

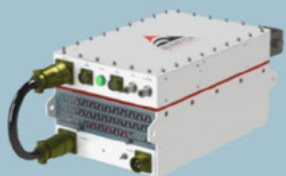
Next Generation Space Defense

MILSATMAGAZINE

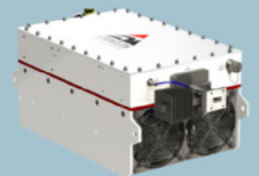
September 2023



Terran Orbital's Nebula smallsat bus, designed for Lockheed Martin's Tranche 0 Transport Layer smallsats for the Software Development Agency's constellation. Image is courtesy of Terran Orbital.



Introducing **GENESIS** - the new series of
Ku-band SSPAs and BUCs from
Advantech Wireless Technologies.



Publishing Operations

Silvano Payne
Publisher + Executive Writer

Simon Payne
Chief Technical Officer

Hartley G. Lesser
Editorial Director

Pattie Lesser
Executive Editor

Donald McGee
Production Manager

Teresa Sanderson
Operations Director

Sean Payne
Business Development Manager

Dan Makinster
Technical Advisor

Curt Blake
Senior Columnist / Contributor

Chris Forrester
Senior Columnist / Contributor

Karl Fuchs
Senior Columnist / Contributor

Authors

Tim Hillner

Brandon Malatest

David Pesgraves

Aniket Roy

Lisa Sodders

Dispatches

Airbus + Blacktree Technology	4	SES Space & Defense + AFRL	14
Benchmark Space Systems + AFRL	6	Shield AI + AFWERX	15
Boeing	8	SpaceX + SDA	16
Rocket Lab + Leidos	9	RTX	17
NGA, NRO + USSPACECOM	10	USSF + Viasat	23
SAS + MAG Aerospace	12	Intelligence Advanced	29
Secure World Foundation	13	Research Projects Activity` (IARPA)	

Features

Government Satellite Report: U.S. Space Command Deputy Commander –	20
There have been three, distinct space ages Author: David Pesgraves	
Space Systems Command (SSC): The A B Cs of Orbital Mechanics	24
Author: Lisa Sodders	
The Work of the 18th Space Defense Squadron	30
Author: Space Systems Command	
MILSATCOM Innovation for Comms-On-The-Move	32
Author: Tim Hillner	
NexGen MILSATCOM: Exploring Emerging Trends + Innovations in SDRs	34
Author: Brandon Malatest	
A Quick Briefing with: Emilia Dobek GISS, and Andrew Bond, ETL Systems	36
Fueling Innovation	
Ground Tactical Radios: Spreading the Word	36
Author: Aniket Roy	

Advertisers

2023 Milsat Symposium	19
2023 Satellite Innovation	18
Advantech Wireless	1 + 7
AvL Technologies	23
CPI SATCOM Products	13
EM Solutions	11
iDirect Government (iDirectGov)	5
SatNews Digital Issues	35
SSPI: Future Leaders Celebration	29

MilsatMagazine is published 11 times per year by SatNews Publishers, 800 Siesta Way, Sonoma, California - 94576 - USA — Phone: (707) 939-9306 / Fax: (707) 939-9235

© 2023 SatNews Publishers — We reserve the right to edit all submitted materials to meet publication content guidelines, as well as for grammar and spelling errors, or to move articles to an alternative issue to accommodate publication space requirements, or remove content due to space restrictions or unacceptable content. Submission of articles does not constitute acceptance of said material by SatNews Publishers. Edited materials may, or may not, be returned to authors and/or companies for review, prior to publication. The views expressed in SatNews Publishers' various publications do not necessarily reflect the views opinions of SatNews Publishers. All rights reserved. All included imagery is courtesy of, and copyright to, the respective companies and/or named individuals. SatNews reserves the right to alter publication dates and print issue designations, based on industry event date changes and circumstances that are beyond the control of SatNews Publishers or the company's staff.

DISPATCHES



Airbus selects Blacktree Technology for UHF SATCOM services across Australasia



Blacktree Technology UHF satcom antenna systems atop the Citadel in London

Airbus Defence and Space has selected [Blacktree Technology Pty Ltd.](#) of Perth, Australia, to provide the ground segment for the Airbus funded, UHF military communications hosted payload on-board a commercial telecommunications satellite manufactured by Airbus.

