contested environment.*"

The other change involves how the military builds its space architecture. The increasingly contested space domain means that operational resiliency is essential to ensure space capabilities aren't compromised.

By distributing and proliferating systems across additional satellites — including those of allied nations and commercial partners — the military can ensure that an attack on any single satellite no longer impacts service delivery.

According to Maj. Gen. Thompson, "*A diversity of options that are space based…will also make for more resilient architecture….Increasing the distribution of [systems] in the SATCOM world and the diversity across bands, across capabilities – both military and commercial – will help us increase the resiliency of those systems as well.*"

To accomplish this diversity and increase resiliency, the General proposed increased use of COMSATCOM services, as well closer partnerships with the COMSATCOM industry.

Maj. Gen. Thompson suggested that the military look to the COMSATCOM industry for innovative ideas and solutions to the military's problems. He also discussed a consortium of commercial and industry partners that work together, as well as compete, to come up with innovative new satellite technologies and solutions for the military.

According to Maj. Gen. Thompson, the Air Force needs to, "*…recognize the commercial capabilities that are out there…also the commercial ideas for how to operate and field systems and deliver capabilities to our customers.*"

Additionally, during this trade show in D.C., SES Government Solutions partnered with Defense One to sponsor an interesting Cocktails and Conversations event entitled, "Space and Satellite in the New Administration."

Although the event didn't focus extensively on President Trump and his administration's impact on space policy, it did bring together senior military space decision makers and satellite industry experts to discuss the future of the US government's space infrastructure and the constantly-evolving challenges impacting our space assets today.

Participants in the panel discussion included:

- *John Hill, the Acting Deputy Assistant Secretary Of Defense For Space Policy at the Department Of Defense (DoD)*
- *Todd Harrison, the Director of the Aerospace Security Project and Director of Defense Budget Analysis at the Center For Strategic And International Studies*
- *Patrick Tucker, the Technology Editor at Defense One and panel moderator*

The conversation began with a discussion of the GPS satellite constellation and how it's become so essential for the US military, effectively enabling previously unthinkable levels of precision when it comes to targeting adversaries and tracking friendly troop movements.

With this constellation so important and mission-critical to today's military, discussion almost immediately shifted to protecting the constellation in today's much more contested space domain and environment.

The panelists noted that the GPS constellation has some benefits that not every military satellite constellation has. Namely, the constellation — by its nature — degrades gracefully, and there is baked-in resiliency since there are more satellites in the constellation than currently needed. This helps make the constellation more resilient and makes it more difficult to compromise the capabilities it delivers.

They also discussed how utilizing other, similar signals and constellations — such as the Galileo global navigation satellite system — could increase this resiliency even more.

This sentiment was echoed by Mr. Hill, who said, "***With GPS, you have a distributed capability, it's also a proliferated capability. It's distributed in that you only need four satellites out of the 24 from the constellation to get your signal. But it's also proliferated in terms of the number of satellites we have up there because these things have a way of not dying. The proliferation takes away the incentives of someone trying to destroy them kinetically***."

John Hill then added, "*[We have] to recognize the point, as technology evolves and democratizes — maybe even commoditizes — that there are pieces of it where the commercial demand - the commercial market - starts driving the innovation.*

"*[We have] to recognize the point, as technology evolves and democratizes — maybe even commoditizes — that there are pieces of it where the commercial demand – the commercial market — starts driving the innovation.*"

But resiliency isn't necessary in just navigation. There are many capabilities that the United States military gets from space and satellites, and these satellites — including communications satellites — need to be up and available for the warfighter on the battlefield with the same reliability as the GPS constellation. In this area, the resiliency that is inherent with the GPS constellation can be a best practice.

Distributing a satellite signal across multiple satellites, and proliferating the number of satellites that can be used to carry a signal, are both effective ways to eliminate an adversary's ability to compromise the capability they deliver.

Mr. Hill illustrated that point when he said, "*What can I do to reduce the incentives to attack a constellation? I would just assume take the thought out of [an adversary's] mind because they realize that it's not going to work since the Americans have multiple approaches to this.*"

But the military's SATCOM constellation doesn't have the baked-in resiliency that the GPS constellation does. There simply aren't enough MILSATCOM satellites in the WGS constellation to replicate the level of resiliency that exists in the GPS constellation.

However, there are enough commercial satellites in orbit across all of the disparate COMSATCOM providers and satellite operators to deliver this resiliency to the military.

By increasing the use of COMSATCOM services from its industry partners and providers, the military can effectively replicate the level of resiliency it enjoys with the GPS constellation for its communications satellites. It can even replicate the desired effect of diversifying navigation signals by using other constellations, such as Galileo, by relying more heavily on COMSATCOM providers.

But the benefits of partnering with the satellite industry don't end at resiliency and redundancy. There is also the benefit of harnessing private industry's innovation and technologies.

The discussion at the Defense One event took an interesting turn when the panelists began comparing the capabilities of private industry and the federal government. What they concluded was that the private space industry has shifted gears and sped past the federal government when it came to innovating new space capabilities and technologies.

According to Mr. Hill, "*[We have] to recognize the point, as technology evolves and democratizes – maybe even commoditizes – that there are pieces of it where the commercial demand – the commercial market – starts driving the innovation. The trick for the DOD is to figure out…where we have ceased to be the innovator and driver, and the commercial side is now that – and how do we capture that and bring it in.*"

Noting that the end user — the warfighter — doesn't necessarily care where their capabilities come from, or who delivers them, just that they work when they're needed, the panelists agreed that COMSATCOM usage should increase.

By leveraging COMSATCOM more aggressively, the military can get access to more bandwidth and deliver more capabilities quickly, while also taking advantage of the advanced technologies that the industry is already embracing.

"*The trick for the DOD is to figure out…where we have ceased to be the innovator and driver, and the commercial side is now that - and how do we capture that and bring it in*," said John Hill

In order to accomplish this, COMSATCOM services need to become more integrated into the military's wider SATCOM architecture.

