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MilsatMagazine

July / August 2020 issue

The launch via Minotaur rocket of the NROL-129 mission from the Wallop's flight facility. Photo is courtesy of the NRO.

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THE MIGHTY MINOTAUR SUCCESSFULLY PUSHES THE NROL-129 MISSION FROM WALLOPS

The classified National Reconnaissance Office's (NRO) NROL-129 mission launched successfully from the Mid-Atlantic Regional Spaceport, known as MARS, at NASA's Wallops flight facility — this was the agency's third launch of 2020.

Of note is that this was the first flight of the Northrop Grumman built Minotaur IV rocket from this launch site and four payloads were lifted to orbit for the NRO. Northrop Grumman and the NRO teams had been preparing for this launch starting nearly two months ago, including the incorporation of the solid propellant engines, the payload encapsulation and all final processing. These actions were all completed in the new payload processing facility at Wallops, with final closeout activities occurring during the past weekend.

The launch occurred at Wallops Pad-0B, with a nearly instantaneous liftoff… full thrust for the Minotaur was attained within 0.2 seconds of engine ignition, far faster than could have been accomplished with a liquid propellant engine.

This mission carried four payloads designed, built and operated by the agency to support the overall national security mission by providing intelligence data to United States' senior policy makers, the Intelligence Community and Department of Defense (DoD). The NROL-129 was the NRO's 54th launch since 1996, with the next launch from NASA Wallops Flight Facility scheduled for Q2, CY2021.

Northrop Grumman's Minotaur rockets have completed 26 missions out of every major U.S. spaceport and have enjoyed 100 percent success. Under the U.S. Air Force Orbital/Suborbital Program-3 (OSP-3) contract, Northrop Grumman integrates, tests and provides space launch services for the Minotaur I, IV, V, VI and C family of rockets.

The OSP-3 contract is managed by the Rocket Systems Launch Program, which is part of U.S. Space Force and Missile Systems Center (SMC). OSP-3 expands on OSP-2 by continuing to use excess ICBM motors and includes potential Evolved Expendable Launch Vehicle new entrant launch vehicles. The OSP-3 contract allows for an indefinite delivery, indefinite quantity with a $900M ceiling based on a firm fixed price service contract strategy.

The latest information regarding upcoming NRO launches include:

- *NROL-44 and NROL 101, both from Cape Canaveral Air Force Station, Q3 of CY2020*
- *Vandenberg Air Force Base, Q4, CY2020*
- *NASA Wallops, Q2, CY2021*
- *The next launch from New Zealand is scheduled for Q2, CY2021*

Executive Comment

"*NROL-129 represents a collaboration between the NRO and our industry partners to design, build, launch and operate a system of satellites that will demonstrate revolutionary capabilities of value to the nation and our allies,*" said Dr. ***Chris Scolese***, the agency's director. "*Despite facing challenges in 2020, we have found new and better ways to collaborate with our partners from a distance, relentlessly pursuing our mission and*

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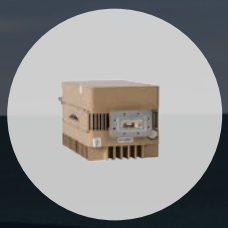

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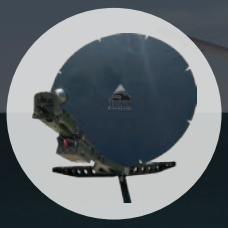

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denying sanctuary to our adversaries. I want to thank all of those involved across NASA, Northrop Grumman, Virginia Space, the Space and Missile Systems Center, and of course, the NRO for pulling together to make this launch a success.

"*The NRO is committed to providing resiliency in our operations through diversified launch options, and the success of NROL-129 is the culmination of years of steadfast collaboration with our civilian, military and commercial space partners to help us achieve that* commitment," said U.S. Air Force Colonel ***Chad Davis***, director of the NRO's Office of Space Launch. "*We have a long record of developing, delivering, launching and operating the world's most advanced space collection systems and capabilities in support of national security, and we're happy to add our first dedicated launch from the Virginia Space Coast to that history.*"

SPACEX SUCCESSFULLY LAUNCHES A MILITARY SATELLITE FOR SOUTH KOREA

The SpaceX launch of South Korea's military Anasis-II mission lifted off from Space Launch Complex 40 at Cape Canaveral Air Force Station in Florida at 2:30 p.m.,PT, on July 20.

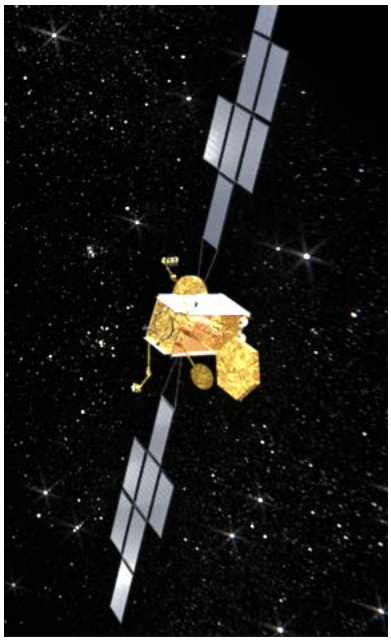
Earlier this month, on July 14, there was a delay as SpaceX explained it was pushing back the launch "*to take a closer look at the second stage, and to swap hardware if needed*" just a day before launch.

Anasis-II is South Korea's first military communications satellite — a a very limited amount of information regarding the mission was available, save for that fact that the satellite is based on Airbus' Eurostar E3000 satellite bus.

ANASIS-II will be deployed into a Geostationary Tansfer Orbit (GTO) by the SpaceX Falcon 9 launcher. The satellite will then use its own propulsion to maneuver into its specified slot. This launch was SpaceX's first GTO mission of 2020.

UK MINISTRY OF DEFENCE SIGNS AIRBUS FOR THE SKYNET-6A SATELLITE

Airbus Defence and Space has signed a contract with the UK Ministry of Defence (MOD) to extend and enhance the Skynet fleet — this project will involve the development, manufacture, cyber protection, assembly, integration, test and launch, of a military communications satellite, Skynet 6A, planned for launch in 2025.



Artistic rendition of Skynet-6A is courtesy of Airbus.

The contract also covers technology development programs, new secure telemetry, tracking and command systems, launch, in-orbit testing and ground segment updates to the current Skynet 5 system. The value of the contract is more than £500 million.

The Skynet 5 program, managed by Airbus, has provided the UK MOD with a suite of highly robust, reliable and secure military communications services, supporting global operations since 2003. Airbus has been involved in all Skynet phases since 1974 and this phase builds on a strong UK commitment to space manufacturing in the UK. The recent program commenced by using the legacy Skynet 4 satellites and then augmenting them with a fully refurbished ground network before launching the Skynet 5A, 5B, 5C and 5D satellites between 2007 and 2012.

The Skynet 5 program has reduced or removed many of the technical and service risks for the MOD, while ensuring unrivaled secure SATCOMs and innovation to UK forces. Through the many years of delivering an exceptionally reliable Skynet service the Airbus teams have managed to significantly extend the lifespan of the Skynet satellites many years beyond their design life, offering significant additional value for money and capability to the UK.

The Skynet 6A satellite will be based on Airbus' Eurostar Neo telecommunications satellite platform. It will use more of the radio frequency spectrum available for satellite communications and the latest digital processing to provide both more capacity and greater versatility than Skynet 5 satellites.

The satellite will feature electric orbit raising propulsion as well as electric station keeping systems for maximum cost effectiveness. Complete satellite integration will take place at Airbus facilities in the UK followed by testing using RAL Space testing facilities at Harwell in Oxfordshire supporting the UK Space Agency initiative for sovereign UK end-to-end satellite production and support.

The satellite is due for launch in 2025, and will have a minimum design lifetime of 15 years. Its orbital position will be announced closer to the launch date.

UK Defence Secretary ***Ben Wallace*** added, "*A new, more advanced satellite capability will provide continued communications support to the UK deployed forces for many years. British defence must continue to innovate and transform, particularly in cyber and space. Investment in first-class equipment like this new Skynet satellite will keep us safe from the threats we face both now and in the future.*"

Executive Comments

Richard Franklin, Airbus Defence and Space UK Managing Director, said, "*Airbus is extremely proud to be awarded this critical UK defence contract continuing our long tradition as the UK national milsatcom end-to-end services provider. Satellite manufacturing, linked to support services, is a critical component of the Government-industry UK space strategy and this contract underpins the UK MOD's and industry's lead position in this sector. Building this military satellite will, like Skynet 5, lead to significant export opportunities in the years ahead, growing high value manufacturing jobs and supporting a diverse supply chain in this increasingly important sector.*"

He continued, "This contract for 6A demonstrates the strong working partnership we have with UK MOD, built on the success we have jointly achieved on the Skynet 5 system since 2003. Airbus is fully committed to delivering world-class military communications services to our Armed Forces across the globe, and look forward to delivering this step change in capability to the MOD."

UK Science Minister *Amanda Solloway* noted, *"Space technology plays an important role in supporting our military and keeping us safe, while also boosting the UK's economy and enabling world-leading science and research. "With this major investment in Skynet 6A, the development of the National Satellite Test Facility and the launch of a dedicated innovation program, we are setting a bold new ambition for the UK in space."*

BLACKSKY TO TRACK COVID-19'S IMPACT ON MILITARY BASES

BlackSky has been awarded a U.S. Air Force contract through AFWERX and the Air Force Research Lab (AFRL) to monitor the efficacy of COVID-19 mitigation efforts worldwide.

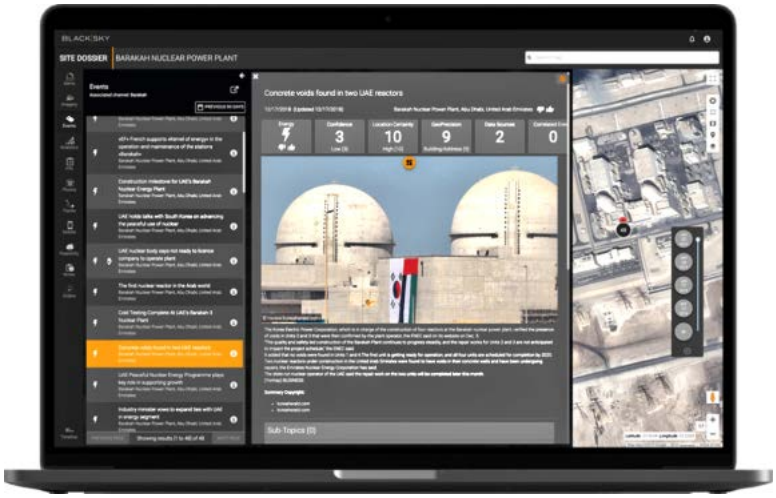
The contract calls for BlackSky to monitor overseas U.S. military bases and help maintain secure supply chains using its Spectra artificial intelligence and machine learning platform. Near-real time global monitoring capabilities will track the spread of COVID-19 to ensure the protection of deployed personnel, and secure critical nodes of the supply chain.

BlackSky's Spectra platform will leverage state-of-the-art image exploitation techniques to automatically analyze anomalies and monitor the application of social distancing. These measurements will then be correlated against the reported infection numbers coming from local governments and integrated into the latest epidemiology models to predict the risk to deployed U.S. Air Force personnel and the surrounding communities.

The major economies of the world have experienced the impact of the rapid onset of the coronavirus. BlackSky will help critical components of the defense industrial supply chain recover by monitoring logistics depots, maintenance facilities, petroleum reserves, and airport facilities. BlackSky will provide alerts and notifications when changes in activity level or other anomalies are observed.