The payload with 18 UHF channels will enable up to 200 simultaneous communications over Europe, the Middle East, Africa, large parts of Asia, as well as the Atlantic Ocean (to eastern Brazil) and the Indian Ocean (to western Australia). The Airbus funded UHF payload will serve allied armed forces including European and NATO countries



Airbus funded UHF payload will serve allied armed forces including European and NATO countries

Australian technology into the wider Airbus supply chain. “We’ve been excited to see how much technology is being developed by local companies to support the development of the Space industry in Australia, and that they are winning selection to provide global solutions in Space,” he said.

Martin Rowse, Airbus Defense and Space Australia director said, “We have selected Blacktree as they offer a proven Australian solution which will support this critical satellite communications capability. The ground segment will be essential in ensuring our customers have access to vital UHF connectivity across the region and beyond.”

Blacktree Technology’s Managing Director, **Joe Nevin**, added, “Blacktree Technology is proud to, once again, be selected to support Airbus with UHF ground segment capability. This builds on our strong heritage providing UHF solutions in Australia and across the globe.”

Airbus has been working with Blacktree for more than 15 years under the UK’s **SKYNET 5** secure MILSATCOM program and is partnering with them in **Team Maier** as part of the bid to address [Australia’s Joint Project \(JP\) 9102](#) to provide a complete **Sovereign Defense Satellite Communications System**. Team Maier members include technology and encryption specialists **Blacktree Technology**, [Clearbox Systems](#), [Penten](#), [UGL](#), [Surrey Satellite Technology](#) and [Willyama](#).

Airbus Chief Representative, Australia, New Zealand and the Pacific, **Stephen Forshaw**, said that the selection reinforced Airbus commitment to integrate

COMPLETE YOUR SATCOM MISSION WITH *iDIRECT* GOVERNMENT



EFFICIENT • SECURE • RESILIENT



Learn more at idirectgov.com

Benchmark Space Systems wins 2nd AFRL contract for new thrusters testing

Benchmark Space Systems has received a two-year, \$2.81 million Air Force Research Laboratory (AFRL) SPRINT (Space Propulsion Research and Innovation for Neutralizing Satellite Threats) award to further develop and test flight-optimized thrusters running on ASCENT (Advanced Spacecraft Energetic Non-Toxic) fuel.

Benchmark Space Systems and AFRL are unleashing ASCENT as a viable, safer, green propellant for defense and government missions.

This is Benchmark's second SPRINT award in two years, after the company successfully demo'd a prototype thruster burning the (AFRL) developed, **Advanced Space Craft Energetic Non-Toxic (ASCENT)** monopropellant without the use of a catalyst bed. The milestone trials opened the door to ASCENT as an affordable, viable alternative for a broad range of on-orbit mobility and tactical missions in space.

Benchmark's collaborative work with AFRL and the U.S. Government is a model example of how the company thoroughly vets the safety and optimizes performance of propellant for use in space, such as the flight-proven **high-test peroxide (HTP)**, bi-propellant running the company's **Halcyon** product line.

Benchmark propellant innovations also include the inert non-toxic powder fueling its Starling systems, and a variety of readily and domestically sourced metals to feed its Electric Propulsion offerings.

Benchmark's propellants team will continue to screen and solve inherent propellant challenges, including hurdles posed by LMP-103, nitrous oxide, water, and other fledgling propellants that have shown promise for specific mission types.

Benchmark's expertise and stringent development and test regimen has led to a growing thruster and propellants lineup that is well positioned to power a wide range of government and commercial missions.

As part of this new AFRL-funded program, Benchmark is building a flight-like, 22 Newton thruster to perform advanced ASCENT, hot-fire demos and will also deliver a preliminary design of a larger, 100 Newton thruster assembly in 2025, with the goal of meeting overall demand for scaled, ASCENT-fueled, spacecraft in the 10-500 Newton range.

Benchmark also unveiled the company's new **Advanced Propellants Group**, led by Director **Michael Martin**, Ph.D., who has spearheaded much of the ASCENT thruster prototype development and testing, both at Benchmark's technology center in Pleasanton, California, and labs at Texas A&M University in College Station, Texas. The new team will build on Benchmark's overall mission to explore and test a broad range of greener propellants for its growing suite of proven non-toxic chemical, electric and hybrid propulsion systems.