Hill added, "*We need to figure out how to better take advantage of what everyone else is doing better in space. How do you incorporate the commercial system into your architecture and do it as a more natural part of your process? How do we look at what's happening in the commercial communications area — with GEO, MEO and LEO — and*

how do we architecturally think about using all of those things in a way such that the ship on the sea, or soldier in the field, or plane in the sky doesn't know or care where the communications is coming from, just that the terminal they're using is working?"

Although those questions are still being pondered across the military and DoD, one thing is certain – the commercial satellite industry is now the innovator in space.

The next important step for the military is figuring out how best to leverage the services of commercial providers.

In late March, a new SES satellite made history when it was a part of something that was never done before. At 6:27 PM EST on March 22, 2017, the SES-10 satellite was successfully launched into space onboard a flight-proven SpaceX Falcon 9 rocket from NASA's Kennedy Space Center. This made SES-10 the first geostationary commercial satellite to ever launch on a flight-proven, first-stage rocket booster.

SES-10 launch photo is courtesy of SpaceX.

That's correct, SES-10 was launched into space on a rocket that had gone into space once before, and then made the trip a second time.

Space flight may become more ordinary every day, but the fact is that it remains pretty fascinating — and it's even truer with this launch, which was certainly anything but ordinary. The implications and importance of this launch cannot be overstated.

The use of the flight-proven Falcon 9 for launching SES-10 propelled the space industry one step closer to rapid rocket reusability – one step closer to faster, easier access to space. That's because reusable rockets will not only drive down the launch cost, they will also allow a higher launch frequency, which will definitely bring a new agility and competitive edge to the satellite industry.

For SES, this first marks another milestone in its endeavor to drive the space race. SES was the pioneer of co-locating satellites, the first to launch with Proton in 1996, and more recently, the first to rely on SpaceX for a geostationary mission in 2013 with the launch of SES-9. Stay tuned for even more history-making from SES in the near future.

The preceding articles are republished courtesy of The Government Satellite Report (GSR) and Executive Editor ***Ryan Schradin****.*

Ryan is a communications expert and journalist with more than a decade of experience and has edited and contributed to multiple, popular, online trade publications that are focused on government technology, satellite, unified communications and network infrastructure. His work includes editing and writing for the GovSat Report, The Modern Network, Public Sector View, and Cloud Sprawl.

His work for the Government Satellite Report includes editing content, establishing editorial direction, contributing articles about satellite news and trends, and conducting written and podcast interviews. Ryan also contributes to the publication's industry events and conference coverage, providing in-depth reporting from leading satellite shows.

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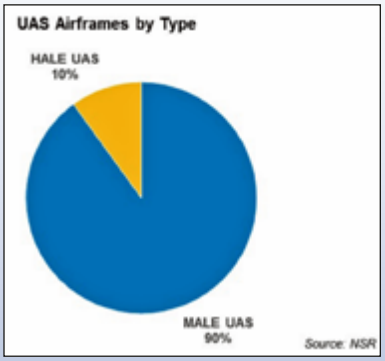
CHANGING GEARS IN UAS

AN NSR ANALYSIS

By Prateep Basu, Analyst, NSR India

Ever since the new US Administration came into office, it has often been embroiled in media controversies, while some geo-political foreign policy strategy shifts, especially pertaining to usage of unmanned aircraft, have gone unnoticed.

Along with the uptick in their use, the role of drones in the battlefield continues to change gears with the introduction of Artificial Intelligence (AI) based algorithms to assist with 'hunting' operations.



Man and machine on the battlefield are being reordered by drones in the same way that ordinary lives were transformed via the introduction of PCs 40 years ago.

NSR's *UAS Satcom & Imaging Markets, 3rd Edition* took a deep dive into these machines, which need Beyond-Line-of-Sight (BLOS) communication capabilities, provided by secure communication satellite links.

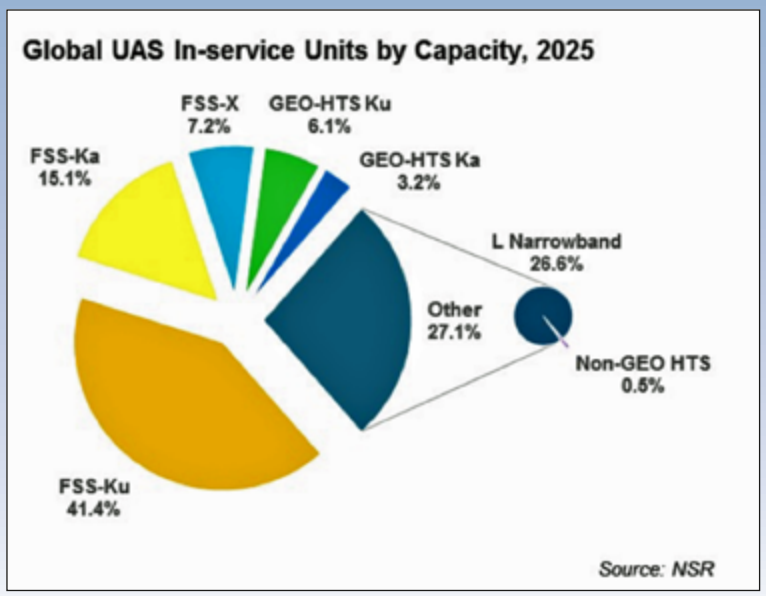
The report found that most of the current global UAS fleet are of the Medium Altitude Long Endurance (MALE) airframe type. The lower complexity of building these machines has enabled countries such as Turkey, China, Italy, and India to develop their own indigenous vehicles.

Currently, MALE UAS can carry out both ISR and strike mission, with SATCOM links being primarily provided by commercial satellite operators.

The addition of mission complexity — such as real-time pattern recognition from videos and images captured by these UAS — and its adoption as a proven military tactic can drastically increase the bandwidth requirements for BLOS communication data links, which would be difficult to meet in a pure FSS Ku-band SATCOM ecosystem.

