SATCOM For Net-Centric Warfare – November 2017

MilsatMagazine

The launch of NROL-52 by United Launch Alliance. Photo is courtesy of Ben Cooper / ULA.

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DISPATCHES

NROL-52 SATELLITE GETS A ULA BLAST OFF

On October 15, a United Launch Alliance (ULA) Atlas V rocket carrying a payload for the National Reconnaissance Office lifted off from Space Launch Complex-41 at Cape Canaveral Air Force Station in Florida at 3:28 a.m. EDT.

Designated NROL-52, the mission is in support of national security.

"*Today's launch is a testament to the tireless dedication of the ULA team, demonstrating why ULA continues to serve as our nation's most dependable and successful launch provider*," said Laura Maginnis, ULA VP of Government Satellite Launch. "*After recovering from Hurricane Irma that came through the area last month, and the last week's weather challenges, the team found the right opportunity today to deliver this critical national asset to orbit.*"

United Launch Alliance Atlas V launch of the NROL-52 satellite. Photo is courtesy of ULA.

This mission was launched aboard an Atlas V Evolved Expendable Launch Vehicle (EELV) 421 configuration vehicle, which includes a 4-meter payload fairing (PLF) and two solid rocket boosters.

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 seventh launch in 2017 and the 122nd successful launch since the company was formed in December 2006.

"*I want to thank the entire ULA team and our mission partners at the NRO and U.S. Air Force who made this, our 26th NRO launch, successful*," said Maginnis.

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

"*Never before has innovation been more important for keeping us ahead of the game. As the eagle soars, so will the advanced capabilities this payload provides to our national security*," said Colonel Matthew Skeen, USAF, Director, NRO Office of Space Launch. "*Kudos to the entire team for a job well done*."

NROL-52is the fourth of five launches slated for the NRO in 2017. The next NRO launch is on schedule for December from Vandenberg Air Force Base, California.

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

With more than a century of combined heritage, United Launch Alliance is the nation's most experienced and reliable launch service provider.

ULA has successfully delivered more than 120 satellites to orbit that aid meteorologists in tracking severe weather, unlock the mysteries of the solar system, provide critical capabilities for troops in the field and enable personal device-based GPS navigation.

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DISPATCHES

MAJOR MOD FOR KRATOS U.S.A.F. CONTRACT

Kratos Defense & Security Solutions, Inc. (Nasdaq:KTOS) has received a modification under an existing contract from the U.S. Air Force to update satellite control and management systems.

Valued at approximately $11.3 million, the update will allow system-consolidation, architectural updates, and security improvements to support current and future military communication satellite missions while decreasing operation and maintenance costs.

Kratos' satellite communication business supports more than 85 percent of U.S. space missions and is used by more than 75 percent of the world's commercial satellite operators, with products and services ranging from command and control (C2) to signal processing, RF interference mitigation, network operations and cybersecurity.

Kratos satellite products include EPOCH® IPS, the industry's leading satellite fleet management system; Monics®, the leading carrier management product; Compass® for managing satellite networks; and NeuralStar® for terrestrial network operations and Service Quality Management (SQM).

Additionally, through its Kratos RT Logic subsidiary, the Company delivers advanced products and capabilities for space-to-ground communications, assured data transport, applied test and training and cyber/mission assurance.

Kratos, through its satellite business, operates the only global network of RF monitoring and interference detection sensors, providing commercial and government clients with important situational awareness data and analytics.

It currently includes 18 worldwide monitoring sites hosting 70+ antennas with visibility to over 60 satellites, 150 beams and 280 transponders.

www.kratostts.com/solutions/satellite-and-space

RUSSIAN MERIDIAN-M MILITARY SATELLITES ON ORDER

Russia's Reshetnev Information Satellite Systems Company has received an order for the production of four Meridian-M military satellites as an upgraded version of Meridian spacecraft series, Company CEO Nikolai Testoyedov told TASS.

"*An order has been endorsed for four Meridian-M satellites to maintain the existing orbital grouping. This is, indeed, an upgrade of existing Meridian satellites, considering the replacement of hardware components while all the technical solutions are the same*," the chief executive said.

A Soyuz-2 launch vehicle with a Meridian satellite payload.
Photo is courtesy of TASS.

The company plans to manufacture the first Meridian-M satellite in late 2018, he said.

"*Further on, the state customer will decide whether to launch the satellite immediately. The next satellite will be ready in 2019, the third in 2020 and the fourth in 2022*," Testoyedov said, noting that the timeframe had been selected taking into account the time when the existing Meridian satellites will start to be retired in a planned manner.

The Meridian series embraces second-generation satellites that came to replace Molniya and Raduga space vehicles. The operational satellites have an active service life of seven years but none of them has yet used up this term.

DISPATCHES

GPS OCX + LCS DELIVERED TO U.S.A.F.

The USAF's Space and Missile Systems Center has announced that the United States Air Force has accepted delivery of the Global Positioning System Next Generation Operational Control System (GPS OCX) Launch and Checkout System (LCS) baseline from Raytheon Intelligence and Information Systems.

Also known as Block 0, LCS demonstrated conformance through test and analysis with all contractual requirements. OCX has had numerous challenges delaying the delivery of this critical capability.