"Benchmark has developed a novel ASCENT thruster technology that provides the high-thrust scalability to make ASCENT a viable propellant across the full necessary performance range of DoD's current and future dynamic space operations. This next two-and-a-half-years of ASCENT thruster prototype development and testing under the SPRINT program will ultimately enable the refinement and scale of storable monopropellant systems and operations to support immediate off-the-shelf availability for rapid deployment defense missions." — **Jake Teufert**, Benchmark Space Systems Chief Technology Officer

"Our expertise in non-toxic propulsion systems and testing means Benchmark is well positioned to provide thrust to a wide range of government and commercial spacecraft on low Earth orbit, lunar, and cislunar missions. We are non-toxic propulsion professionals who will open the door even wider for ASCENT usage, as we also explore bringing in other underutilized and promising green chemical, electric and hybrid technologies to power the space economy." — **Michael Martin**, Ph.D. and Director of Benchmark's Advanced Propellants Group



EARTH CALLING...



When 'Long Distance' takes
on a whole new meaning...

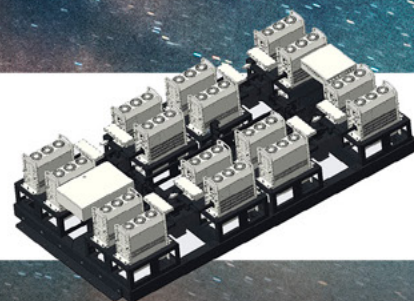
Advantech Wireless Technologies

SUMMIT

for Near and Deep Space applications.

HIGH POWER Solid State Amplifiers and Systems

- 800W to 16kW of transmit power
in L/S, C, Low X, Std. X and Ku-Bands
- Communications and Ranging
- Antenna-Pad, Work-Platform
and Side-Arm Mounting Configurations
- Gateway Earth Stations,
Deep Space, DTH, Satellite Tracking



advantechwireless.com

Boeing's new military satellite



Boeing [NYSE: BA] recently unveiled the company's Protected Wideband Satellite (PWS) design that features Boeing's Protected Tactical SATCOM Prototype (PTS-P) payload hosted aboard the U.S. Space Force's Wideband Global SATCOM (WGS)-11 spacecraft.

The combination of military satellite communications (MILSATCOM) and anti-jam capabilities underpin the PWS design. Both programs are based on Boeing's **702X**, software-driven technology enabling real-time and automated beam-forming for improved stand-off performance and signal protection.

The program is scheduled for launch in 2024, with on-orbit testing slated for 2025. After the on-orbit demo, the PTS-P payload will be available to transition for operational use.

The PTS-P design features automated anti-jam capabilities, including jammer geolocation, real-time adaptive nulling, frequency hopping and other techniques, harnessing the power of the U.S. military's **Protected Tactical Waveform (PTW)** to ensure the warfighter can stay connected in a contested environment.

By flying PTS-P on the **WGS-11** spacecraft as part of the WGS constellation, PWS works

seamlessly with all the existing WGS user terminals, while allowing gradual fielding of PTW modems in a theater of operation.

WGS provides the **Department of Defense** with a broad majority of tactical communications going through the constellation that currently includes 10 satellites.

*"The joint force is relying on us to deploy capabilities that enable secure communications in a prolific jamming environment. We also need mission-relevant speed and affordability, while being mindful of the evolving threat in the battlefield. The Boeing PTS-Prototype payload hosted on WGS-11 is an exciting leap forward for new warfighter capabilities." — **Charlotte Gerhart**, Space Systems Command's Tactical SATCOM division chief at the U.S. Space Force*

*"The Protected Wideband Satellite combines significantly upgraded WGS capability with PTS-P's automated anti-jam features. This capability sets the stage for future generations of protected wideband systems that can operate in both legacy transponded and new onboard processed modes." — **Michelle Parker**, Vice President of Boeing's Space Mission Systems*



DISPATCHES

Rocket Lab to launch four Leidos HASTE missions



Rocket Lab USA, Inc. (Nasdaq: RKLB) has signed a contract with Leidos to launch four HASTE (Hypersonic Accelerator Suborbital Test Electron) missions.

The missions, scheduled across 2024 and 2025, will lift off from **Rocket Lab Launch Complex 2** at Virginia's **Mid-Atlantic Regional**



Spaceport within **NASA's Wallops Flight Facility**.

Rocket Lab was selected by Leidos to provide hypersonic test launch capabilities with HASTE under the **MACH-TB** project.