NSR expects the dominance of FSS Ku-band capacity to reduce as a result, forcing the defense industry to 'patch-up' existing UAS designs for accommodating such retrofits, or move to HTS systems faster than previously expected.

Demand for L-band based communication data links is also expected to increase by the turn of this decade, as this offers a less expensive alternative for Command & Control



operations, as well as a 'fallback' option when the primary, broadband SATCOM link is unavailable.

While both the global peace and security situation could be further impacted if these drones continue to proliferate at the current rate, NSR's forecast shows the commercial SATCOM industry reaches more than $2 billion in annual revenues by 2025.

A good bulk of this satellite capacity allocation will continue to be over the Middle-East and North Africa, as the new US President makes drones more pervasive.

Moving forward, a potential market restraint could arise from a blowback if more civilian casualties are caused by the increasing use of UAS.

NSR sees the demand for commercial SATCOM capacity increasing as battlefield operations become more network-centric, as indicated by new policy statements from the US government.

As technology evolves and collides, the scope of what a UAS can do on the battlefield will also change. Adding political and military will to use these machines only makes them more potent and bandwidth-hungry, presenting opportunities for satellite operators in the near to mid-term future in the capacity leasing market.

The use of armed surveillance drones has been a matter of international contention for human right defenders, but that hasn't deterred defense forces from across the globe to continue using drones, calling them a 'necessary evil.'

NSR has tracked this market for more than a decade and noted how drone usage increased during President Obama's

time in the Oval office. However, despite the uncertainties over changes in the new US Administration's drone policy, one thing is certain: commercial SATCOM vendors will not stand to lose as the US, the largest UAS fleet operator, is poised to adopt a more aggressive global stance against terrorism to keep its election promises.

The escalation of conflicts in Asia and Middle East under the new US Administration is a picture of foreign affairs that has attracted more attention with the new Administration's policy stance during the election.

This leads NSR to believe that one of its forecast scenarios of ~50 percent of capacity revenues being generated from UAS over these regions could take place.

Taking stock of these developments , NSR's ***UAS – Satcom & Imaging Markets, 3rd Edition*** report forecasts in-service units to almost double between 2015 to 2025 at a CAGR of 8.5 percent, leading to an increase in COMSATCOM capacity leasing revenues for these vehicles above $300 million annually by 2025.

This growth in capacity revenues from the UAS sector will not be evenly distributed among frequency bands, as the appeal of FSS Ku-band slowly starts to deteriorate with newer airframes being built with multiple-band capabilities for catering to military demand for interoperability and having greater operational flexibility.

Difficulty to jam a signal and the availability of surplus bandwidth at lower $/Mbps provides good opportunities for GEO-HTS capacity leasing being favored within the military, and NSR estimates ~10 percent of global UAS will fly on such capacity by 2025.

An important finding of this report however was the growth in UAS airframes outside of the US it should come as no surprise if a more aggressive US under the new administration spurs a 'drone race' globally in the name of security and strategic force, leading to greater opportunities for commercial SATCOM players for supporting the ever-increasing number of bandwidth consuming sensors onboard these UAS.

A constant pain for the COMSATCOM industry, in spite of the positive trends that the UAS industry has shown in the recent past, is the traditional procurement process adopted by the military.

The success of the Pathfinder-1 program (started in 2014), after a shaky start, has opened avenues for sustainable long-term capacity procurement by moving away from the expensive on-the-spot market capacity and purchasing it from dedicated funds rather than the Overseas Contingency Operations funds.

However, the failure of the Pathfinder-2 program to kick-off still looms large over the current Pathfinder-3 program, as the US DoD looks to purchase pre-launched transponders aboard commercial satellites, serving regions beyond the US. NSR expects the new US Administration to be more private-industry friendly, which could help the Pathfinder-3 program materialize favorably for COMSATCOM players.

The new US President may believe that his nation should not meddle in global affairs, but he will find it difficult to shy away from the role of global superpower, and do away with a powerful legacy of combating terrorism without putting soldiers at risk.

The change of the guard at the most powerful office in the world at a time when global conflicts are escalating leads NSR to believe that the trajectory for UAS growth will only point upwards, signaling a positive trend for the otherwise slow moving government and military SATCOM market.

To learn more about NSR's UAS SATCOM and Imaging Markets, 3rd Edition, please visit:

www.nsr.com/research-reports/satellite-space-applications/uas-satcom-imaging-markets-3rd-edition/

Based in Bangalore, the Silicon Valley as well as the space city of India, Mr. Basu joined NSR as an analyst in 2014. He authored the first edition of NSR's Unmanned Aircraft Systems study and was a co-author of the fifth edition of Satellite Manufacturing & Launch Services report. His areas of expertise and interest include launcher and satellite manufacturing, UAVs, Earth Observation, and Fixed Satellite Services markets.

Mr. Basu comes to NSR after completing a 'Masters in Science' from the International Space University, Strasbourg in the area of 'Space Studies.' Prior to attending ISU, Mr. Basu had a two year term with the Indian Space Research Organization (ISRO) as an engineer at the spaceport of Sriharikota, where he worked on six launch missions of the PSLV, and as a system engineer for the GLSV MK-III project. He has also worked closely with ISRO as an intern in the areas of launch vehicle engineering and business development at various centers across India, like the Vikram Sarabhai Space Centre (VSSC), Liquid Propulsion System Centre (LPSC), and the commercial wing of ISRO, Antrix, while pursuing his 'Bachelors in Technology' in the field of 'Aerospace engineering' from the Indian Institute of Space Science and Technology (IIST), Trivandrum.

"Very well put together event. Nice mixture of military and commercial personnel. I look forward to London and 2017. Plenty of food for thought!"
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SAVING TIME AND RESOURCES:

MESH SPACE AND GROUND NETWORKS

by *David K. Chan, Ph.D., Vice President, Sales & Marketing, Quintech Electronics, Inc.*

Manufacturers and designers of satellite terminals (modem, transceivers) and other wireless radio devices and networks can face significant "lab logistics" challenges in testing and validating RF signals for mesh (any to any) network topologies.