This delivery marks a significant program milestone providing the Air Force with a cyber-hardened ground system to support the launch and on-orbit checkout of the GPS III satellites. OCX Block 0 is the foundation for Raytheon's future Block 1 and 2 delivery, slated for delivery in 2022.

Today mission operators are utilizing LCS as part of the GPS III Mission Readiness Campaign. The ground system is performing as expected during the rehearsals and space vehicle checkout, giving the Air Force confidence in its readiness to support launch and on-orbit operations. The first launch of a GPS III satellite is scheduled for 2018.

Air Force Space Command's Space and Missile Systems Center, located at Los Angeles Air Force Base in El Segundo, California, is the U.S. Air Force's center of acquisition excellence for acquiring and developing military space systems. SMC's portfolio includes the Global Positioning System, military satellite communications, defense meteorological satellites, space launch and range systems, satellite control networks, space based infrared systems and space situational awareness capabilities.

DISPATCHES

ADVANTECH WIRELESS REVEALS NEXT GENERATION PRODUCTS

Advantech Wireless has presented the details of their Second Generation Advanced GaN based SSPAs/BUCs and WaveSwitch™ "on-the-fly" SATCOM Waveform Switching Technology during the recent AfricaCom and Global MilSatcom 2017.

At AfricaCom, Advantech Wireless discussed the latest developments in using Gallium Nitride (GaN) technology for solid state power amplifiers.

This unique technology enables a wide variety of commercial and military applications, from Ultra HD TV transmission, SATCOM-on-the-Move (SOTM), internet access for aircraft passengers, and SATCOM manpack terminals.

The new generation of GaN based SSPAs provide higher performance and reliability, combined with the smallest form factor and lowest power consumption on the market.

To address the high complexity of new generation multiservice IP broadband satellite deployments, Advantech Wireless introduced WaveSwitch™, the company's multi-service modeling architecture that optimizes waveform assignment to achieve the highest application performance, with minimum satellite bandwidth resources and the highest network utilization.

At SMi's Global MilSatCom 2017 in London, Advantech Wireless presented details of their new line of GaN based Solid State Power Amplifiers for Advanced Defence Communications along with the firm's Military Grade VSAT Hubs with unique WaveSwitch™ Technology for their ASAT II Multiservice VSAT System.

Cristi Damian, Vice President Global Sales and Business Development, RF and Microwave Products at Advantech Wireless, noted that as the Satellite Market is evolving, so does SATCOM technology.

He added that applications that could not be addressed in the past, are now possible, with the correct combination of network planning and hardware selection. Cost can be drastically reduced, by adopting advanced technology.

Additionally, he emphasized that as a state-of-the-art designer of High Power RF, SATCOM modems, and full VSAT Networks, Advantech Wireless has the expertise to help in these decisions and assists users in avoiding expensive mistakes

www.advantechwireless.com

SATCOM FOR FIGHTER JETS

Israel Aerospace Industries (IAI) has received their first order for the company's SATCOM terminal with a conformal electronic-steered antenna for fighter jets.

ELTA's ELK-1882T SATCOM network system will be installed for the first time on tens of very advanced Western fighters, with first deliveries planned for 2021. This network system is the latest technology developed by ELTA Systems Ltd., a group and subsidiary of IAI (IAI/ELTA). IAI/ELTA's SATCOM solutions was on display at SMi's MilSatCom Show in London.

The customer has selected the innovative ELK-1882T Ku-band phased array SATCOM network for the product's ease of installation and integration, which boasts minimal impact on aircraft performance due to the conformal installation. This conformal flush installation generates negligible drag, as opposed to conventional high profile SATCOM dish antennas.

In addition, the new system has no moving parts, which greatly enhances reliability and robustness, especially on board modern high maneuvering fighters. The onboard system (terminal) includes a conformal phased antenna installed on the jet's fuselage, comprising the transceiver, modem and High Power Amplifier (HPA) in a single LRU, with an IP LAN connection to the aircraft avionics.

Nissim Hadas, IAI Executive VP and ELTA President, noted that this significant achievement is the first milestone in positioning ELTA as a leader in electronic steering technology for aircraft communication solutions.

www.iai.co.il/

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ORIGINS: IDIRECT GOVERNMENT (IDIRECTGOV)

INNOVATION FROM THE START — A PERSONAL VIEW

by John Ratigan, President, iDirectGov

The genesis of iDirect Government (iDirectGov) was delivered by a dedicated group of satellite communications experts who built a superb COTS product targeted at the federal government.

As is the case with most technology start-ups, the origins of iDirectGov are quite modest. A great product, hard work and a bit of luck thrown into the mix resulted in success. Here's our story...

iDirectGov began as iDirect in 2002, a small start-up with less than 40 employees funded by venture capital. In February of 2003, I arrived at the doorstep of this small satellite start-up. During the first week of my tenure with the company, I secured a meeting with a company outside of Ft. Monmouth, New Jersey, named Tamsco. That company had been tasked with the installation of two networks for the military, as the unannounced war in Iraq was beginning.

I spent the entire day with them. Our experts educated Tamsco on time division multiple access (TDMA) and that technology's merits over other channel-sharing techniques, such as frequency division multiple access (FDMA) and code division multiple access (CDMA).