Executive Comment

"BlackSky is giving decision makers the crucial information they need to protect U.S. interests at home and overseas amid today's rapidly shifting threat landscape," said ***Brian O'Toole***, CEO of BlackSky. *"By combining global geospatial data sources with satellite remote sensing data, Spectra provides a near-real time look at the evolving pandemic and provides critical insights to inform national security. It is imperative to have transparency into the status of critical nodes of the supply chain for planning purposes. With BlackSky's global monitoring capability, the U.S. Air Force can maintain a watchful eye over its supply chain. Spectra will provide the Air Force an easy to use outbreak monitoring and decision support tool. The platform will help us combat the spread of COVID-19, manage risk and ensure the protection of personnel around the globe."*



PARADIGM'S HORNETKU VSAT APPROVED FOR USE ON THE MAVERICK VSAT SERVICE

Paradigm's portable and compact HORNETKu VSAT is now approved and fully qualified for use on the Network Innovations Group's MAVERICK VSAT service.

NIC4, the U.S. Government focused subsidiary of Network Innovations, has successfully introduced the HORNETKu VSAT into their customer base as a fully-integrated MAVERICK flyaway system with embedded modem for ease of transport and use. The fully scalable MAVERICK VSAT service provides efficient and flexible services to VSATs, running on multiple satellites and supporting different frequencies and path beams.

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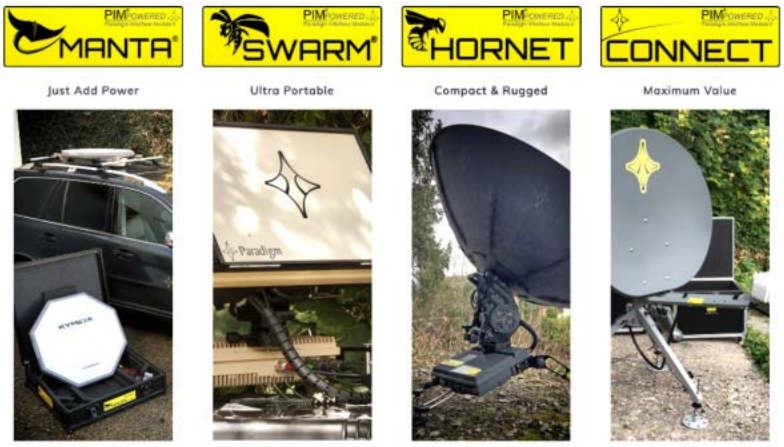
This network is ideally suited to the Paradigm HORNETKu, Paradigm's rugged portable PIM (Paradigm Interface Module) -based VSAT terminal. The field proven HORNETKu provides a single SATCOM solution for many different operational requirements.
The HORNETKu is environmentally rugged, yet still lightweight and crucially, even the largest 100 cm variant can be packed into a single airline-friendly case. The HORNETKu integrates the easy-to-use and field-proven PIM, which allows any non-skilled user to point the antenna in just a few minutes.

The PIM controller provides the modem, baseband switching, assisted pointing and setup functions for the HORNET and comes with a built-in visual crosshair and audio pointing device. As well as making pointing straightforward for any user, the PIM supports Power over Ethernet devices and provides a multitude of services to the end user – from VLAN setup and management to smart auto-selecting of AC and DC power interfaces. MAVERICK provides flexibility of service, bandwidth on demand and state of the art coding and modulation to ensure customers enjoy the benefits of increased link stability.

With true dynamic bandwidth allocation, MAVERICK services can be shared across fleets of HORNETKu terminals, adding and deploying to new sites as needed.



Executive Comments

Jon Godfrey, General Manager at Paradigm, commented, *"The HORNET is easy-to-use and extremely portable, now on MAVERICK, its high throughput capabilities are available in the remotest locations on affordable and flexible plans."*

Chad Gatlin, CEO at NIC4, noted, *"NIC4 is excited to incorporate this fully integrated terminal into the MAVERICK network. The combination of the HORNET's SWAP and ease of use are an ideal complement to the flexibility and exceptional reliability MAVERICK offers to meet the stringent demands of our U.S. Government customer base."*

U.S. SPACE FORCE SMC'S WIDE FIELD OF VIEW SATELLITE OK TO SHIP TO LAUNCH SITE

Approvals have been issued after a joint NASA / United States Space Force (USSF) Space and Missile Systems Center (SMC) management and technical review in which the Wide Field of View (WFOV) Testbed spacecraft has been declared ready to ship to launch site. WFOV is informing the Next Gen OPIR, a missile warning satellite system acquisition program that will deliver advanced capabilities to keep pace with adversary advancements.

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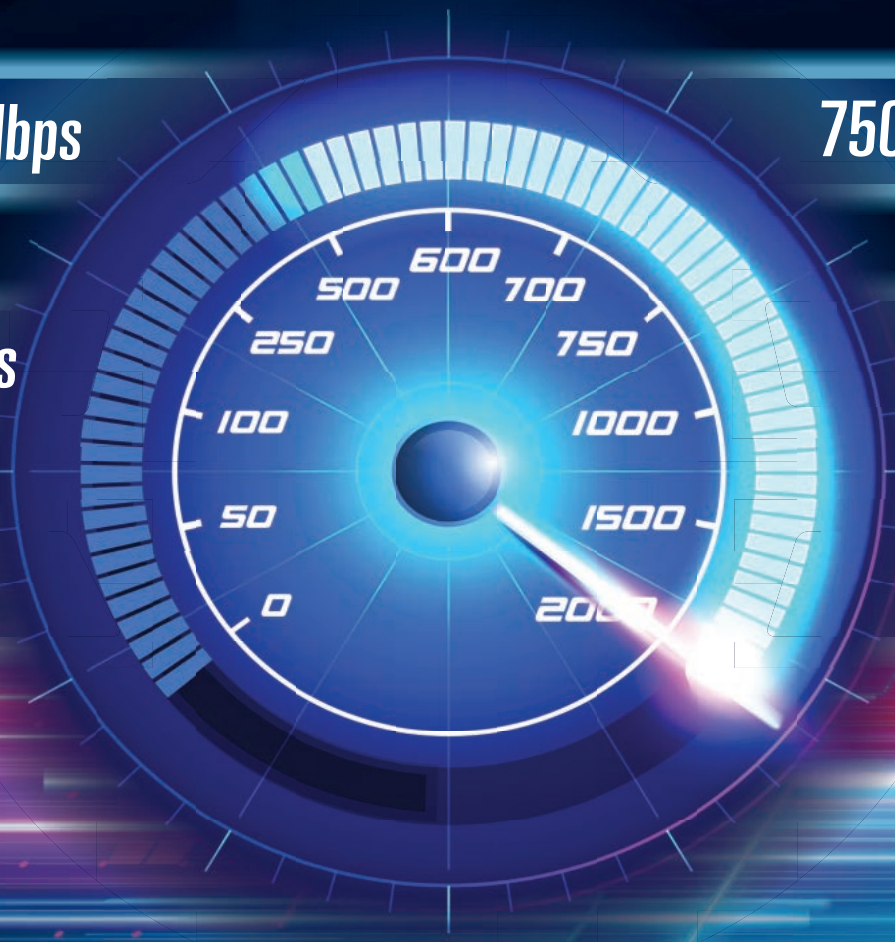

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A *United Launch Alliance* (ULA) ATLAS V rocket will launch the spacecraft next year. The approval came when *Millennium Space Systems*, a division of *Boeing*, passed this major program milestone after detailed reviews of the satellite's performance in environmental testing.

While awaiting launch, NASA and USSF SMC are planning risk reduction tests with the integrated spacecraft with its ULA launch interfaces and its integrated ground segment. Following those tests, the satellite will ship next year to the launch site. It is scheduled to launch in 2021 on its mission in geosynchronous orbit (GEO).

"*The Wide Field of View program highlights our commitment to innovation and is critical to advancing the technology required to meet the growing threat*," said Col. ***Charles Galbreath***, Deputy Director, Innovation and Prototyping, Development Corps, Space and Missile Systems Center. "***Working with our incredible partners, we've demonstrated how to prototype new missile warning sensors, created a flexible testbed to fly them on, and qualified a new satellite platform for GEO at a significant cost savings. These are all capabilities we need now to support our warfighters and allies worldwide***."

"*The WFOV Pre-Ship Review is the capstone of the integrated space vehicle design verification and ensures readiness for flight*," said ***Jennifer Schaaf***, Millennium Space Systems program manager for WFOV systems engineering, integration and test. "*A large portion of the AQUILA M8 bus leverages Millennium's in-house capabilities. These organically developed capabilities are a key enabler for executing agile, affordable space programs.*"

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

WFOV Testbed is designed for a 3 to 5-year life in GEO with a total mass up to 3,000 kg and a payload accommodation over 350 kg. The satellite's primary mission on-orbit is to explore future missile warning algorithms with data collected in space.

WICKR, INC. AWARDED SECURE COMMS CONTRACT BY U.S.A.F.

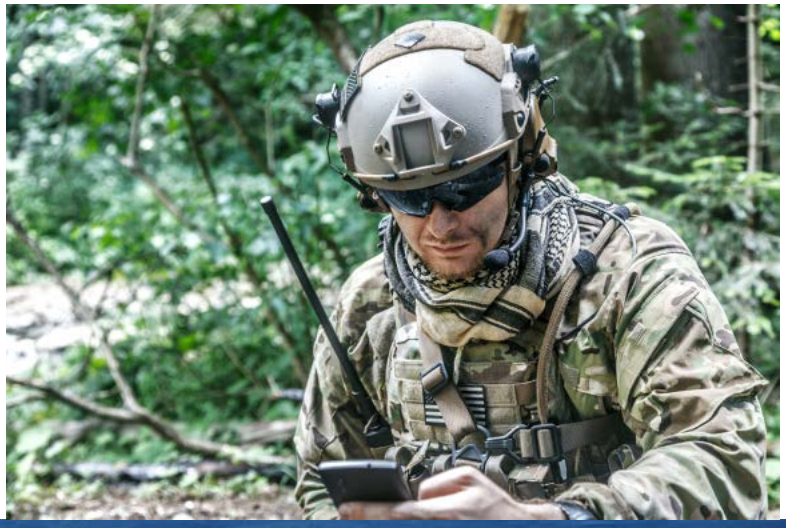
Wickr, Inc. has been awarded a $35 million dollar contract from the United States Air Force to provide its Wickr-based recall, alert and messaging (Wickr RAM) throughout the United States Department of Defense (DoD).

With this new Air Force contract, Wickr further extends its services across all three major DoD departments, expanding to provide secure communications for the Army, Navy, Marine Corps, and Air Force with end-to-end encrypted file, video, chat, text and voice services for end-users.

To meet Department of Defense (DOD) security requirements, Wickr RAM enables full administrative and compliance controls. The contract names Wickr RAM as a DoD approved Federal Information Processing Standards (FIPS) certified application suite, and is additionally Federal Risk and Authorization Management Program (FedRAMP) FedRAMP certified, an imperative criteria to consider when selecting a collaboration service that ensures the highest levels of security for nationally recognized government entities.

Wickr RAM, the self-hosted end-to-end encrypted collaboration platform designed for and accredited by the DoD, is the only collaboration service with full functionality to meet all security criteria of the National Security Agency (NSA), and require an Air Force Cloud One and Air Force Special Operations Command cloud certified fully managed service provider.