Yet, the ability of mesh networks to rapidly adapt, self-heal, and meet on-the-move and other requirements continues to create demand for mesh connections in the field. This article discusses test lab challenges and how test engineers have found they can achieve dramatically reduced test schedules and increase accuracy in RF link testing for mesh networks by using new advanced RF matrix switch test and measurement systems.

Satellite and terrestrial wireless mesh network connectivity requirements have been part of the commercial and military SATCOM landscape for years. Examples in the SATCOM world include VSAT and mobile satellite service networks for voice connectivity.

Commercial space constellations, such as Iridium, which employs inter-satellite mesh RF communications links, are part of the network fabric used for some military and COTM applications. Just one example — the US Defense Information Systems Agency (DISA) recommends DVB-RCS, which uses a TDMA mesh return path, for two-way broadband satellite systems for the US military. A number of requirements are increasing the rate of demand for wireless Mesh Networks in military communications.

MESH NETWORKS IN MILITARY FIELD COMMUNICATIONS

The evolution of military field communications has grown to include live video, voice and data over wireless digital data networks that require very large uplink and downlink bandwidths.

Over-the-air (OTA) networks for field personnel are typically mission critical and require more than 99.999 percent resiliency in a mobile environment. The network needs to be flexible to allow the nodes to maintain connectivity as they change distance with respect to each other. These requirements are increasing demand for wireless Mesh Networks relative to Hub-based networks.

HUB-BASED NETWORKS

Basic hub (also known as Star) networks rely on a central server and substations to manage traffic between nodes (*Figure 1*). This network configuration contains single points of failure that then requires redundancy designs to maintain network connectivity.

For some field applications, the resiliency of this network may require costly redundancies. The hub and number of substations need to be planned in advance to accommodate the changing configuration of the network where the distance between the nodes and hub and substations will change. If there are not enough substations built into the network, there is a risk that the nodes will lose connectivity.

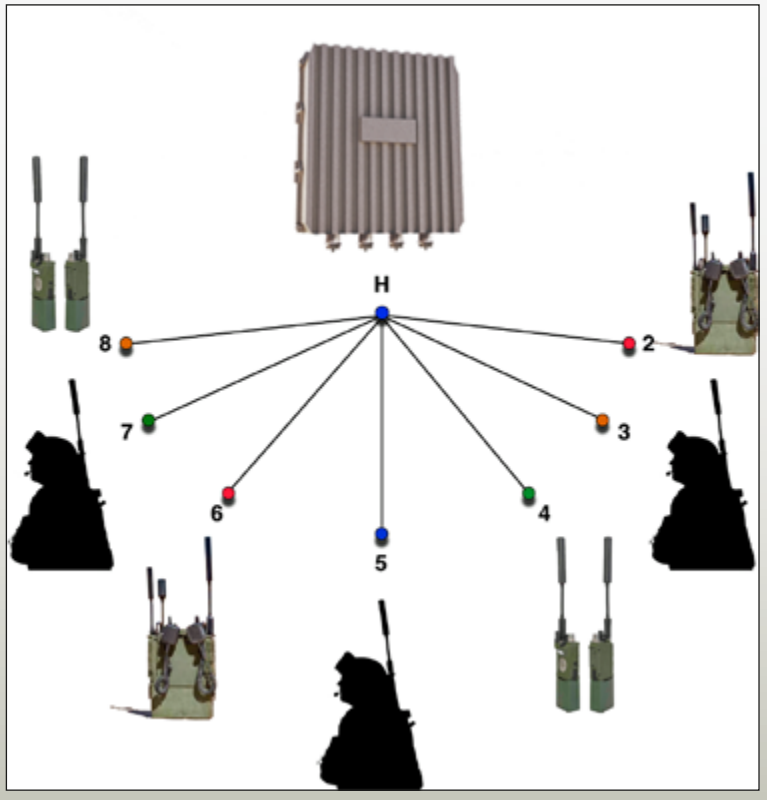

Figure 1. Hub network.

MESH NETWORKS

A mesh network integrates the server capabilities into each node, so that each node in a full mesh network can have a point-to-point connection with another node, and also each node can pass the data packet along to the next node. As there are multiple paths available to make a point-to-point connection, a mesh network would always to able to make and maintain a connection even with a loss of a node.

Figure 2 shows an 8 port full mesh network where each node can have 7 direct connections.

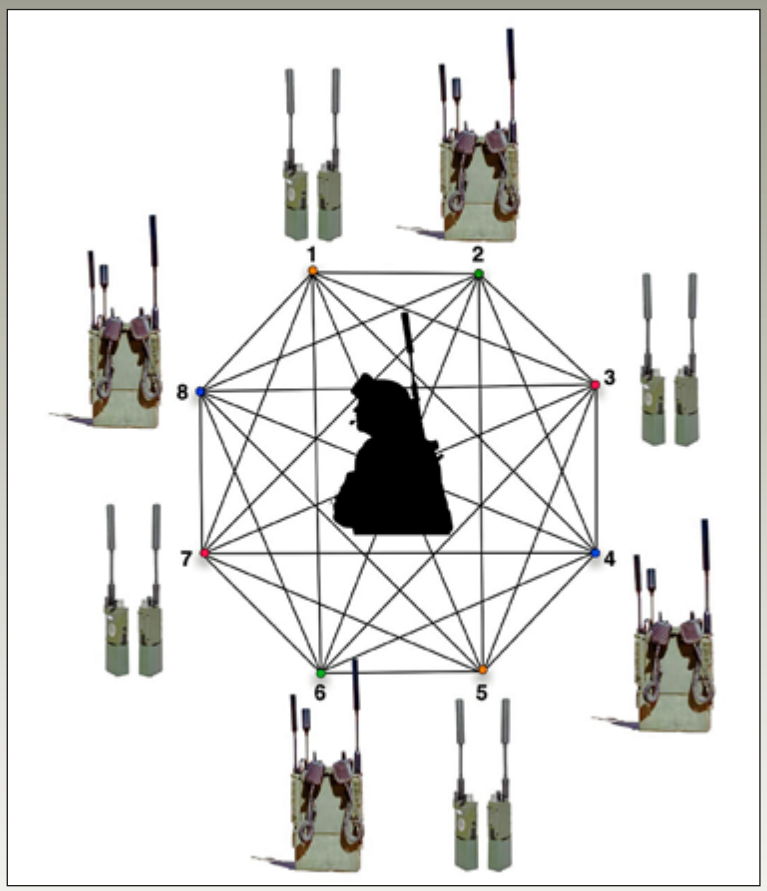

Figure 2. Full mesh network.