In a day long meeting with a firm that was destined to be our first government customer, the iDirectGov team demonstrated why our solution was viable in the military and federal marketplace.

After the meeting, they asked me to compose a proposal for the two military networks. The task at hand was creating a proposal from nothing — absolutely nothing. As a start-up, we didn't have a spec sheet, a picture, a network diagram, a competitive analysis or even a working printer.

The iDirectGov team group photo taken at the company's headquarters.

What we did happen to have was a superb product that worked — and worked well. There was also a group of smart and dedicated people behind the build of this product. This product, however, remained unproven to the military.

Faced with no field tests, we went to work and assembled an entire stack of colorful paper with some salient numbers and delivered this material to New Jersey to present the iDirect proposal to the potential customer.

The iDirect team conveyed the company's strengths so well that we gained this contract for two separate SATCOM networks, each with about 100 satellite routers. At the time, we didn't realize that the U.S. military was just a month away from going to war.

iDirect was awarded the contract for $1.2 million of equipment, and this was the largest contract iDirect had ever secured at that time and was definitely a pivotal moment as the company's equipment was tested by the users — the warfighters themselves.

The remotes were tested, sent to the customer and 200 operational remotes were then deployed in theater where they performed flawlessly. The customer was delighted with the equipment and this was the start of the iDirect Federal team, later becoming iDirectGov.

In 2003, iDirect grew by tens of millions of dollars to a $19 million company. Momentum took off for the commercial and federal groups, each one successful in their own right.

The growth continued, resulting in additional engineering, sales and professional hires. iDirect closed 2004 with $50 million in revenue, with about a third of the revenue being derived from the federal group.

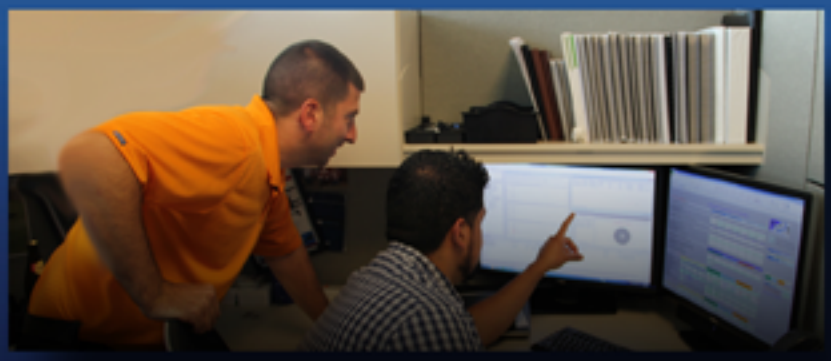
iDirect was ranked locally and in *Forbes* magazine as one of the fastest-growing companies in the United States. By 2005, iDirect sales were approaching $100 million and, in December of 2005, the company was acquired by Singapore Technologies for $165 million.

The federal group continued to grow and we were quickly becoming the SATCOM technology provider of choice for the U.S. military as well as many civilian agencies. We were fortunate that, along with advanced technologies, the company was hiring the correct people who placed the customer first, maintained a positive attitude and worked hard to grow the firm. This customer-centric approach, initiated from the start of the company, has helped us to accomplish growth year after year and has resulted in products that meet customers' needs.

In 2006, we ignited our sales with the second largest single purchase order in iDirect history — a $7.9 million purchase order. This order was dwarfed in 2012 when a purchase order was received to upgrade all of the satellite routers in the U.S. military's largest satellite network. That order was for $40 million and propelled iDirectGov proudly into a leadership position with U.S. Armed Forces.

We started that network in 2004 in a laboratory at Ft. Belvoir, and our partnership with the U.S. Army allowed the company to grow to adroitly serve the needs of soldiers around the world.

In 2008, we formally incorporated iDirect Government as a stand-alone corporation to serve the diverse and specialized needs of the U.S. Department of Defense (DoD) and civilian government agencies.



iDirect Government 10
2007-2017

Then, in 2010, due to our foreign ownership and the classified nature of our work, we initiated a proxy agreement with the U.S. government.

From 2008 to present, we have provided SATCOM products and services to DoD and civilian government agencies, including the U.S. Coast Guard, as well as to all of the branches of the armed forces and the special operations and intelligence communities.

iDirectGov's goal is to maximize satellite communications bandwidth efficiencies and increase satellite network performance, and this drive continues to this day. Unlike the early days, iDirectGov products are tested in the field and user-proven.

Today, iDirectGov is a wholly owned subsidiary of VT iDirect, Inc.; VT Systems is a wholly owned subsidiary of Singapore Technologies Engineering Ltd. (ST Engineering).

iDirectGov is dedicated to offering satellite IP communications technology that enables anytime and anywhere voice, video and data applications in diverse and challenging environments.

Whether in the air, at sea or on land, iDirectGov's advanced satellite IP solutions are used for critical ISR, airborne, maritime and COTM connectivity to support force protection, logistics, situational awareness, disaster recovery and emergency response.

https://idirectgov.com/

...now celebrating 10 years of excellence...

John Ratigan is President of iDirect Government, Herndon, Virginia.

iDirect Government's Timeline of Success

2007
iDirect Government is established as a wholly owned subsidiary of VT iDirect. This separation lays the groundwork for the company to better serve its U.S. government customers.