The application suite, built for secure communication and collaboration control and deployed to address the requirements to serve recall, alert, and messaging, includes servers that run in a DOD approved cloud data center and client applications that run on government issued, personal, and temporary computers and mobile



devices with a DoD validated secure mobile application. Combined with its end-to-end encryption and zero trust infrastructure, Wickr RAM ensures privacy for the Air Force, Navy, and Army in the harshest environments.

The Air Force is obligating over eight million dollars for fiscal operations and maintenance funds to be performed at the Air Force Installation Contracting Center in Hurlburt Field, Florida and is expected to be completed May 31, 2022.

Executive Comments

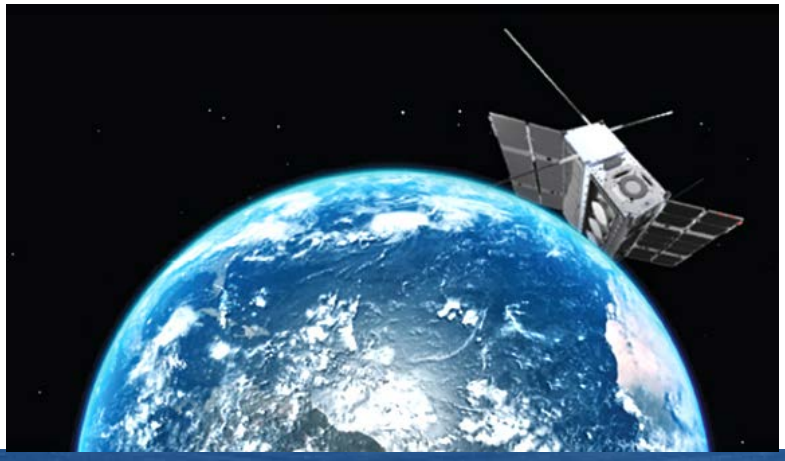
"Providing secure communications to the tactical edge and higher on government & personal devices for data up to IL4 FOUO to include PII & PHI is greatly improving situational awareness and enabling commanders to have more complete decision making data," said ***Dan Skinner,*** Head of Federal Operations, Wickr.

"Wickr is honored to be the recipients of this contract that will be used to enhance Air Force security and meet the government's needs for their most essential, private communication with the utmost secure communication and collaboration tools," said ***Joel Wallenstrom***, CEO of Wickr. *"We hope that this partnership will continue to inform the global encryption discussion and highlight the need for true security in government agencies."*

HORIZON TECHNOLOGIES' SIGINT SYSTEMS RESPONSIBLE FOR £4+ MILLION IN ORDERS

Horizon Technologies has reported £4+ million in additional orders for the company's FlyingFish™ airborne, Sat Phone SIGINT systems to NATO end-users.

The orders consist of a total package including Group A kit and ILS support for a variety of airborne ISR platforms.



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Horizon Technologies remains on track to launch their first Amber™ smallsat next year and is working with the company's UK and international partners on planning for additional launches to commence quickly after the Amber-1 smallsat is on-orbit.

Amber™ is a space-based Maritime Domain Awareness (MDA) intelligence system and is part of a public/private partnership with the UK Government.

This award is on top of the £100,000 Grant assigned to the company to help fund its AMBER™ CubeSat-based Intelligence Data Service.

Executive Comment

Horizon Technologies CEO ***John Beckner*** said, "*Despite Covid-19, our business continues to grow, and these current orders reflect customers moving their SIGINT requirements forward, and getting additional ISR assets into the field more quickly. While details are not in the public domain, our products continue to be part of NATO and EU missions worldwide ranging from refugee rescue, counter terrorism, smuggling & trafficking interdiction, etc. FlyingFish™ reliability is unsurpassed, and our customers consider FlyingFish™ as Essential Mission Equipment in all their critical ISR operations. Our expanding FlyingFish™ sales are having a very beneficial impact on our Space-Based MDA Data as a Service (DaaS) Amber™ business.*"

John went on to say, "*As European business travel is coming back, the Horizon Technologies team is back again conducting face-to-face meetings with commercial and government end-users. As AMBER™ is a Public/Private partnership with the UK Government, we are most grateful for the continuing support from the UK Government; DIT and DSO in particular. Despite the worldwide disruptions due to COVID-19, our legacy FlyingFish™ business is increasing, and our list of AMBER™ end-users continues to grow—2020 will be our most successful year yet.*"

He added, "*The Innovate UK Grant is a Continuance Grant which will be put to good use in making sure our AMBER™ Processing Centre (APC) will be up and running in the near future.*" Beckner notes, "*The APC needs to be fully tested and operational in order be able to provide terrestrial AMBER™ data for integration testing for our AMBER™ end-users in addressing their Maritime Domain Awareness (MDA) requirements. Using Horizon Technologies' unique IP, the APC processes AIS, Sat Phone, Maritime Radar, and GNSS Spoofer signals sent to it from the AMBER™ payload.*"

2.4K SPACE OPERATORS TO TRANSFER TO U.S. SPACE FORCE

Following the May application window for active-duty Airmen in specified career fields to volunteer to transfer to the U.S. Space Force, the service has selected 2,410 members in the organic space specialties of space operations (13S) and space systems operations (1C6) for transfer starting on September 1.

These space operators will officially commission or enlist, as applicable for officers or enlisted, into the Space Force and will grow the initial ranks of the new service.

Members selected for transfer will receive MyPers messages later in July with instructions for required administrative tasks to complete prior to executing their transfers.

While most members will execute their transfers around September 1, some members awaiting various administrative processes, such as a pending promotion board, will transfer at a later date when those actions are completed.

The actual number of members who complete transfers may differ slightly from the number approved for transfer as members make this personal decision based on their individual and family circumstances at that time.

In total, more than 8,500 active-duty Airmen from 13 eligible officer and enlisted career fields volunteered to transfer. The 2,410 members selected were in space operations career fields.

The remainder of the volunteers come from career fields common to both the Air Force and the Space Force: intelligence (14N), cyberspace operations (17X), developmental engineer (62E), acquisition manager (63A), operations intelligence (1N0), geospatial intelligence (1N1), signals intelligence (1N2), fusion analyst (1N4), targeting analyst (1N8), cyberspace support (3D0), and client systems (3D1).

Members in the common specialties will undergo a transfer selection process that will balance space experience, space credentials, and performance and potential as evaluated during a transfer board.

Transfer boards for officer common career fields are scheduled for the end of July, and for enlisted common career fields later in the fall. The results will be announced approximately 30 days after each board is completed.

Transfers for personnel selected from these boards are expected to begin February 1, 2021.

As active-duty space operations missions and functions will completely transfer to the Space Force and will no longer be available in the Air Force, space operators who declined to transfer during the May volunteer window will also receive MyPers messages later in July explaining next steps.

Options for those members include applying for retraining into another career field, applying to transition into the reserve components, or applying for separation or retirement, if eligible.

In the meantime, those members will remain in the Air Force and may be assigned duties in the Space Force. At the end of the transition period, expected to be sometime in 2022, organic space specialties will be removed from Air Force inventory and assignments in those mission areas will no longer be an option for Air Force members.

Air Force Reserve and Air National Guard personnel remain critical to the space mission. Today, Air Guard and Air Force Reserve units executing space missions are currently aligned to the Space Force, and will continue supporting Space Force missions in this status while the future of the reserve component for the Space Force is determined.

The status of Department of the Air Force civilians, whether assigned to Air Force or Space Force organizations, is unchanged.

For members of the other military services, the time frame for Army and Navy space requirements to move to the Space Force is in fiscal years 2022-23.

Although legal provisions exist for members of other services to transfer to the Space Force, the current focus is on Air Force members.

The Space Force will release further details for a limited inter-service transfer program for other sister services for fiscal year 2021.

Members in organic space career fields needing more information may contact their servicing military personnel flight or the Total Force Service Center.

Executive Comments

"*This is an exciting and historic time for these space operators who will be some of the first members to join the Space Force,*" said Lt. Gen. ***David "DT" Thompson***, Vice Commander, U.S Space Force. "*Each one of them has an important responsibility to contribute bold ideas to shape the Space Force into a 21st century service.*"

"*There has been substantial planning behind the scenes between the Space Force and Air Force personnel lists to get us to this day,*" said ***Patricia Mulcahy***, Deputy Chief of Space Operations for Personnel and Logistics. "*We understand the personal circumstances that influence a member's decision to volunteer for transfer, and I am incredibly proud of the team's thoughtfulness put into every decision to ensure we provide members with as seamless a transfer process as possible.*"

MODERNIZED ISR BACKHAUL BY SATELLITE

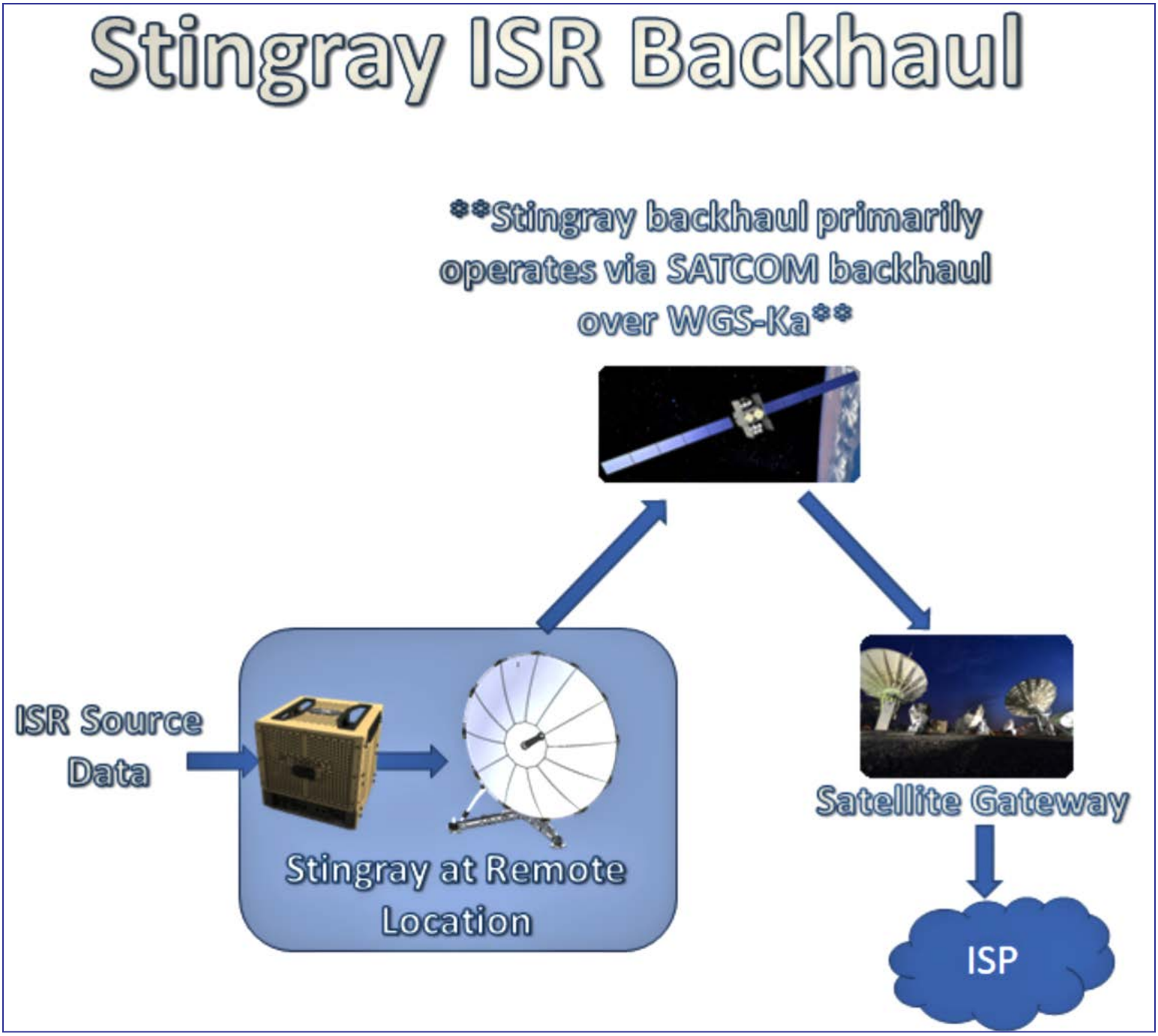
by Talmadge Beasley of Sigma Defense Systems and David Provencher of AvL Technologies

Intelligence Surveillance and Reconnaissance (ISR) implies a broad range of data collection capabilities within the Department of Defense (DoD).