In a real life wireless mesh network, a full mesh network is dependent upon the distance between nodes. As the distance between nodes increases or the line of sight is lost, the connection between nodes will be lost.

Figure 3 shows an example of a partial mesh network where nodes have a limited number of nearest neighbor connections due to signal level connectivity. As the nodes move relative to each other, the network connections will change depending on detected signal strength.

Nodes that move away from each other will have decreased signal level until connectivity can no longer be maintained. Nodes that move toward each other will have increased signal level to a point where a connection is made. The mesh network can accommodate these changes.

The 'server intelligence' built into each node is limited in comparison to a full server. In a partial mesh network, a node can have a connection with a node that is not its nearest neighbor by having its nearest neighbor pass the packet along to its next nearest neighbor and so on until the packet reaches its intended node.

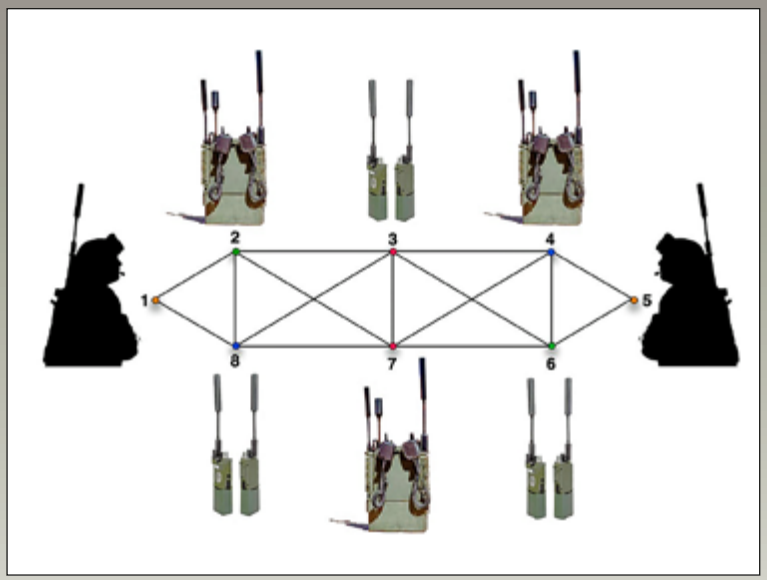

Figure 3.

Depending upon the intelligence of the server, it can route the packet along the shortest path, or, it can be randomly routed along many paths until it reaches its intended node. The number of different paths will affect the time (latency) for the packet to reach its intended node. For many networks, the latency can be critical to the speed of the network.

Time division multiple access (TDMA) networks use multiple channels to transport bandwidth signal, *e.g.*, a 40 Gbps bandwidth can consist of 4 channels of 10 Gbps signals that are aggregated to 40 Gbps. The packets that are transmitted are expected to arrive within a predefined tolerance (which is dependent upon bandwidth) of each other.

If there is too much delay between packets, an error occurs and the system is required to ask for the packets to be resent. The latency tolerance can be increased using forward error correction (FEC).

A hub network relies on the substations to route the packets toward the intended target. The substations can be subject to delays due to heavy packet traffic, which can increase the transmission latency.

A mesh network minimizes latency with a one hop connection when available. Packet routing in a mesh network has additional complications as nodes can be added or dropped at any time.

Due to spatial and line-of-sight constraints, the mesh network is most likely a partial mesh configuration, where each node has a limited number of nearest neighbors. The number of nearest neighbors can change over time as the nodes move with respect to each other.

Dynamic configuration presents many challenges for packet routing, and TDMA networks need to be able to adjust to the changing number of nodes, number of nearest neighbors, etc. Latency in a partial mesh test matrix switch can be increased as additional traffic is generated since every node that is not the intended target is re-transmitting the packets.

To ensure that the network meets the resiliency requirements, it is imperative that the firmware is able to adapt to the constantly changing network configuration. Firmware needs to be tested and verified on a network where the number of nodes, the distance between nodes and the nearest neighbor connectivity are changing. A simple base line test configuration of packet hopping through multiple nodes would be a string configuration (*Figure 4*).

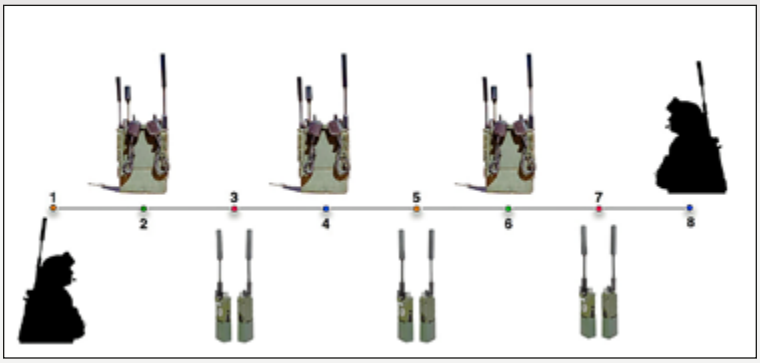

Figure 4. String network.

TESTING MESH RF SIGNALS

Emulation of terrestrial RF wireless (or satellite RF) signals in a test bed requires shielding the signals from outside commercial signals and other sources of Electromagnetic interference by transporting the RF signals over coaxial cable.