2008
iDirect Government places its first subject matter expert (SME) onsite at a government location to support and ensure network efficiency. Today, iDirect Government has permanent onsite SMEs deployed worldwide in support of government missions.

2009
iDirect Government opened its Technical Assistance Center (TAC) to provide 24/7/365 support to U.S. government customers.

2010
iDirect Government is awarded a proxy agreement by the U.S. government. By obtaining this status, iDirect Government is able to obtain a Top Secret Facility Clearance allowing us to better serve our customers. Since being awarded a proxy, iDirect Government has achieved superior status on all seven inspections.

2011
iDirect Government, the Defense Information Systems Agency (DISA) and the U.S. Air Force successfully test high-speed video, voice and data transmissions for U.S. military aircraft on the move. This successful test set the groundwork for the future of iDirect Government airborne SATCOM solutions.

2012
iDirect Government is named to Defense Systems "Super 75" ranking of leading military contractors. The Super 75 recognizes innovative and agile companies operating in the net-centric battlespace.

2013
iDirect Government invests in product development engineers to speed innovation and develop specialized market solutions for the Department of Defense and civilian agencies. The team is established to develop next-generation products to meet demand for smaller, faster and more powerful mobile and portable devices.

2014
iDirect Government is selected to operate the Army Distance Learning Network, allowing the Army to provide anywhere access to relevant tailored training and education to soldiers, leaders and Army civilians.

2015
FEMA selects iDirect Government network to be the backbone of its disaster response system — providing all 50 states with vital emergency communications in the event of a natural disaster, terrorist attack or man-made event.

2016
iDirect Government introduces its fastest most efficient family of satellite routers, the 9-Series. Featuring extended frequency ranges, which allow users to access the Wideband Global Satellite (WGS) constellation, as well as High Throughput Satellites (HTS), the 9-Series supports the ability to receive multiprotocol encapsulation (MPE) broadcasts. For secure traffic, the 9-Series will support both one-way and two-way TRANSEC and be certified at FIPS140-2 Level 3.

2017
In its tenth year, iDirect Government introduces the 9-series Airborne Satellite Routers, providing enhanced functionality in a variety of form factors, enabling government organizations to use the best options for their military missions. Whether coordinating with ground elements, transmitting high-definition intelligence, surveillance and reconnaissance (ISR) video or conducting in-flight mission planning, the 9-Series airborne product line is fast, secure and efficient.

A NEW PILOT PROGRAM MAY PRESENT A CHALLENGE FOR ARMY ACQUISITION

by Bill Reiner, Senior Director of Business Development, SES Government Solutions

Last month, the Association of the United States Army (AUSA — *www.ausa.org/*) held their annual meeting and conference at the Walter E. Washington Convention Center in Washington, D.C.

Each year, this event brings the senior leaders of the U.S. Army together with industry experts to discuss the current state of the Army, the challenges that America's warfighters are facing and the new technologies and innovations that can help our soldiers be more ready and capable should threats arise.

This year's conference, in particular, was very eye opening and brought with it some headline-grabbing comments regarding how the Army acquires new products, services and solutions, and the future direction of Army networks. Some of these changes could be very positive for the Army and America's warfighters, while others could lead to problems down the line.

First, let's discuss the changes in acquisition.

A NEW PATH FORWARD FOR MORE RAPID EVALUATION AND ACQUISITION

The entire U.S. military — including the Army — has historically struggled with acquisition.

The Department of Defense (DoD) and branches of the military have found it difficult to evolve a system that acquired physical items — such as firearms, tanks, boats and planes — to one that acquires services and technologies.

When acquiring physical items — such as planes and tanks — the design, acquisition and implementation process can afford to move at a slower pace. Many of these platforms will be in circulation and service for decades.

However, services and technologies create challenges — especially when you consider the near-glacier speed of the federal acquisition process. This is something that I witnessed first hand as a Signal Officer in the Army.

Service providers struggle when doing business with the DoD and federal government because they need employees to meet the demands of government customers. Staff up too quickly and have the contract process move slowly, and they're carrying employees and salaries for a long time waiting for the contract to be awarded. Wait until the award to staff up, and they're left scrambling to hire the human resources necessary to meet contract demands.

Technology acquisition is similarly impacted by the slow acquisition process simply because technology moves too quickly. Often, by the time a new technology is evaluated, acquired, and implemented, it's no longer a new technology and the latest and greatest has already entered the marketplace and become the new industry standard.

Satellite acquisition has faced similar challenges. We recently published a Q&A with Maj Gen Jay Santee, USAF (Ret.), who now serves as the Director for Resilient, Affordable Space at the MITRE Corporation, all about the challenges the DoD faces when acquiring satellite services, and the steps he thinks are necessary to overcome them. (You can find that article HERE.)

So, how is the Army planning on changing this? With a new pilot initiative that creates eight interdisciplinary teams responsible for identifying requirements and evaluating new solutions. The concept is expected to help warfighters better inform the materiel planning and acquisition process, while also expediting it to bring new solutions to bear on the battlefield in a more effective and efficient manner.