Reliable ISR collection, distribution, availability and consumption is quite often the cornerstone upon which many – if not most – modern battlefield decisions are built. The vast number of ISR sources in use today require very specific handling from source to destination to ensure products reach intended consumers with the fidelity required to execute mission objectives.

Transporting ISR products, or ISR backhaul, is moving data from its frequently tactical point-of-origin over a network for distribution to intended consumers/decision makers. ISR backhaul must be robust and responsive.

Satellite connectivity plays a key role as it enables robust connectivity in austere locations. Also key are new technologies and innovative products that meet the unique and ever-changing challenges presented by ISR transport, even the ability to use modernized satellite-based ISR in a potentially contested environment.



Legacy vs. Modernization

Existing legacy ISR systems performed a similar function but were built as a "system of systems" vice a ground up ISR backhaul solution. Recent requirement changes and DoD modernization initiatives necessitated a one-size-fits-all solution to propel ISR transport and standardization to the next level.

ISR modernization is a priority for the DoD and it includes sharing data across multiple environments — land, sea, air, space and cyber.

The Stingray Solution

ISR modernization requires a modular, scalable, easy-to-use solution – and the Stingray tactical ISR backhaul system was designed and built to meet and exceed this requirement. The Stingray system addresses modernization concerns by integrating proven vendor solutions into a core kit built specifically to address the demanding modularity and SWaP needs of tactical ISR backhaul, while retaining the ability to adjust scalability as needed.

Stingray can be thought of as a data transport capability at a high level – one that is filled with the best suited equipment to address a given customer's problem set. At its core, the Stingray system uses a commonly seen tactical architecture – antenna > modem > network distribution.

The version two — or V2 — employs an AvL Technologies satellite communications terminal that is the culmination of two years of joint development collaboration and certification testing between AvL Technologies and Sigma Defense Systems.

Part of this customization effort added ARSTRAT certification components, a modem outdoor unit (ODU), and a GBS receiver ODU with onboard router. As such, the ISR version of the AvL's FiT 135 antenna is ideally suited for the tactical ISR backhaul mission.

Satellite Backhaul Terminal

The highly modified ISR version of the FiT 135 antenna provides the system a means of long-haul reach back over military Ka-band frequency as the primary use case with the flagship offering of the Stingray V2 system.

When configured for use with the Sigma Defense Stingray V2, the terminal consists of a highly portable and lightweight 1.35m tri-band (X-, Ku- and Ka-bands) USASMDC/ARSTRAT-certified antenna system configured for Ka band operation over the Wideband Global SATCOM (WGS) satellite constellation.

The terminal features a Ka-band feed network that enables simultaneous and switchable reception of both left- and right-hand polarizations from WGS satellites. End users carry out their mission in either polarity and simultaneously receive two channels of Global Broadcast Service (GBS) data. This dual polarity feature may also allow users to transport one less antenna on their deployments.

Frequency bands can be changed between X-, Ku- and wideband (commercial and military) Ka-band in less than one minute due to fully integrated and modular RF kits.

The terminal includes two ruggedized ODUs, including the modem ODU which features Enhanced Bandwidth Efficient Modem (EBEM) technology and complies with the widest possible range of U.S. Government and commercial standards. It is fully compliant with MIL-STD-188-165, complies with STANAG 4486 Edition 3 (EBEM), as well as the IESS–315 commercial standards at data rates allowing support for multiple full motion video feeds.

The L-band satellite modem can be configured for FIPS-certified TRANSEC and will inter-operate with other certified EBEM modems. Integrated into the modem ODU is AvL's Terminal Interface Unit (TIU) allowing the system operator to monitor and control via a color display and keyboard without the use of a PC – and with push button satellite acquisition.

Terminal monitor and control (M&C) provides access to the antenna controller, solid state power GaN amplifier (SSPA) and modem. Depending on mission requirements, alternate modems can be interfaced with the terminal due to the common form factor modem ODU. Testing has been performed using the latest industry protected SATCOM waveforms.

Accompanying the modem ODU, the receiver ODU integrates a provider-grade router and switch for the purposes of enforcing unclassified/sensitive data segregation, with sensitive data encrypted prior to arrival at the ODU. The receiver ODU network equipment also acts as a services demarcation router for the remote site, providing connectivity for Command and Control (C2) functions, encrypted ISR sources, and most any other Ethernet-based outputs.

Additionally, the ODU houses dual outdoor rated GBS receivers for two-channel reception of GBS broadcasts with DVB-S and DVB-S2 capable demodulators. The core system offers added port density beyond the primary included ports for adding custom services--should customer port density requirements exceed the core system, the vehicle offers approved add-on enclave kits as a feature.

Sensitive Data Management

Sensitive ISR data primarily aggregates in a controlled facility and is encrypted by the Stingray V2 rack for transport over the satellite terminal to the enterprise network for consumption. The rack contains an NSA Type-1 tactical encryptor, an ISR network edge router, video server, video transcoder and video encoder.

This equipment complement fields common video codecs like MPEG2, H.264, and H.265, as well as video transcoding to ensure any ISR source can be connected, encoded, modified, hosted, served and backhauled over satellite to intended consumers.

Sources can interface with the Stingray over copper coaxial (SDI/analog), pre-encoded Ethernet, or even via RF with added Rover receivers. With legacy systems, most of these independent functions were present, but required a higher level of user expertise to configure and manage multiple devices, IP addresses, passwords and interfaces.

Addressing user experience issues with legacy systems was a primary concern for the Sigma Defense Systems development team while designing the V2 system. The production Stingray V2 rack incorporates many enhanced features for user interface and overall operator ease-of-use.

The Stingray Control Unit (SCU) interface provides users a consolidated interface to configure and monitor the entire rack for ISR backhaul without modifying any M&C IP addresses, skipping the usual cable hopping exercise – all with a single cable interface point. The SCU communicates with preconfigured virtual machines (VMs) inside the video server to make independent device interface transparent to the operator.

Typical video stream setup is completed in less than one minute, which includes server setup for local video hosting at the remote location.

Modernization Requirements Met

Vendor-agnostic design, push-button satellite acquisition with the AvL FiT 135, SCPC/FDMA dedicated bandwidth over Mil-Ka, GBS/DVB receivers, built-in unclassified/sensitive data separation, simplified user interface with SCU, all in 6 transit cases and an overall 405 pound (28 cubic foot) pack out.

The Sigma Defense Systems Stingray V2 system with AvL FiT 135 ISR variant is a purpose-built tactical ISR backhaul system for the most demanding and dynamic battlefield environments – an innovative, flexible solution for an objective-oriented customer.

The Stingray II ISR Reachback Terminal is available through the General Services Administrative (GSA).

https://www.avltech.com

sigdef.com/

Author Talmadge Beasley is the Lead Systems Engineer for the Stingray program at Sigma Defense Systems. He is a career communicator with more than 18 years of experience in tactical and strategic communications--more than 10 years of those working directly with ISR collection platform systems/solutions.

Author David Provencher, Vice President & Director of New Business Development at AvL Technologies. Dave has 30+ years of experience in the telecommunications industry including roles in engineering and program management at Harris Corp., U.S. Military Ground Mobile Communications Systems at IBM, VP and GM at Andrew Kintec, Founder and President of TracStar Systems, Inc., and President and GM at Cobham, PLC. Dave has an engineering degree from the University of Central Florida, where he also holds a courtesy faculty position.

AvL Technologies is a world leader in the development, production and distribution of land mobile satellite communications equipment. Founded in 1994, and privately held, AvL is located in Asheville, NC, with 110,000 square feet of engineering, manufacturing and test facilities and 270 employees. AvL's products are distributed into US DoD/Government and international commercial markets including emergency response, public safety and law enforcement, oil/gas and mineral exploration and media/broadcast.

Sigma Defense Systems, Inc. is a Service-Disabled Veteran Owned Small Business (SDVOSB) specializing in global ISR transport solutions, network engineering, systems engineering, systems integration support, program management and project management for the U.S. Department of Defense (DoD). Located in Perry, GA, Sigma has over 100 employees at multiple customer sites across the continental U.S., Europe, Asia, and Africa.

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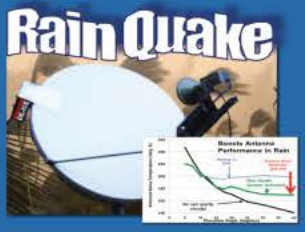

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COMMAND CENTER: KOEN WILLEMS

Head of International Government SATCOM, ST Engineering iDirect

Koen Willems has +20 years' experience working in different technology industries. Before joining ST Engineering iDirect (Europe) CY n.v. (formerly known as Newtec), he was Product Marketing Manager for Europe at the electronics giant TOSHIBA. Currently, Koen holds the position of Head of International Government Market & Strategy with focus on the global government, defense and humanitarian satcom markets at ST Engineering. In this role, Mr. Willems is in charge of developing and defining the strategy for the government and defense market worldwide for ST Engineering as well as supporting large programs.

Koen obtained a Master's degree in English & Scandinavian Languages (University Ghent, Belgium, 1997) and a Master's degree in Marketing Strategy and Management (Vlekho Business School in Brussels, 1998). More recently, he received the degree for 'High Studies in Security and Defence' at the Belgian Royal Higher Institute for Defence as well as the degree for the SERA program (European Session for Armament Officials) which focuses on European defence acquisition regulation, challenges and procedures at the French National Institute of Higher Defense in Paris.

Koen is widely known as a technology and thought leadership evangelist through his regular appearance in editorials in satellite focused publications, white papers and through his presentations at government and defence oriented conferences around the world.

Mr. Willems, what services and products does your company provide to the military / agency / government (MAG) market segments?

Koen Willems (KW)

ST Engineering iDirect provides a range of products and solutions to government, military and humanitarian end-users. We provide technology, ground segment services and equipment such as modems, frequency converters and switches, or VSAT platforms which come in different flavors.

We have both defense and commercial-grade VSAT platforms so it depends on the end-user application and security requirement to determine the best fit . Different applications have varying requirements related to efficiencies, affordability, security and resilience.

Our platforms are flexible to support a broad range of end user satcom applications whether they are fixed, on-the-move or on-the-pause. If the end-users prefer managed SATCOM services coming from our partners or prefer to run their own VSAT networks we can cater for both scenarios.

Moreover, we are increasingly involved with large national programs and waveform developments. This means that we approach nations, or inter-governmental agencies via our partner network as a sole provider of ground segment technology and services.

We provide the baseband, or VSAT platform, waveform technology, terminal and teleport equipment but not satellite capacity or satellite services, which end-users would typically procure from satellite operators and service providers. We also provide integration services of the ground segment infrastructure. Furthermore we develop specific commercial, secure and protected waveforms. These waveforms can be developed for a nation seeking a proprietary national waveform that only they can use for their sovereign national applications for example.