A mesh test system requires the use of a splitter at every device node that is interconnected to all the other nodes. An attenuator at each node is needed to vary the signal strength. It is long and tedious to manually change cable connections between nodes and vary the signal levels.

An RF mesh test matrix, such as Quintech Electronics, Inc. NEXUS brand of Test & Measurement switches, allows node-to-node Layer 1 connectivity that emulates connections of the RF signals between nodes.

The NEXUS matrix switches integrates the splitters, attenuators and switches into a remotely controlled chassis. *Figure 5* in the next column shows a) **full mesh**, b) **partial mesh** and c) **string networks** that are rapidly configured using the NEXUS mesh matrix switch.

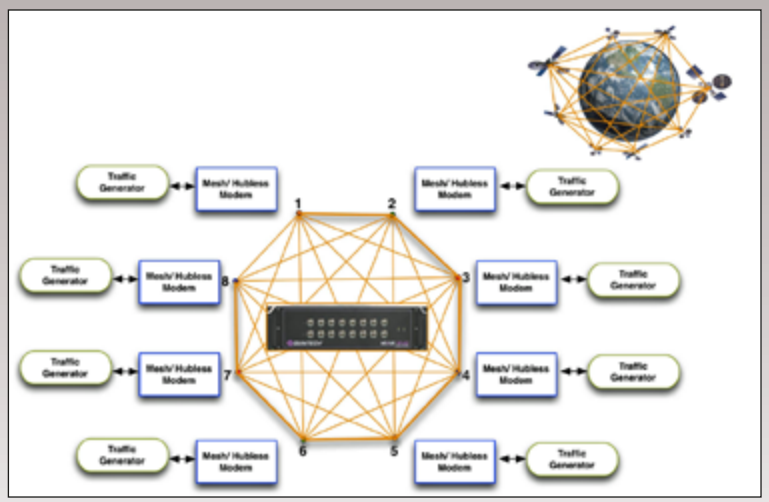

Figure 5a. Full mesh.

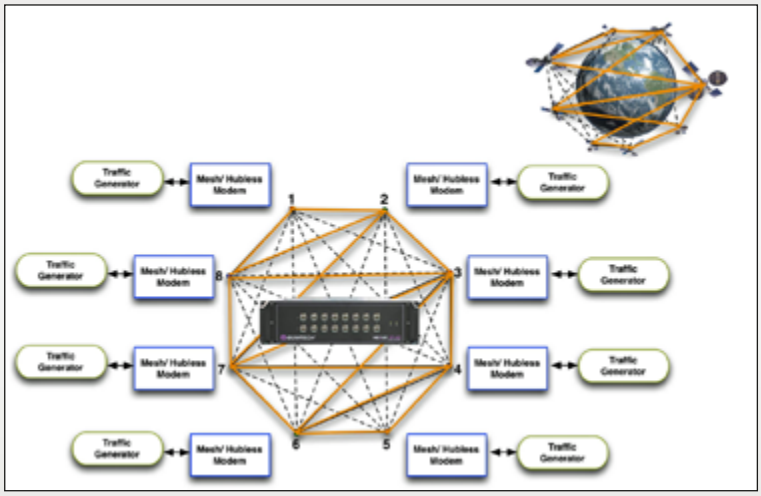

Figure 5b. Partial mesh.

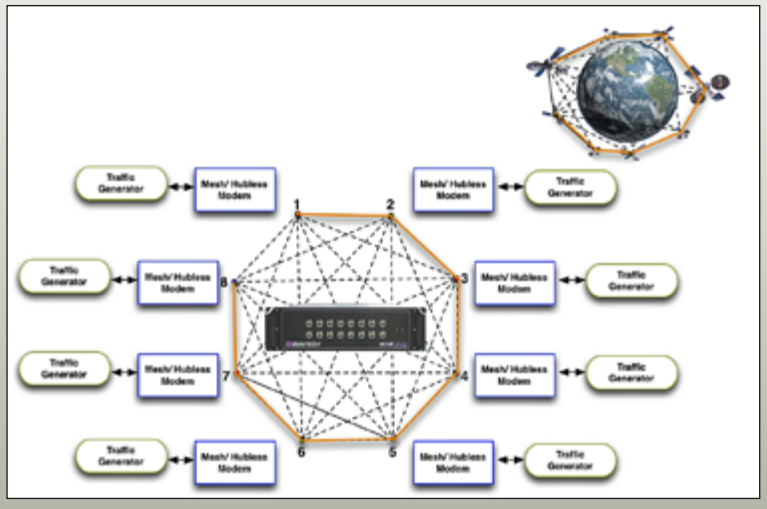

Figure 5c. String.

The NEXUS provides any node to any node connections and allows distance between nodes to be emulated using variable attenuators to adjust the signal levels. The NEXUS matrix is an industry proven non-blocking RF matrix switch that can connect any A port to any B port with independent 0-60 dB variable attenuation per connection.

The addition of a splitter array enables any node to any node connectivity to fully implement the mesh network topology. The NEXUS mesh matrix is an inherently modular design that provides excellent scalability and can be configured to support 8, 16, 32, 64 and 128 nodes. Link parameters such as link path loss and connectivity (on/off) for any node to node can be changed in milliseconds.

Test engineers are able to emulate joining, leaving, grouping and splitting of mesh networks using the NEXUS' mesh matrix ability to provide real time switching and attenuation of all the radio links individually.

A test engineer or team can use the NEXUS mesh matrix to develop, analyze and verify the upper layer protocols in multiple realistic configurations and test the mesh network's resilience under dynamic configurations. Performance testing of packet loss, latency and throughput can be measured in greater efficiency and accuracy than by manually changing a patch panel.

Figure 6 is an example of the time saved and the increased number of configurations tested, as achieved by one manufacturer of RF and satellite products through use of the NEXUS mesh matrix.