Although the program is just a pilot with little authority over acquisition practices early on, it is an innovative and interesting step that's receiving initial praise from senior leaders across government. According to Senate Armed Services Chairman John McCain, "*The Army's decision to restructure its acquisition process and streamline its modernization program is an example of the kind of bold steps that will be necessary to fix a broken system.*"

But that wasn't the only change the Army committed to at this year's event. The other has to do with their networks, and — if executed incorrectly — it could leave the Army less ready to face the threat of advanced adversaries in the future.

In an upcoming article on the Government Satellite Report's infosite, I'll take a closer look at the impending changes to army networks, and discuss why it's essential that satellite plays a role in defense networks of the future.

To listen to an interesting podcast on the state of satellite acquisition in the DoD, featuring Jeff Rowlison, the Vice President of Government Affairs at SES GS, head to
ses-gs.com/govsat/policy/podcast-military-leaves-money-on-the-table-when-acquiring-comsatcom/

William Reiner is a Senior Director of Business Development at SES Government Solutions. Prior to joining SES GS, he served as the Director of Business Development and Marketing for the Boeing Commercial Satellite Services Organization.

Editor's note:
This article is republished, courtesy of The Government Satellite Report (GSR).

The Executive Editor of GSR is ***Ryan Schradin****. He 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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CONSORTIUM FOR EXECUTION OF RENDEZVOUS AND SERVICING OPERATIONS (CONFERS)

by Todd Master, Program Manager, Tactical Technology Office (TTO)

Recent technological advances have made the longstanding dream of on orbit robotic servicing of satellites a near-term possibility. The potential advantages of that unprecedented capability are enormous. Instead of designing their satellites to accommodate the harsh reality that, once launched, their investments could never be repaired or upgraded, satellite owners could use robotic vehicles to physically inspect, assist, and modify their on-orbit assets. That could significantly lower construction and deployment costs while dramatically extending satellite utility, resilience, and reliability.

DARPA's Consortium for Execution of Rendezvous and Servicing Operations (CONFERS) program aims to help overcome these challenges and provide the foundation for a new commercial repertoire of robust space-based capabilities.

CONFERS envisions a permanent, self-sustaining, and independent forum where industry could collaborate and engage with the U.S. Government about on-orbit servicing. This industry/government forum would be composed of experts from throughout the space community.

In fact, efforts to achieve the goal of on orbit servicing are already underway, including DARPA's Robotic Servicing of Geosynchronous Satellite (RSGS) program, which focuses on services for satellites in geosynchronous orbit.

However, these efforts all face a major roadblock: the lack of clear, widely accepted technical and safety standards for responsible performance of on orbit activities involving commercial satellites.

This includes rendezvous and proximity operations (RPO) that don't involve physical contact with satellites and robotic servicing operations that would.

Without these standards, the long-term sustainability of outer space operations is potentially at risk.

DARPA, primarily in partnership with NASA, will bring decades of operational experience from government missions to the consortium. Participants would leverage best practices from government and industry to research, develop, and publish non-binding, consensus-derived technical and safety standards that servicing providers and clients for on orbit servicing operations would adopt.

In doing so, the program would provide a clear technical basis for definitions and expectations of responsible behavior in outer space. The standards would be broad enough to allow individual companies to pursue their own implementations of these standards to suit their individual businesses, while assuring that the implementations adhere to best practices for operational safety.

DARPA aims to transfer CONFERS leadership and funding to industry by 2021, when the Agency is scheduled to perform its first on-orbit demonstration of RSGS. The Agency also intends, by that time, to release the standards for general use by commercial on orbit servicing organizations.

Mr. Todd Master joined DARPA in April 2016 from his previous position with Orbital ATK as a missions systems engineer. He was also the launch operations manager and deputy program director at International Launch Systems. He is now a program manager in DARPA's Tactical Technology Office.

ROBOTIC SERVICING OF GEOSYNCHRONOUS SATELLITES (RSGS)

by Dr. Gordon Roesler, RSGS Program Manager, Tactical Technology Office (TTO)

Hundreds of military, government and commercial satellites reside today in geosynchronous Earth orbit (GEO) some 22,000 miles (36,000 kilometers) above the Earth.

That altitude is an ideal perch for providing communications, meteorology and national security services, but one so remote as to preclude inspection and diagnosis of malfunctioning components, much less upgrades or repairs.

Even fully functional satellites sometimes find their working lives cut short simply because they carry obsolete payloads — a frustrating situation for owners of assets worth hundreds of millions of dollars. With no prospects for assistance once in orbit, satellites destined for GEO today are loaded with backup systems and as much fuel as can be accommodated, adding to their complexity, weight and cost.

But what if help was just a service call away?

DARPA's Robotic Servicing of Geosynchronous Satellites (RSGS) program intends to answer that question by developing technologies that would enable cooperative inspection and servicing in GEO and demonstrating those technologies on orbit within the next five years.

Under the RSGS vision, a DARPA-developed modular toolkit, including hardware and software, would be joined to a privately developed spacecraft to create a commercially owned and operated robotic servicing vehicle (RSV) that could make house calls in space.