We also develop waveforms, which can be used in joint military operations. In this case waveform standards must be taken into account to allow for interoperability. The European Protected Waveform is a good example of that.

How has the merger of ST Engineering iDirect and Newtec improved the company's capacity to address the crucial needs of the MAG market segments?

KW

The merger has enabled us to scale and has given us the capability to deal with large programs on both the commercial and government side where we can provide engineering capacity and support.

In bringing the two companies together, we offer a larger range of capabilities, of products, and of technologies in order to respond to both the traditional military GEO wideband satellites and the new type of multi-orbit satellite constellations and to address these large national programs. The merger has allowed us to add certain capabilities.

Newtec has always been involved in waveform development and has unique expertise in this field whereas iDirect's strong suite has always been in network development and secure, high performance defense equipment. In combining the two, we bring forward a strong value proposition of secure, efficient, flexible technology, which can be used by both the government and the defense market, and also that we can tailor to accommodate individual requirements.

Our platforms meet the priorities of the customer and whether it's security and resilience or affordability and efficiency – we have the platform to suit it all.

How is ST Engineering iDirect addressing the needs of the Department of Defense, other national and international agencies as well as the armed forces of the U.S. and Allies?

KW

ST Engineering iDirect does not deal with the US DoD directly. Our subsidiary, iDirect Government, has a product suite developed specifically for US DoD requirements. We do, however, deal with international governments and US partner nations such as NATO nations and European, Asian, African and Latin American nations as well as international institutions.

We work very closely with our customers which are typically satellite operators, prime integrators and service providers and stay in close contact with government and defense end-users in order to capture their needs, and to make sure that our products are aligned with their latest upcoming requirements for efficient operations.

How is ST Engineering iDirect's technology actively engaged in assisting NGO, First Responder and Emergency services connectivity needs?

KW

I think in this instance it makes sense to address the emergence of the COVID-19 pandemic. Its international impact has raised critical questions on the capability of emergency communications networks for a whole host of users.

From healthcare institutions to businesses and schools, the requirement for a resilient, multi-service, scalable and flexible network to cope with upcoming emergency response (or the realization that must be put into place) has become a priority for many businesses and organizations.

This has been an immensely challenging time, when on-the-spot changes have been implemented in order to respond to the medical emergencies, surging connectivity requirements for response coordination and people working remotely relying on networks to contact family and friends. Adaptation has been key.

Now more than ever, when there is a heightened reliance upon communications for everyone, on a global scale, the need for a resilient, multi-service, scalable and flexible networks to cope with upcoming emergency situations and disasters is firmly evident. Our technology is designed to support these needs and to enable rapid and seamless adaptation to changing circumstances.

In order to act quickly, a multi-service crisis management network is essential. It enables users to cater to a wide range of services, applications and platforms using one single centrally managed system.

A multi-service platform allows the network provider to connect to any satellite constellation in any orbit and enables both regional and global connectivity. It enables efficiency, and this multi-service capability also ensures that a network can scale and that the platform being used supports both small and large network deployments. Critically, any excess capacity to be used to support temporary emergency networks.

What other types of solutions are used in emergency scenarios and what does the future look like in terms of emergency communications?

KW

We also consider pooling and sharing configurations as an important feature of emergency communications. This is where the network operator aims to pool satellite capacity as well as satellite services and ground segment infrastructure and share these amongst government and defense agencies to provide guaranteed access to satcom for a wide range of applications requiring security and reliability such as first responders and humanitarian networks.

Next-generation satellite technology uses important developments such as orchestration and virtualization, cloud-based networks, software-defined modems and terminals that are quick and easy to deploy. It is these kind of features that allow VSAT hubs and deployed modems to be easily reconfigured and upgraded to react quickly to changing conditions in emergency operations and to operate with resiliency.

As digitalization changes our daily lives, government agencies are driving initiatives to transform health, transport, urban solutions, finance and education services, based on the latest developments in digital technology. Using sensors and smart systems that communicate with each other, nations hope to improve quality of life for their citizens, to provide more effective and efficient government services and to make their country a safer place.

An integral application for these Smart Nation networks will be the support of emergency services. Underpinning these networks will be the convergence of terrestrial and satellite connectivity to offer many applications and a single platform for VSAT, 5G, IoT and Big Data. Satellite will also serve as the primary or back-up solution to connect to 5G cellular backhaul networks or to give immediate SATCOM access to remote terminals.

At this time, when individuals need fast access to the latest information, when contact tracing systems must be supported and when governments seek to develop Early Warning and Response systems to boost public health emergency preparedness and response, this is essential.

We recently held a webinar and produced a whitepaper on this subject and both can be viewed *at this direct link* or at the company's content hub *at this direct link*.

Why should a client consider ST Engineering iDirect as a preferred solutions provider?

KW

ST Engineering iDirect has consolidated its strong knowledge, capabilities and expertise to present a one-stop shop to our Government and Defense customers. We have a significant installed base which reflects our vast experience in the field and our customers.

We have a 44 percent government and defense market share and serve 21 of 27 EU Nations and 19 of 30 NATO Member States. We partner with the key integrators worldwide to address national government and defense programs.

We also have a very close relationship with our customers , government and defense end-users. We listen to them and this helps to shape our product lines to meet their requirements. We are very much a technology-centered company.

We are dedicated to the development of innovative technology that improves the performance, efficiency, security and resilience of networks to increase the effectiveness of operations. We have the capability to converge all of these networks to one centrally managed VSAT platform, making sure that these operations are seamless.

With operations being so dispersed, the network must be flexible in order to add or remove remote sites and to mix applications on a single platform so that multiple critical services can be offered using data, voice and video. We give the end user the capability to quickly reconfigure the network through a central user interface and make sure that they can quickly react to the situation at hand, and that they also can deploy as soon as possible.

Then, there's resiliency. ST Engineering iDirect has always been a leader in making links secure through our defense-grade product offering and resiliency. And we are still very much investing in that, but resiliency doesn't simply mean resilience in terms of modem or hub infrastructure redundancy. It's also about providing multi-frequency, multi-network, multi-constellation terminals that can quickly switch from one satellite to another in case of jamming or severe interference.

Finally, it's about size, weight and power (SWaP). There are currently increased investments in flat panel and smaller size terminal technology. Obviously, you want to have equipment that is portable, that can easily be transported and that is ruggedized and able to cope with certain environments. We are making sure that our equipment and technology can deal with the miniaturization trend and still provide the highest throughput at maximum availability.

What may we expect ST Engineering iDirect to reveal over the next few months?

KW

We have some notable releases that have recently been made.

Our Evolution Defense release 4.2 enables users to leverage the best in performance, efficiency and security capabilities of the ST Engineering iDirect 9-series modems. The Evolution Defense 4.2 and the 9-series, Adaptive TDMA performance is up to 29 Msps single carrier and ten times the packets per second (PPS) improvement over past years with achievements up to 64,000 PPS of simultaneous traffic. These increased speeds and throughput are ideal for ISR content, larger volumes of simultaneous voice calls as well as other bandwidth-intensive applications from land, air or sea.

For defense airborne applications, powerful MF-TDMA waveform enhancements greatly improve the availability of ultra-small disadvantaged terminals thus improving reliability particularly for COTM networks. The updated 9800 AE+ features better tolerance to vibration and exposure to high amounts of moisture with different mounting techniques, inside cabling, and all open and unused connectors on the boards are now sealed and potted.

Our point-to-point DVB-S2X MDM9000 modem expands our portfolio of WGS-certified solutions and adds the flexibility of acting as a modulator, demodulator, or modem depending on network configuration. The MDM9000 has a large installed base in military and government networks across the world.

ST Engineering iDirect's MDM9000 Modem.

The modem will typically be used in MILSATCOM networks for higher data rate links from 1 Mbps up to 425 Mbps (850 Mbps duplex) to support the transmission of video, data and voice in a very efficient, secure and reliable way. It is especially suited to ISR applications and is typically installed at both ends of a point-to-point satellite link.

The modem may also be deployed on a wide range of traditional wideband or HTS satellite constellations (military, government and commercial) in different frequency bands (C-,Ku-,Ka-,X-band) and satellite orbits (GEO, MEO, LEO, HEO and HAPS).

During the current COVID-19 crisis the MDM9000 has been deployed across dispersed emergency centers and used for a range of situational awareness, video conferencing, internet access for doctors and patients, logistics and e-medicine services.

What do you believe are the most significant challenges that need to be addressed within the MAG sectors?

KW

The first big challenge is providing the government and defence end user with more agility to run their operations. This has been highlighted by COVID-19. Users must be able to deploy quickly with easy-to-use, portable equipment to get connectivity where it needs to be as rapidly as possible.

Technology must be able to deal with mobility and also with the smaller antennas. With assets on the move, the service must be able to switch seamlessly and to roll across multiple satellites, multiple orbits or multiple networks.

Technology is enabling us to overcome these challenges in terms of being able to run dispersed networks over a single platform on a global scale.

Finally, there is the increased demand for data due to the growing need for situational awareness and increased use of bandwidth-hungry sensors in ISR applications and applications such as the connected soldier.

This increased demand is met by delivering more performant platforms that can deal with HTS satellites and more efficient waveforms.

Whether COVID was the cause, or whether COVID has accelerated the process, many things have changed in the satellite market in general.

I see a lot of convergence, of companies coming together — both manufacturers and service providers, scaling to address a larger market and big constellations and finally to enable new innovations to better address the current and future government and defence requirements.

www.idirect.net

BRIEFING: SCOTT SPRAGUE, ISOTROPIC SYSTEMS

Cracking The Connectivity Code For Defense

Isotropic Systems' transformative terminals are in milestone trials with the U.S. Army and U.S. Navy, aimed at delivering new LEO, GEO and MEO satellite-delivered connectivity to the battlespace. New high-powered satellites and constellations in GEO, LEO, and MEO orbits are on the verge of commercial launches over the next two years. New-age capacity in space, however, is only half of the equation to solve connectivity challenges that defense and government agencies have struggled with for years across battlefields around the world.

In a conversation with *MilsatMagazine*, *Scott Sprague*, Chief Commercial Officer for Isotropic Systems, explains that high-throughput ground infrastructure is required to unleash new multi-orbit connectivity across a broad range of markets — especially mission critical defense initiatives.

There's been a lot of focus on new high-powered satellite constellations bringing a new era of connectivity to critical markets such as the military and defense. But the government can't tap that new age capacity without a new age antenna, correct?

Scott Sprague (SS)

That's absolutely right and exactly why Isotropic Systems is so dedicated to redefining the antenna market. Engineers with U.S. government and defense agencies have shared with our team how they've tried for years to crack the code to develop new antenna technologies capable of unlocking the full potential of new high throughput satellite capacity coming online in the 2022 timeframe. And they are thrilled that Isotropic Systems has cracked the code. In fact, we're in the latter phases of developing what has recently been called the Holy Grail of terminals.

Our multi-beam antenna uses patented optical beamforming lens technologies that allow the government and armed forces to arbitrage capacity from commercial and military satellite capacity over a single antenna to deliver data at the tactical edge like never before.

Why do government and defense agencies need new higher throughput terminals today? Aren't parabolic antennas getting the job done? Don't electronically-steered antennas have multi-beam capabilities?

SS

Mission-critical demand for real-time, reliable communications and Intel, Surveillance and Reconnaissance (ISR) data has never been higher. That's the biggest driver behind new innovations in high throughput ground infrastructure and terminals capable of harnessing capacity across GEO, MEO and LEO orbits for government and defense programs.