The top panel in *Figure 6* shows how a test of just three network configurations took 8 weeks without using the NEXUS. The bottom panel shows how using the NEXUS setup allowed the engineers to test four times as many configurations while increasing productivity four-fold, resulting in the NEXUS solution enabling a 3 percent savings in schedule. With frequency range spanning 600 to 6000 MHz, the NEXUS mesh matrix can be used for LTE and WiFi for mobile mesh networks and L-band and part of the C-band for satellite spot beam and MF-TDMA mesh and hubless networks.

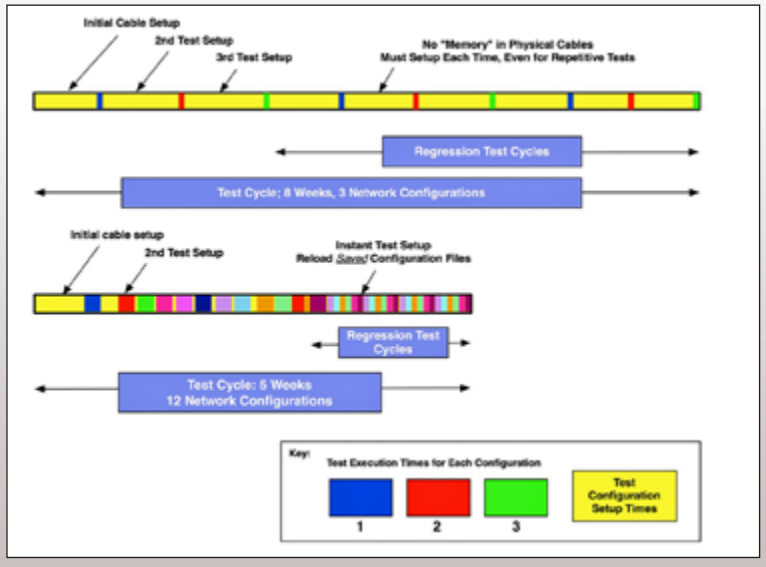

Figure 6. Sample comparison of RF test project saves.

SAVING TIME AND LABOR, AUTOMATING ACCURACY

Engineers require test systems that can be easily configured and controlled to create test scenarios that emulate fee space in a controlled environment. Replacing patch panels with an automated RF switching matrix enables much more rapid and less error-prone re-routing of RF signals. It also offers hot-swappable configurability for multiple tests from a single setup.

In addition to reducing time and difficulty of re-cabling, a suitable RF matrix can reduce the test cycles for many scenarios to a simple routine, easily repeatable operation. RF matrix switches such as Quintech's NEXUS switch in milliseconds what would take hours with a manual patch panel.

By performing attenuation, addition, and switching on signal paths, the NEXUS can limit the need for external combiners and attenuators, thereby reducing lab costs. In addition, lab engineers and teams can schedule and use a NEXUS system via its Q-LAAMP automation software, allowing multiple overlapping programs or projects to conduct testing more efficiently.

In one successful example, a provider of fighter aircraft avionics and navigation radio systems and vehicle mount military radios needed to validate and certify its new product for compliance with Joint Tactical Radio Systems (JTRS) Software Communications Architecture, and "to leverage its expertise in more than 50 waveforms and functions used on advanced networks and platforms" to create a battlefield communications radio for the US military.

The system needed to support on-the-move communications using a broad range of RF communications technology and missions. By using Quintech's mesh matrix testing solution, the hardware supplier could rapidly test the mission's baseline waveforms, such as WNW, SR; cross-banding and channel bandings, as well as future waveforms such as SINCGARS, V/U LOS, UHF SATCOM, and MOUS.

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NEW PARTNERSHIP = GREATER COVERAGE AND OFFERING A HELPING HAND TO CANADA

In early April of this year, Intelsat General entered a strategic alliance with Airbus Defence and Space that will give their customers access to the X- and UHF frequency bands using the Skynet satellite constellation, increasing the firm's capabilities and services in the APAC region.

"*This new partnership will enable Intelsat General to offer Skynet services to their already strong existing customer base*," said Richard Franklin, head of secure communications at Airbus Defence and Space. "*The services will notably be using the newly relocated Skynet 5A satellite and enable users to operate in the Asia Pacific regions, and augment and complement their existing services.*"

The hardened Skynet fleet of seven satellites complements Intelsat Epic^{NG}, Intelsat's HTS platform. Three of these HTS spacecraft, Intelsat 29e, 32e and 33e, are currently in service with the most advanced digital payload on a commercial spacecraft.

The latest, Intelsat 33e, entered service on January 29 operating from 60 degrees East, extending Intelsat's high-throughput satellite services in C-, Ku- and Ka-band to the Asia Pacific region, among other areas.

Airbus moved its Skynet 5A satellite from 6 degrees East to 95 degrees East to provide global X-band and UHF coverage in the APAC region. Skynet X-band coverage and services are now extended from 178 degrees West to 163 degrees East.

X-band is a special frequency set aside for government and military use. Extremely low rates of atmospheric attenuation means that X-band SATCOM remains reliable in harsh weather conditions, even when using very small terminals.