By executing the RSGS program, DARPA seeks to:

- *Demonstrate in or near GEO that a robotic servicing vehicle can perform safe, reliable, useful and efficient operations, with the flexibility to adapt to a variety of on-orbit missions and conditions*
- *Demonstrate satellite servicing mission operations on operational GEO satellites in collaboration with commercial and U.S. Government spacecraft operators*
- *Support the development of a servicer spacecraft with sufficient propellant and payload robustness to enable dozens of missions over several years*

Dr. Gordon Roesler joined DARPA in May 2014 after working as a Senior Project Engineer at the Australian Centre for Space Engineering Research at the University of South Wales. His past research interests have included space systems, robotic naval vehicles, sensor systems, and energy systems. At DARPA, he is primarily interested in developing a capability for robotic servicing of satellites.

DARPA + SSL JOIN FORCES FOR SATELLITE SERVICING

In an important step toward a new era of advanced, cost-effective robotic capabilities in space, DARPA today announced that it has selected Space Systems Loral (SSL), based in Palo Alto, California as its commercial partner for the Agency's Robotic Servicing of Geosynchronous Satellites (RSGS) program.

DARPA and SSL seek to develop technologies that would enable cooperative inspection and servicing of satellites in geosynchronous orbit (GEO), more than 20,000 miles above the Earth, and demonstrate those technologies on orbit. If successful, this research and demonstration effort would open the door to radically lowering the risks and costs of operating in GEO, a harsh and difficult-to-access domain that is critically important for both military and civilian space assets.

Under an agreement drafted jointly by DARPA and SSL, the two entities would share costs and responsibilities for the program. While such public-private partnerships have become common in several domains of research and development—saving taxpayer dollars by requiring commercial partners to invest significantly in projects rather than simply receive government funding—the RSGS public-private effort would be a first for DARPA in the space-servicing domain. As such, the Agency's selection of SSL and the pending agreement have been submitted for review by the Defense Department's Under Secretary of Defense for Acquisition, Technology and Logistics.

With RSGS, DARPA plans to develop a robotic module, including hardware and software, and provide technical expertise and a Government-funded launch. SSL would provide a spacecraft and would be responsible for integrating the module onto it to create a robotic servicing vehicle (RSV) and the RSV onto the launch vehicle, as well as providing a mission operations center and staff.

After a successful on-orbit demonstration of the RSV, SSL would operate the vehicle and make cooperative servicing available to both military and commercial GEO satellite owners on a fee-for-service basis. In exchange for providing property to SSL, the Government would obtain reduced-priced servicing of its satellites and access to commercial satellite servicing data throughout the operational life of the RSV, again at great taxpayer savings. The capabilities that RSGS aims to make possible include:

- *High-resolution inspection*
- *Correction of some types of mechanical anomalies, such as solar array and antenna deployment malfunctions*
- *Assistance with relocation and other orbital maneuvers*
- *Installation of attachable payloads, enabling upgrades or entirely new capabilities for existing assets*

In parallel with the RSGS partnership, DARPA also intends to provide the Government-developed space robotics technology to other interested U.S. space corporations. Qualified companies would be able to obtain and license the technology through cooperative research and development agreements.

Separately, to help ensure the long-term sustainability of RSGS and other future space operations—and provide the foundation for a new commercial repertoire of robust space-based capabilities—DARPA recently solicited research to develop and publish consensus operational safety standards for on-orbit rendezvous and proximity operations (RPO) and robotic servicing operations. The awardee would establish and manage the Consortium for Execution of Rendezvous and Servicing Operations (CONFERS), which would include both private sector and government technical experts.

Through CONFERS, DARPA will establish an industry/government forum composed of experts from throughout the space community. The forum would develop non-binding, consensus-derived technical and safety standards for on orbit servicing operations, and help create definitions and expectations of responsible behavior in outer space.

"As the worldwide space industry expands and access to space becomes more routine, the need for norms of behavior—the 'rules of the road'—will become increasingly important to preserve the ability of companies and government agencies to safely operate their space systems," *said Brad Tousley, the Director of DARPA's Tactical Technology Office, which will oversee RSGS.* "With these two high-value DARPA programs, we hope to accelerate the development of norms of operation supporting a robust space servicing capability, which in turn could radically transform the way we build and operate satellites and, in time, enable future large-scale logistics and construction in the GEO environment."

SatCom Frontier

PERSPECTIVES: THE MAN BEHIND U.S. SPACE OPERATIONS, THE CIC PROGRAM AND A PODCAST OVERVIEW OF SPACE AND SATELLITE TRENDS

The following articles are courtesy of Intelsat General Corporation and are authored by the SatCom Frontier editorial department.

When the U.S. military needs satellite connectivity for any of its operations, it turns to Lt. General David Buck, Commander of both the 14th Air Force of the Air Force Space Command and the Joint Functional Component Command (JFCC) for Space under the U.S. Strategic Command.

General David. J. Buck.

The 14th Air Force is the service's operational space component to the U.S. Strategic Command. As the 14th Air Force's Commander, General Buck leads more than 19,500 men and women responsible for providing strategic missile warning; nuclear command, control and communication; the Global Positioning System; space situational awareness; satellite operations; space launch; and range operations.

Wearing his other hat, General Buck also directs all assigned and attached USSTRATCOM space forces as the Commander, JFCC for Space. His office provides tailored, responsive, and synchronized theater and global space support of national security and combatant commander objectives. His operation is also responsible for protecting and defending critical U.S. and allied space capabilities.