Governments can no longer rely on patch-work and disparate connectivity networks in an increasingly adversarial world. Parabolic antennas, which are widely used by the U.S. Government, will not support the seamless switching between satellites in Geostationary Orbit (GEO), Medium Earth Orbit (MEO) and Low Earth Orbit (LEO).

It's no secret that all U.S. Government users of satellite capacity must absolutely have the capability going forward to simultaneously use the WGS network along with existing and new commercial Ka-band capacity coming online. While Electronically-Steered Antennas (ESA) are being developed to provide multi-beam capabilities, these are not full performance beams.

Isotropic Systems patented optical beam forming technology allows us to offer multiple full performance beams. This gives the government customer the ability to simultaneously connect to multiple satellites, while also offering some very unique interference mitigation and positioning, navigation and timing capabilities.

What are the key differentiators that allow Isotropic Systems' new terminal to meet the demands of new age defense operations?

SS

Isotropic Systems has developed, and is using, patented transformational optics and circuitry in our terminals, which are resilient and secure, lightweight, and require a minimal amount of power. The optical lens technology at the core of our antenna solution is the key difference that enables our antenna to simultaneously connect to multiple satellites.

Our platform only uses the optical beam elements necessary to link to the mix of satellites needed to enable a specific mission or operation, requiring less power per beam and generating less heat than phased array antennas. That opens the door to far more mission-critical use cases for the government and military.

Our multi-beam lens modules are also modular and conformal to the fuselage of a UAV or aircraft, the deck of a Navy ship or even a soldier's backpack. As a result, Isotropic Systems is building partnerships and inking major collaborative antenna development contracts with U.S. government and defense agencies.

Can you share details about some of those developmental partnerships and contracts with the U.S. Government?

SS

Isotropic Systems has had a very busy and successful 2020 to date. We just recently announced a major antenna evaluation and development contract with the Defense Innovation Unit (DIU) of the Department of Defense (DoD) to test the ability of our multi-beam antennas to unlock high-powered bandwidth aboard next-gen Navy ships at sea.

As the U.S. Navy expands the size and communications capabilities of its global fleet, the DIU is reviewing Isotropic Systems' beamforming lens module technologies during an extensive series of environmental and interference tests throughout the year. Teams will measure the impact of harsh elements, such as intense winds, salt water, and electromagnetic interference (EMI), in preparation for installations aboard new-age Navy vessels.

We have signed another significant agreement with another U.S. defense agency that we will be announcing soon. We've also inked a collaborative agreement with QinetiQ, whose innovative work in the fabrication of high-performance materials is enabling Isotropic Systems to further crack the code with our line of disruptive terminals.

The collaboration between QinetiQ and Isotropic Systems has focused on the development of optics materials that are Isotropic in nature, which eliminates the loss of bandwidth signal that is typical in other low profile terminals using meta materials.

We are also licensing the core components of our scalable, cost-effective beamforming antennas to leading aeronautical and defense system integrators to accelerate customized designs, certifications and deployments of our terminals aboard commercial, business and government aircraft around the world. The licensing process is well underway with the goal of unleashing a new era and new level of inflight connectivity in the very near future.

We are fast approaching the milestone terminal tests with SES that will occur in September that are part of our collaborative partnership to produce scalable, cost-effective multi-beam antennas capable of unlocking access to the groundbreaking O3b mPOWER system — across government, defense, telco and cellular backhaul, aero, maritime, and offshore markets. The developmental alliance with SES will culminate in a series of comprehensive engineering evaluations of Isotropic Systems' multi-beam antenna components, prior to the commercial launch of our terminals and the O3b mPOWER MEO system late next year.

This has certainly been an action-packed year so far, despite the challenges of a global pandemic. Where does the Isotropic antenna roadmap ultimately lead?

SS

COVID-19 has certainly raised challenges at every turn for everyone. It's been anything but business as usual, but Isotropic Systems, like a lot of innovative companies, has used a range of connectivity networks to drive business continuity and collaborations across our team and with customers and partners.

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DISENTANGLING CONVENTIONAL + NUCLEAR ASSETS

By Bruce W. MacDonald, Senior Advisor, and Cameo Lance, Physicist, Rhea Space Activity

A subtle but serious challenge to strategic nuclear stability is growing largely unnoticed in the international military environment. Known as "nuclear entanglement," this challenge is characterized by how a country's nuclear capabilities can become deeply intertwined, or "entangled" with its non-nuclear capabilities.

For example, at the present time, U.S. overhead persistent infrared (OPIR) capabilities, such as Space Based Infrared System (SBIRS) and Defense Support Program (DSP) satellites that provide launch detection system (LDS) function, including early warning of adversary long-range ballistic missile launches, can also, under certain conditions, detect battlefield non-nuclear missile launches. This was demonstrated as far back as nearly 30 years ago, in the midst of Operation Desert Storm, when DSP detected SCUD launches from Iraq.

Until 2007 this sort of "*entanglement*" was not a matter of much concern for Western militaries, as China did not have a demonstrated anti-satellite (ASAT) capability. Of course, China has now had this capability for more than a dozen years. In fact, according to a number of Chinese military officials and analysts, such capability would make these U.S. satellites legitimate targets if China and the U.S. were to become embroiled in a conflict.

U.S. expressions of caution to China about the implications of targeting these foundational components of the U.S. strategic nuclear architecture in a conventional conflict have elicited little more than a shrug from Peoples Liberation Army (PLA) counterparts.

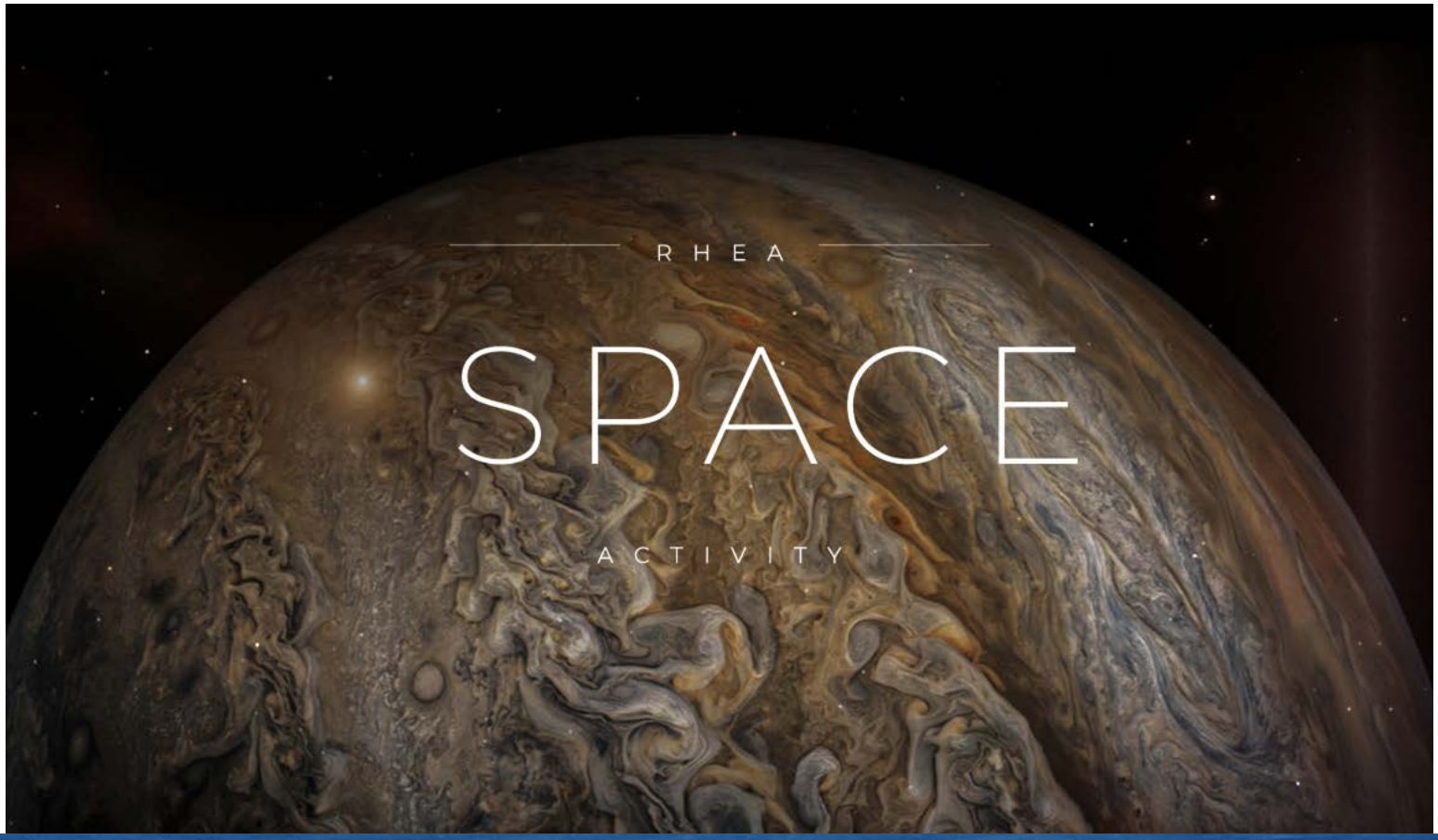
China conveys the message that if a system is used to support conventional military conflict, it cannot be considered off-limits for targeting. This raises the spectre of Chinese attacks on an essential part of the U.S. nuclear infrastructure, when tensions would already be at a fever pitch as conventional conflict was underway.

The seriousness with which the U.S. would treat such an attack is underscored by the 2018 DoD Nuclear Posture Review, which explicitly states that the United States could employ nuclear weapons in response to "*attacks on U.S. or allied nuclear forces'… [or] warning and attack assessment capabilities.*" As such, an adversary attack on OPIR assets could trigger a U.S. nuclear retaliation.

In times past, such a PLA attack would be considered ample enough reason for a U.S. nuclear response against China. Because of this, China would very likely have to carefully consider carefully the overall costs of attacking U.S. SBIRS or DSP systems.

As fraught with danger as this situation may be, immediate future prospects are even more worrisome. The OPIR remote sensing constellation is, arguably, the most entangled, non-nuclear, military capability that is coupled to the U.S. strategic nuclear triad. In a bid to make U.S. strategic early warning capabilities more resilient in the face of possible attack, constellations of disaggregated satellites are now being considered.

Many considerations exist for the future strategic architecture of the United States when following current and proposed efforts by commercial and government entities alike. Disaggregating the



system and putting tactical capability into Low Earth Orbit (LEO) could be problematic due to the demonstrated efforts by China and, more recently, India, to make LEO unusable by either kinetic or non-kinetic attacks.

Also, recent proposed efforts to create mesh networks in LEO by SpaceX, Amazon, One Web and/or others would increase the congestion in LEO as well as introduce additional interference, both physical and radio frequency (RF) alike, for assets sitting in Geosynchronous Earth Orbit (GEO) that are trying to look back through the mesh network.

One could project that with a substantial increase in LEO satellites, there could be a time where a missile track is either not initially detected, impacting timelines, or the detection is interfered with as a result of greater congestion down below in LEO. Challenges will continue to increase no matter where infrared payloads are orbiting. Therefore, it is important to assess the implications of disaggregating the architecture in favor of clearly delineating our strategic assets to our adversaries, in order for them to better understand that there is, in fact, a red line laid out before them that they must not cross.

Yet, it may still be possible to derive a solution to this problem that is beneficial for both the U.S. and for China from a strategic nuclear stability perspective.