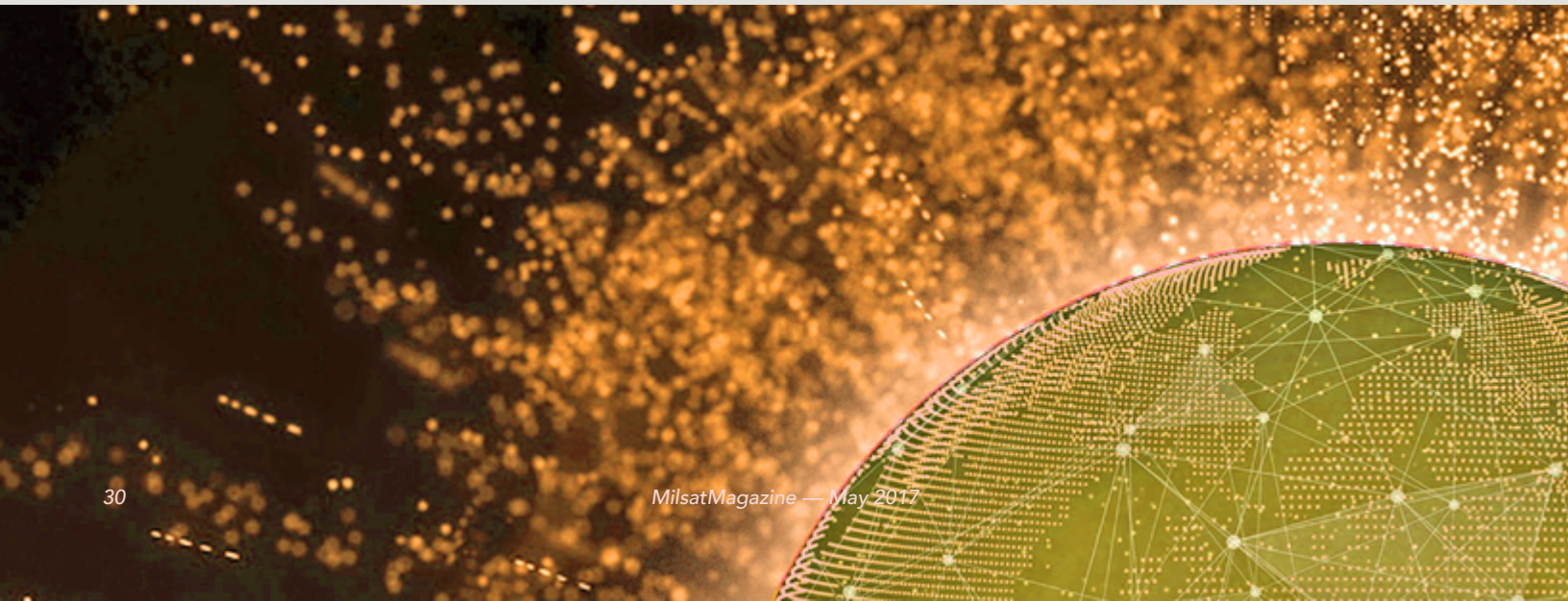
Artistic rendition of the Intelsat 33e satellite.

X-band's position on the RF spectrum also allows for higher throughput, delivering more voice, data and imagery without the need for spread spectrum techniques.

Together, Intelsat General and Airbus will help augment the satellite capacity that is currently available in the Asia Pacific (APAC) region with highly resilient military satellite communication services.

It is well known that there is not as much capacity in APAC as there is in areas such as EMEA, and the global satellites operators do not have as much flexibility to respond to sudden increases in usage. Other SATCOM available in the region only offers fragmented spectrum and is owned wholly or partly by non-US government agencies.

The theater of space is going through a period of transformation — whether it requires third-party capacity, next-generation satellite performance or new approaches



such as managed services, Intelsat General is committed to supporting the warfighter.

Also of note is that Canada is attempting — for the second time — to kick off a project that would put satellites into the Arctic to improve communications for its military and federal departments.

However, while Canada looks to its neighbors to help foot the bill, the country could save significant time and money by taking a look at what's available from the commercial satellite industry.

Under a previous government, Canada's National Post reports, the Canadian Space Agency and the country's military proposed a plan for a system of satellites for the Arctic — the project was ditched when costs skyrocketed.

The current project, dubbed the Enhanced Satellite Communication Project, is estimated at C$2.4 billion. Canada is in discussions with Norway, Denmark and the US to see if they'll help fund the program. If it moves forward, a contract will be awarded in 2020 and a spacecraft will be launched around 2024.

In the meantime, the clock is ticking. Canada's communications requirements will continue to grow, with or without its budget, as warming seas open ice-free shipping lanes to international traffic for longer periods of time during the year.

By going commercial, Canada can be assured that it will have continuous access to the technological innovation and refresh cycles necessary for keeping up with the rapid changes in the Arctic. According to the Canadian military officer in charge of space activities.

Brigadier General Blaise Frawley, he is aware that the country needs to be actively thinking ahead. He said planning in advance for space systems is important because, unlike warships or aircraft that can last 30 or 40 years, spacecraft have a life expectancy of between five and 10 years. That short life cycle requires better planning. When a constellation of satellites is fielded in space, the follow on should already have been thought through, otherwise there will be a capability gap in many cases.

Commercial space is a competitive market, with Intelsat and other operators constantly investing in technology to better manage their own operations and to stay ahead of the competition. Operators of small constellations even hand over the operation of their satellites to Intelsat to ensure that the satellites are operated by skilled professionals who know how to use the latest technologies.

Intelsat's recent announcement of a merger with OneWeb is evidence of the forward thinking taking place in the commercial sector. Together, the companies will create a space industry leader in both geosynchronous Earth orbit (GEO) and low Earth orbit (LEO). Together, they are looking to create the world's first LEO/GEO Ku-band network. How GEO and LEO can work together was a hot topic at the recent Satellite 2017 conference in Washington, DC.

Commercial satellite companies have programs underway that could meet or exceed Canadian requirements for consistent communications for its military forces and government agencies, as well as provide connectivity for the country's northern communities and for Arctic science experiments.

The combination of OneWeb's proposed constellation of as many as 648 LEO satellites and Intelsat's global constellation of more than 50 GEO spacecraft would give Canada access to wide-ranging communications capabilities, even in the nation's far northern latitudes, as early as 2020, well ahead of the projected timeframe of its proposed government satellite project.

The longer Canada waits to launch its satellites, the more urgent their SATCOM needs will become. By considering commercial SATCOM capacity, Canada can access the latest satellite technology, improve coverage and performance while also saving a great deal of money. Hopefully, that's the kind of value proposition in space Canada simply can't ignore.

The preceding articles are courtesy of Intelsat General's SatCom Frontier infosite and their editorial team.

intelsatgeneral.com/