Overseeing two large military organizations is no easy feat, but General Buck brings a wealth of experience to his roles. He received his commission in 1986 as a distinguished graduate of Officer Training School.

In addition to a variety of command, test and evaluation, and staff assignments, General Buck's operational experience includes missile operations, space launch and range operations, satellite command and control, space force enhancement, and space control.

Prior to assuming his current position, General Buck was first the Director of Operations, then Vice Commander, Air Force Space Command.

As a result of holding these two commands, he is "in position of not only organizing, training, and equipping space forces, but also being a main point-person for the space part of any military operations," Space News said in a recent article.

When a military unit needs space support, it submits the request to the Joint Space Operations Center (JSpOC).

Airmen of the Joint Space Operations Center (JSpOC) at Vandenberg Air Force Base monitor computer systems designed to detect, track, and identify all artificial objects in Earth's orbit at Vandenberg AFB, Calif, Sept. 27, 2014. Its mission is to provide a focal point for the operational employment of worldwide joint space forces and enable the commander of Joint Functional Component Command for Space to integrate space power into global military operations.
Photo is courtesy of U.S. Air Force — Airman 1st Class Krystal Ardrey.

"*Typically, we will get those space support requests and say 'how can we best support this campaign?'*" General Buck said at a breakfast earlier this year, hosted by the Air Force Association's Mitchell Institute for Aerospace Studies. "*Typically, in a campaign like this, notionally, it would involve optimizing the precision, navigation, and timing constellation — GPS — and also making sure that our satellite communications systems are queued and ready to support.*"

In addition to overseeing day to day operations, General Buck is thinking strategically about the U.S. military's future space capabilities. For instance, the JFCC for Space is tasked with assessing the

Commercial Integration Cell (CIC) project. The CIC is a pilot program to determine how information sharing and collaboration between the Department of Defense and commercial satellite operators can be improved (*please see the sidebar regarding CIC*).

General Buck is also strategizing the best way to beef up the organizations' intelligence capabilities. "*To me, intelligence drives operations, and we have to get ahead of adversary actions*," he said at the AFA event. "*Just like every other domain, I need domain awareness: knowledge of who, what, where, when, and why.*" To this end, General Buck is working with the Air Force Deputy Chief of Staff for Intelligence, Surveillance, and Reconnaissance, Lieutenant General VeraLinn "Dash" Jamieson. Together, they are trying to determine the best way to attract intel personnel to space career fields.

General Buck's efforts to collaborate with commercial satellite partners and achieve an intelligence advantage illustrate his long-range view of the importance of space in military operations.

Intelsat General partner Kratos is producing Constellations, a podcast featuring top influencers in satellite and new space. The first edition of Constellations features the President of Intelsat General Corp., Skot Butler, and is entitled "*Big Data, HTS and Drone Races*." *Select Skot's photo to hear the interview.*

Skot talks about the concepts involved in "*new space*" and where Intelsat fits within the larger picture. He presents a high-level overview of innovations in space and on the ground as they relate to Big Data, the Internet of Things (IoT) and mobility. This includes how HTS and small, flat panel antennas are combining to enable rapid decision making in aviation, maritime, and other critical operations. Listeners will also learn how Intelsat is providing global satellite coverage through its partnership with OneWeb to enable connectivity in the air and on the ground.

Listeners will learn how the form factor of antennas is evolving, how antennas are making it easier to join the network as well as gaining a sense of the scope of the data being transmitted by IoT today and in the future.

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THE CIC PROGRAM

CIC allows satellite operators from commercial companies to sit alongside military personnel at the JSpOC. The goal is to enhance the JSpOC commander's situational awareness of the space domain and develop tactics and procedures for combined operations, helping achieve a better integration of commercial satellite operators and the warfighter.

The CIC is a pilot program to see how information sharing and collaboration between DoD and commercial satellite operators can be improved. This program is being operated under Cooperative Research and Development Agreements (CRADAs), which are approved by the Air Force Research Laboratory (AFRL) and address technology transfer challenges between Air Force activities and commercial collaborators.

Intelsat General's Tim Turk was assigned to the CIC project and witnessed the program's success firsthand, stating the project "laid the groundwork for sustained, combined operations, and clearly paved the way for an enduring relationship as true mission partners."

The CIC collaboration seeks to improve conjunction assessment and space object catalog maintenance; enhance rapid identification, diagnosis and resolution of RFI events; identify on-orbit anomalies; and increase overall resilience of government and commercial satellite operations. One particular focus was on exploring the possibility of machine-to-machine interfaces for the exchange of "ephemeris data," numbers that indicate exact spacecraft locations.

Six commercial companies participated in the CIC: Intelsat General Corp., SES-GS, Eutelsat-America, Iridium, Inmarsat and Digital Globe. Intelsat General helped craft and perform the concept of operations (CONOP), working as an integrated member of the DoD. Relationships were built, procedures learned and contingency plans for space jointly developed.

The CONOP was performed as part of the recent Schriever War Game and the increased optimization of space assets and additional resiliency shown was judged a huge success. The Wargame, which was set in the year 2025, explored critical space issues, such as spacecraft jamming to cyber warfare attacks on ground-to-space control infrastructure and the use of anti-satellite weaponry.