If it were possible to disentangle the battlefield launch detection system from the strategic nuclear ballistic missile detection system, China would likely still be wary about the possibility that the U.S. might retain its capability to use the strategic nuclear launch detection system for detection of shorter-range ballistic missile launches. However, it appears likely that China would be more inclined to target the battlefield LDS systems rather than the SBIRS/DSP system — an action that would be far less likely to incur the risk of a rapid escalation to nuclear war,

Consequently, the U.S. would then have little interest in wanting to use the SBIRS/DSP system if an alternative option were available. Presumably, there would also be practical reasons for the U.S. to use a system designed expressly for the non-nuclear battlefield LDS, rather than a system that was designed for a much different and much more perilous nuclear mission, and incidentally had some capability in a conventional context.

The drawback is that such a separate LDS system would likely involve additional costs, though it would also lighten the tasking burden on the SBIRS/DSP system. This modest drawback would be a small price to pay for providing an unambiguous and easily differentiated red-line that would be an important off-ramp on a major escalatory path to all-out nuclear conflict.

Important questions remain to be answered as the United States plans its next generation OPIR remote sensing capabilities:

1) *How will Next Generation OPIR remote sensing capabilities affect the nuclear entanglement problem and the Nuclear Posture Review objectives from 2020-2035?*
2) *Will the blossoming smallsat revolution eventually disentangle OPIR from U.S. nuclear forces?*
3) *What will be the impact on strategic nuclear stability?*
4) *How effectively can future OPIR constellations dissuade China and Russia from threatening U.S. strategic early warning systems?*
5) *What impact will large numbers of LEO smallsats, whether for OPIR or other missions, have on the performance of the SBIRS/DSP LDS?*
6) *Will China and Russia face similar entanglement issues for which comparable solutions may exist? Is there a role for diplomacy to help reduce the entanglement challenge to lessen the chances of strategic nuclear conflict in a crisis or purely conventional conflict?*
7) *What will be the impact of emerging technologies relevant to the space domain? Will nuclear and non-nuclear space systems become entangled in a way that will challenge U.S. national security interests?*

It will not be easy to answer these questions; however, given the stakes involved, it is very important to try to do so.

A first step is to recognize the implications of the LDS modernization architecture for larger strategic stability issues and for such issues to be accorded a proper role in designing tomorrow's OPIR architecture. Let's not ignore the forest for the trees.

After that, the next step to assess the impact of alternate architectures on strategic stability will be experimentation through tabletop exercises and war games.

The final step should be to then evaluate each architecture in terms of cost, mission performance, resilience, and strategic stability. Failure to assess strategic stability in particular would be a dangerous oversight. Strategic LDS is a crucial element in the U.S. strategic nuclear posture.

Any architecture that has the inadvertent effect of increasing the likelihood of adversary attacks against that strategic LDS would have to be looked upon as seriously deficient. A future President would be placed in the excruciating position of needing to back up the credibility of U.S. nuclear deterrence by initiating escalation into nuclear conflict, or damaging that credibility by not doing so — even when an enemy has taken a decision that it expects will lead to such an escalation.

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EXECUTIVE SUMMARY

The Department of Defense (DoD) is embarking on the most significant transformation in the history of the U.S. national security space program. Space is now a distinct warfighting domain, demanding enterprise-wide changes to policies, strategies, operations, investments, capabilities, and expertise for a new strategic environment.

This strategy identifies how DoD will advance spacepower to enable the Department to compete, deter, and win in a complex security environment characterized by great power competition. Space is vital to our Nation's security, prosperity, and scientific achievement. Space-based capabilities are integral to modern life in the United States and around the world and are an indispensable component of U.S. military power.

Ensuring the availability of these capabilities is fundamental to establishing and maintaining military superiority across all domains and to advancing U.S. and global security and economic prosperity. Space,

however, is not a sanctuary from attack and space systems are potential targets at all levels of conflict. In particular, China and Russia present the greatest strategic threat due to their development, testing, and deployment of counterspace capabilities and their associated military doctrine for employment in conflict extending to space.

China and Russia each have weaponized space as a means to reduce U.S. and allied military effectiveness and challenge our freedom of operation in space. Rapid increases in commercial and international space activities worldwide add to the complexity of the space environment.

Commercial space activities provide national and homeland security benefits with new technologies and services and create new economic opportunities in established and emerging markets. The same activities, however, also create challenges in protecting critical technology, ensuring operational security, and maintaining strategic advantages. Internationally, allies and partners also recognize the benefits of space for military operations, and increasingly understand the threats to those space activities. Allies and partners who are actively expanding their defense space programs, present novel opportunities to increase defense collaboration and cooperation.

In response to this new security environment, and in accordance with the 2018 National Strategy for Space (NSfS) and the 2018 National Defense Strategy (NDS), this Defense Space Strategy (DSS) provides guidance to DoD for achieving desired conditions in space over the next 10 years. The DoD desires a secure, stable, and accessible space domain, whose use by the United States and our allies and partners is underpinned by comprehensive, sustained military strength.

The strategy includes a phased approach for the defense enterprise to move with purpose and speed across four lines of effort (LOEs):

(1) Build a comprehensive military advantage in space
(2) Integrate space into national, joint, and combined operations
(3) Shape the strategic environment
(4) Cooperate with allies, partners, industry, and other U.S.Government departments and agencies.

The Department is taking innovative and bold actions to ensure space superiority and to secure the Nation's vital interests in space now and in the future. Establishing the U.S. Space Force (USSF) as the newest branch of our Armed Forces and the U.S. Space Command (USSPACECOM) as a unified combatant command, as well as undertaking significant space acquisition reform across the DoD, has set a strategic path to expand spacepower for the Nation. It is a path that embraces space as a unique domain of national military power that, together with the other domains, underpins multi-domain joint and combined military operations to advance national security.

This Defense Space Strategy (DSS) is designed to achieve the following desired conditions at an accelerated pace over the next 10 years, focusing on the military application of spacepower through control, exploitation, and influence of space to achieve strategic, operational, and tactical objectives.

DESIRED CONDITIONS:
The space domain is secure, stable, and accessible. The use of space by the United States and our allies and partners is underpinned by sustained, comprehensive U.S. military strength. The United States is able to leverage our use of space to generate, project, and employ power across all domains throughout the spectrum of conflict.

To achieve these desired conditions, DoD will advance spacepower through the pursuit of the following defense objectives:

Maintain Space Superiority: DoD will establish, maintain, and preserve U.S. freedom of operations in the space domain. DoD will be prepared to protect and defend U.S. and, as directed, allied, partner, and commercial space capabilities and to deter and defeat adversary hostile use of space.

Provide Space Support to National, Joint, and Combined Operations: DoD space forces will deliver advanced space capabilities and effects to enable national, joint, and combined operations in any domain through sustained, comprehensive space military advantages. DoD will leverage and bolster a thriving domestic civil and commercial space industry.

Ensure Space Stability: In cooperation with allies and partners, DoD will maintain persistent presence in space in order to: deter aggression in space; provide for safe transit in, to, and through space; uphold internationally accepted standards of responsible behavior as a good steward of space; and support U.S. leadership in space traffic management and the long-term sustainability of outer space activities.

SPACEPOWER:
The sum of a nation's capabilities to leverage space for diplomatic, information, military, and economic activities in peace or war in order to attain national objectives.

Opportunities

The emerging strategic environment also presents numerous opportunities that may enhance the Department's ability to attain its desired conditions:

Great power competition defines the strategic environment. Space is both a source of and conduit for national power, prosperity, and prestige. As a result, space is a domain that has reemerged as a central arena of great power competition, primarily with China and Russia.

CENTRAL PROBLEM:
The U.S. defense space enterprise was not built for the current strategic environment. The intentions and advancements of potential adversaries in space are threatening the ability of the United States to deter aggression, to protect U.S. national interests, and to fight and win future conflicts.

More than any other nation, the United States relies on space-based capabilities to project and employ power on a global scale. Today, U.S. reliance on space has increased to the point where space capabilities not only enhance, but enable our way of life and way of war. U.S. national security and prosperity require unfettered access to and freedom to operate in the space domain.

The reemergence of great power competition and a rapid expansion of allied, partner, and commercial activities in space in recent years have drastically changed the character of the space domain. The actions, intentions, and military strategies of potential adversaries have transformed space into a warfighting domain. In parallel, growth in allied, partner, and commercial space capabilities has added complexity to the space operating environment while creating an unprecedented level of collaborative opportunities.

These factors amplify the need to strengthen the U.S. defense posture and present several threats, challenges, and opportunities as the Department seeks to attain its desired conditions.

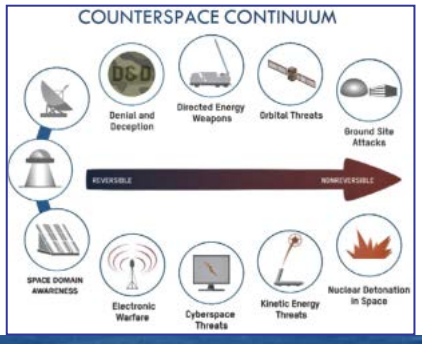
THREATS, CHALLENGES, AND OPPORTUNITIES

Threats

China and Russia present the most immediate and serious threats to U.S. space operations, although threats from North Korea and Iran are also growing. Chinese and Russian strategic intentions and capabilities present urgent and enduring threats to the ability of the Department to achieve its desired conditions in space.

China and Russia have analyzed U.S. dependencies on space and have developed doctrine, organizations, and capabilities specifically designed to contest or deny U.S. access to and operations in the domain. Concurrently, their use of space is expanding significantly. Both countries consider space access and denial as critical components of their national and military strategies. Specifically, Chinese and Russian military doctrines indicate that they view space as important to modern warfare and consider the use of counterspace capabilities as a means for reducing U.S., allied, and partner military effectiveness and for winning future wars. China and Russia have weaponized space as a way to deter and counter a possible U.S. intervention during a regional military conflict.

Challenges: Several factors may limit DoD's ability to achieve its desired conditions:

- *The DoD will continue to depend on space to project power and to respond rapidly to crises worldwide to a greater extent than potential adversaries operating in their respective regions.*
- *The DoD has limited operational experience with conflict beginning in or extending into space, despite rapid counterspace advancements by potential adversaries.*
- *International understanding and agreement of what constitutes unsafe, irresponsible, or threatening behavior in space is nascent.*
- *U.S. activities, both terrestrial and in space, are increasingly exposed by advances in potential adversary, rest-of-world, and commercial space-based capabilities, impeding the U.S. military's freedom of maneuver and action in all domains. Meanwhile, potential adversaries are leveraging technological advancements in the commercial space sector at decreased costs and broader accessibility to expand their space technologies and capabilities.*
- *Public understanding of their reliance on space systems, the changing character of the space domain, and the significantly growing counterspace threats to the United States and its allies and partners remains cursory.*
- 

Opportunities

The emerging strategic environment also presents numerous opportunities that may enhance the Department's ability to attain its desired conditions:

- *National leadership recognizes the criticality of space to national security and prosperity. Space, including space security, is a top national priority with increasing resources to ensure continued U.S. leadership in this critical domain. Strategic guidance, including the National Security Strategy, the NDS, and the NSfS underscore the Nation's vital interest of unfettered access to, and freedom to operate in, space.*

- *The creation of new space-focused organizations in DoD offers an historic opportunity to reform every aspect of our defense space enterprise. The USSF, the newest branch of the Armed Forces, will bring unity, focus, and advocacy to organizing, training, and equipping space forces. USSPACECOM, the newest combatant command, will bring additional operational focus to deterring threats and shaping the security environment in space. Concurrent with ongoing space acquisition activities within the Department of the Air Force, the Space Development Agency was established under a new model for rapid acquisition to rapidly develop and field new space capabilities. Taken together, the establishment of these organizations institutionalizes the commitment of both the legislative and executive branches of government to champion strategic change across the national security space enterprise. These new institutions bring focus and momentum to addressing current and future challenges.*

- *New leadership and management for space acquisition has been established to unify the Department's space acquisition efforts into a streamlined structure for better integration and speed of delivery. A new Assistant Secretary of the Air Force for Space Acquisition and Integration ASAF(A&I), along with a new Space Force Acquisition Council (SFAC), will simplify the leadership and synchronization of the DoD's space development efforts by overseeing and directing: the Space Development Agency, the Space and Missile Systems Center, and the Space Rapid Capabilities Office. When the transfer of the Space Development Agency is completed, the Department will have a new unified structure.*

- *The United States has long maintained a robust and prolific arrangement of alliances and partnerships built on trust, common values, and shared national interests. This approach creates an important advantage for the United States and its allies and partners. Many U.S. allies and partners acknowledge space as an integral component of their respective national security strategies and recognize the increasing counterspace threats posed by potential adversaries. As a result, they are increasingly interested in collaborating in the development of space capabilities, sharing space-related information and intelligence, and partnering in space operations to secure access to, and ensure freedom of action in space.*

- *Commercial space activities have expanded significantly in both volume and diversity, resulting in new forms of commercial capabilities and services that leverage commoditized, off-the-shelf technologies and lower barriers for market entry. These developments are contributing to a burgeoning space industry driven by entrepreneurial innovation and investment, advanced technology, decreased costs, and increased demand for space-based services. The DoD has an opportunity to leverage innovation and cost-effective investments driven by the private sector, presenting opportunities for collaboration to develop game-changing capabilities with a more streamlined and responsive acquisition process.*

The Department is rapidly transforming its approach to space from a support function to a warfighting domain in order to achieve our desired conditions and strategic objectives over the next 10 years in the face of identified threats, challenges, and opportunities.

CENTRAL IDEA:
The Department will grow its spacepower capacity over the next 10 years to ensure space superiority and secure the Nation's vital interests. The Department will take action rapidly to leverage opportunities and U.S. strengths in close cooperation with our allies, partners, and industry.

Generating an enduring superior spacepower capacity will take a number of years and will require DoD to rely in the near-term on enhancing existing capabilities. The Department will expand its space partnerships and will establish new and deeper pathways to collaborate with allies, partners, industry, and other U.S. Government departments and agencies, making cooperation and collaboration a matter of course in future capability development and operations.

These actions will be undertaken while the Department builds comprehensive military spacepower through a trained and ready force that is integrated into Joint Force plans to support the Department's objectives to compete, deter, and win across the spectrum of conflict. This will require embracing space as a unique domain of national and military power while also embracing principles of joint warfare.

The Department will pursue the following prioritized lines of effort (LOEs) to achieve our desired conditions while addressing identified threats, opportunities, and challenges:

- *1) Build a comprehensive military advantage in space.*
- *2) Integrate military spacepower into national, joint, and combined operations*
- *3) Shape the strategic environment.*
- *4) Cooperate with allies, partners, industry, and other U.S. Government departments and agencies.*

LOE 1

Build a comprehensive military advantage in space.

The Department must transform its space enterprise by: reforming its organizations; fielding resilient architectures; building capabilities to counter hostile uses of space; and developing spacepower expertise, doctrine, and operational concepts commensurate with the threat.

DoD will develop an agile space enterprise that can take advantage of emerging technological and commercial innovation in order to continually outpace adversary threats. Space superiority will be achieved through on-orbit, multi-domain, and cross-component operations that are fully integrated with our allies and partners.

The establishment of the USSF as a new branch of the Armed Forces offers a historic and immediate opportunity to rapidly transform the enterprise to achieve space superiority. Additionally, the creation of a new ASAF (A&I) and SFAC will further unify DoD space acquisition efforts, improving the synchronization of space systems and programs and ensuring integration across the national security space enterprise. DoD components will prioritize necessary resources for this LOE for the duration of the DSS timeframe. Specific objectives include:

- *Build out the U.S. Space Force.*
- *Develop and document doctrinal foundations of military spacepower.*
- *Develop and expand space warfighting expertise and culture.*
- *Field assured space capabilities.*
- *Develop and field capabilities that counter hostile use of space.*
- *Improve intelligence and command and control (C2) capabilities that enable military advantage in the space domain.*

LOE 2

Integrate military spacepower into national, joint, and combined operations.

Military spacepower achieves its greatest potential when combined with all other forms of military power. The integration of superior space capabilities into and throughout the Joint Force, along with operational integration with allies and partners, is essential for securing our military advantage against threats in space

As DoD builds superior space forces, it must further develop and enhance integration of space warfighting doctrine, capabilities, and personnel into national, joint, and combined operations. The establishment of USSPACECOM as a new combatant command provides a full-time operational focus on deterrence, integration, and employment of military spacepower. DoD components will prioritize necessary resources for this LOE for the duration of the DSS timeframe. Specific objectives include:

- *Enable USSPACECOM to plan, exercise, and execute joint and combined space operations across the spectrum of conflict.*

- *Realign operational authorities and update rules of engagement.*

- *Integrate space warfighting operations, intelligence, capabilities, and personnel into military plans and staffs.*

- *Update security classification for DoD space programs.*

- *Integrate allies and partners into plans, operations, exercises, engagements, and intelligence activities.*

LOE 3

Shape the strategic environment.

DoD will deter aggression and attacks in space and, if deterrence fails, be capable of winning wars that extend into space. Additionally, DoD will take actions that enhance domain stability and reduce the potential for miscalculations. In this context, international views about space as a warfighting domain and what constitutes acceptable and unacceptable behavior in that domain are nascent or, in some cases, non-existent.

DoD will partner with the Department of State (DoS) to work closely with allies and partners in order to develop common understandings of appropriate behavior in space. The United States must align with allies and partners to engage proactively and assertively with the wider international community, including with potential adversaries, to advance U.S., allied, and partner national security interests and to reduce the possibility of mishaps and misperceptions. This LOE must be executed in close cooperation with DoS and across all key DoD components, using appropriate authorities, without adversely affecting space capability development, production, and fielding activities.

Overall, LOE 3 activities are enduring but critical in the near-term in order to leverage U.S. strengths as the Department develops space warfighting policy and builds associated warfighting capacity. Specific objectives include:

- *Inform international and public audiences of growing adversarial threats in space.*

- *Deter adversary aggression against the space capabilities of the United States and its allies, partners, and commercial interests.*

- *Coordinate space messaging.*

- *Promote standards and norms of behavior in space favorable to U.S., allied, and partner interests.*

LOE 4

Cooperate with allies, partners, industry, and other U.S. Government departments and agencies.

Partnering is both inherent in the first three LOEs and a distinct LOE in its own right. In close partnership with key U.S. departments and agencies, DoD must enhance space cooperation with international partners and commercial entities, many of whose space capabilities are already integral to collective security. DoD will promote burden-sharing with our allies and partners, developing and leveraging cooperative opportunities in policy, strategy, capabilities, and operational realms. Pursuit of LOE 4 will be ongoing, with the most significant attention needed in the short-term to lay foundations for benefits over the long-term. Specific objectives include:

- *Expand information sharing relationships with capable allies and partners.*

- *Align with allies and partners on space policy.*

- *Join with allies, partners, and other U.S. Government departments and agencies to promote favorable standards and norms of behavior in space.*

- *Expand cooperative research, development, and acquisition (RD&A) with allies and partners.*

- *Leverage commercial technological advancements and acquisition processes.*

- *Modernize DoD's approach to the commercial licensing approval process.*

This strategy provides an opportunity to build upon existing work by taking immediate and enduring steps to generate and employ a superior spacepower capacity. Successful implementation of this strategy requires embracing space activities as a unique source of national and military power and incorporating the principles of joint warfare into space operations. Implementation of the strategy will posture the Department to achieve its strategic objectives with the necessary prioritization of resources and risk management to advance U.S. national interests.

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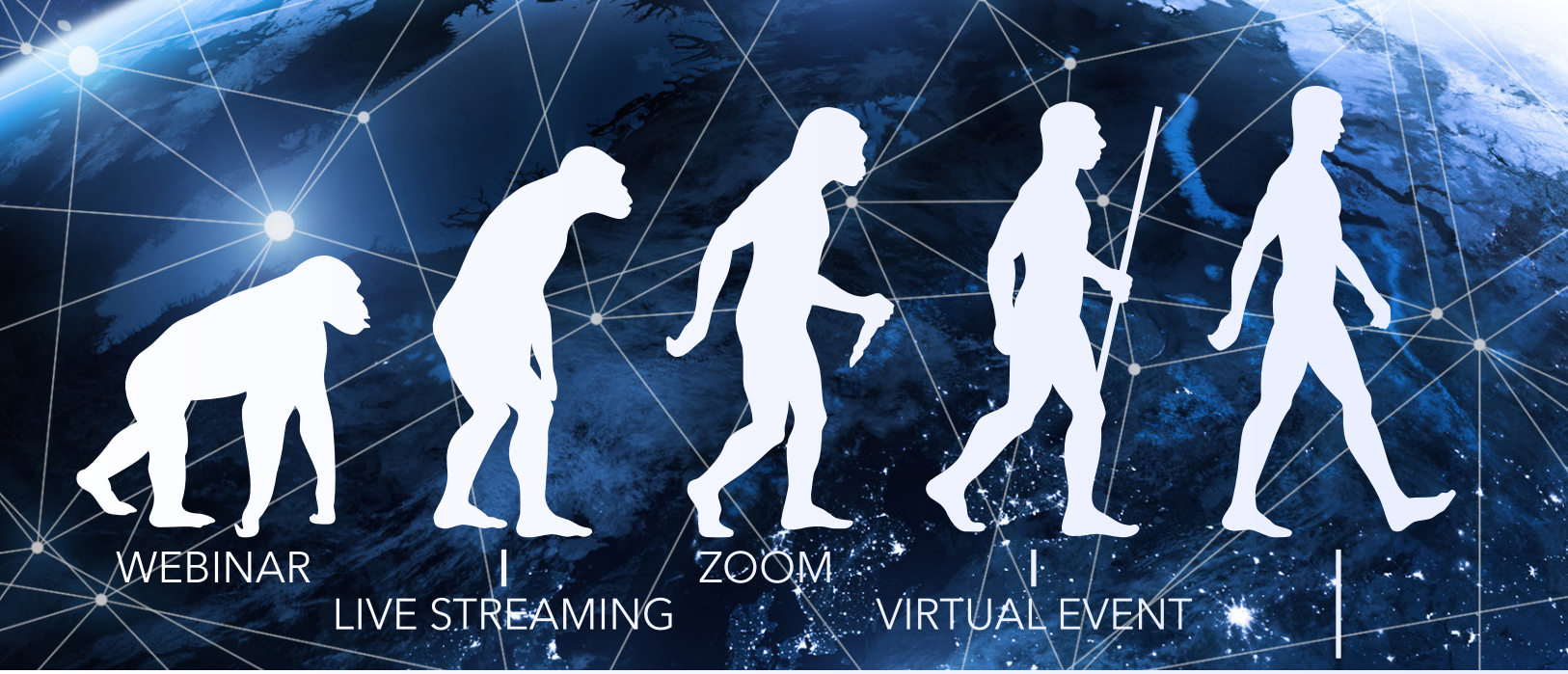

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