The value of a commercial presence inside the JSpOC cannot be overstated. There is the obvious value of improved satellite catalog accuracy and faster, more secure coordination and resolution of interference events. The CIC pilot has laid the groundwork for sustained, combined operations and clearly paved the way for an enduring relationship as true mission partners.

This closer partnership is critical, not just in peaceful times but as preparation for potential times of threat. Placing commercial personnel on the inside greatly improves military and commercial communications by mitigating problems before they occur and increasing response time.

Joint Functional Component Command for Space (JFCC Space) will now assess the CIC program and establish the framework for further collaboration. Tim Turk believes the success of the CIC demonstrates the immense potential represented by closer military and commercial coordination of space assets. As the program continues, the JFCC for Space is establishing a framework for further collaboration.

RECON: DISA + LI-FI

LI-FI TECHNOLOGY OFFERS BENEFITS IN MOBILITY, SPEED, COST, SECURITY

Light fidelity, or Li-Fi, is a ground-breaking light-based communication technology which makes use of light waves instead of radio technology to deliver data.

Li-Fi is a bidirectional, high-speed, and fully networked wireless communication technology similar to Wi-Fi, but capable of 10 times faster transmission rates from point to point.

"*Li-Fi technology has the potential of being faster than any radio based technology existing at present,*" said Dr. Bill Butler, project lead for the DISA Li-Fi University Affiliated Research Center (UARC) Project. "*With Wi-Fi, all devices are fighting for the same 800 megabits per second (Mbps) of bandwidth. With Li-Fi, the entire visible and non-visible light spectrum is available for use - laying the groundwork for 10 gigabits per second* (Gbps) transmission rates within the next calendar year."

Li-Fi can provide the military with high speed, non-detectable communications that cannot be identified through current direction-finding technology. The high-speed, multi-frequency communication capability inherent in Li-Fi can free up bandwidths used in critical legacy applications that haven't converted to newer technology.

With Li-Fi, inter-soldier, inter-vehicle, and inter-ship line-of-sight communications can render mobile units ubiquitous relays of information and orders without any verbal communication, while remaining totally invisible in the battlespace.

Li-Fi will be especially valuable in commercial applications, such as communication between cars and other vehicles requiring integrated high-speed motion detection; in hospitals, where radio waves interfere with delicate instrumentation; in airplane environments,

where radio frequencies (RF) can interfere with navigation equipment; and in construction, where heavy explosives are currently detonated through radio signals.

HOW IT WORKS

According to Dr. Butler, *"light is already used for data transmission in fiber-optic cables and for point-to-point links, but Li-Fi is a special and novel combination of technologies that allow it to be universally adopted for mobile ultra-high speed internet communications using normal light frequencies across the 440 to 770 terahertz (THz) spectrum. However, Li-Fi can also be used in the non-visible frequencies, such as infrared, X-ray, and ultra-violet frequencies between 300 gigahertz (GHz) to 400 THz - presenting endless possibilities for manufacturing new and complex communication equipment."*

Li-Fi uses a photo-detector to receive light signals and a signal processing element to convert the data into 'streaming binary digital' content. An LED lightbulb is a semi-conductor light source, meaning that the constant current of electricity supplied to an LED lightbulb can be dipped and dimmed, up and down at extremely high speeds, without being visible to the human eye.

For example, data is fed into an LED light bulb (with signal processing technology), it then sends data (embedded in its beam) at rapid speeds to the photo-detector (photodiode).

The tiny changes in the rapid dimming of LED bulbs is then converted by the 'receiver' into electrical signal. The signal is then converted back into a binary data stream that we would recognize as web, video, and audio applications running on internet enabled devices.

BENEFITS

"Li-Fi offers benefits in mobility, speed, cost, and, most importantly, security," said Dr. Butler.

Currently available Li-Fi commercial products run on visible light, and because light cannot penetrate through solid walls, signals can't be intercepted while being transmitted — unlike traditional radio frequencies. This is a critical advantage when it comes to protecting classified and sensitive DOD missions.

"In battlefields, Li-Fi can be used for vehicle-to-vehicle communications through the use of headlights and taillights without system interference, and the data is secure because information is only transmitted to those in the line of direct sight. It can also replace the complex cabling required in forward-deployed command centers by combining the network access points in the overhead lighting. This reduces power consumption and simplifies command center setups," said Dr. Butler./ *"Additionally, there is greater bandwidth availability in light waves than radio waves, and the transmission of data using LEDs is highly energy efficient."*

ON THE HORIZON

DISA is in the early stages of exploring Li-Fi technology and the applicable uses for DOD. The technology was demonstrated in a classified work environment and initial pilots confirmed Li-Fi provided secure networked communication within an enclosed space.

"Right now, we are working to procure equipment and configure a demonstration of Li-Fi within a secure, multipoint networked environment," said Dr. Butler. *"We will continue to work with our academia partnerships to explore and prototype the next-generation DODIN and move the DOD towards a wireless non-RF complimentary environment."*

In the future, Li-Fi may be offered as an enterprise service for secure environments, and may also serve as a solution for other communication requirements.

Data for laptops, smart phones, and tablets is transmitted through the light in a room using diodes pulsing at extremely high speeds undetectable to the human eye. Security is established through direct light transmission; therefore, if you are not in the amplified light network, you cannot access the data or other networked appliances.

www.disa.mil/