The project was awarded by **Naval Surface Warfare Center (NSWC) Crane** through the **Strategic and Spectrum Missions Advanced Resilient Trusted Systems (S2MARTS) Other Transaction Authority (OTA)** vehicle on behalf

of the **U.S. Department of Defense (DoD) Test Resource Management Center (TRMC)**.

Rocket Lab Launch Complex 2 within the Mid-Atlantic Regional Spaceport at NASA Wallops Flight Facility in Virginia is the launch site for HASTE.

Tailored specifically for technology demonstration missions, HASTE launches from Wallops carry on the extensive tradition of suborbital launch from Virginia's coast and stands

ready to serve the current and future technology needs of hypersonic and suborbital test missions.

Rocket Lab's HASTE suborbital launch vehicle is derived from

the company's Electron rocket but has been modified to support hypersonic payload deployment.

By leveraging the heritage of Rocket Lab's low-cost Electron, HASTE offers true commercial testing capability at a fraction of the cost of current full-scale tests.

Rocket Lab launched the first HASTE mission on June 17, 2023, for Leidos under the **Multi-Service Advanced Capability Hypersonic Test Bed (MACH-TB) program**.



HASTE is operated under **Rocket Lab National Security (RLNS)**, the Company's wholly owned subsidiary created to serve the unique needs of the U.S. defense and intelligence community and its allies.

*"Our first HASTE mission in June this year successfully demonstrated HASTE's ability to accelerate the cadence of hypersonic flight testing for the nation. We're proud to now follow it up with a series of four additional missions for Leidos to support hypersonic technology innovation and technology maturation." — **Brian Rogers**, Senior Director, Global Launch Services*

DISPATCHES

NGA, NRO, USSPACECOM plan for threats to commercial satellites



The National Geospatial-Intelligence Agency (NGA), the National Reconnaissance Office (NRO) and U.S. Space Command (SSC) recently signed a first-of-its-kind agreement outlining a framework to enable the protection of commercial remote sensing space assets vital to the nation's intelligence collection mission.

The ***Commercial Space Protection Tri-Seal Strategic Framework (Executive Summary)*** finds the three organizations jointly engaging in threat information and conduct as well as other measures to avoid or reduce harm to commercial satellites from potential threats.

This is the first comprehensive agreement between the intelligence community and ***USSPACECOM*** on how to bring commercial vendors into the information-sharing process to help ensure effective joint collaboration and cooperation from the minute an event happens, with near real-time information sharing about any risks and threats to NRO-contracted commercial space capabilities.

The global commercial satellite industry continues to grow exponentially, with the launch of hundreds of

commercially-built satellites into orbit in the last few years and thousands more planned in the near future.

Similarly, the U.S. intelligence and defense communities increasingly rely on commercial satellites to add resiliency to U.S. capabilities and provide commercial imagery and other services to complement and extend the reach of government-owned space assets.

The unclassified, shareable nature of commercial imagery makes it an especially valuable source for information sharing with U.S. partners and allies.

For example, it has played a significant role in the Russia-Ukraine conflict. NGA and NRO have applied tailored tasking and acquisition strategies to maximize collection over the region, working with partners and commercial suppliers to expand user access and enable the rapid dissemination of commercial imagery.

Of course, the growing impact of those commercial resources has also increased adversaries' attention on them. As commercial providers expand their space-based capabilities, their assets face higher risk of targeted interference.

The new framework begins to address those concerns and helps ensure NRO-contracted commercial imagery providers are aware of — and can plan for — threats within a more congested and contested space environment. It also facilitates communication about potential threats between the government entities and commercial providers.

Overall, the framework defines the roles and responsibilities of NGA, NRO and USSPACECOM in three critical areas — threat information sharing, anomaly investigation and response and collection strategies:

- *Threat information sharing between the U.S. government and the commercial sector creates a better understanding of the space domain in general and the threats to collection assets specifically*
- *Anomaly reporting, investigation and response are needed to inform appropriate and timely actions in the face of current and emerging threats*
- *Commercial imagery collection strategies may need to be adjusted if threats require a change to commercial collection postures*

U.S. Space Command will lead threat information sharing with

NRO-contracted commercial imagery providers and the **NRO Operations Center** for space events, counterspace attack and USSPACECOM warning problems.

The command will also lead investigations into anomalies reported by commercial imagery providers, in coordination with NGA, NRO and other organizations as appropriate.

By delineating roles and responsibilities in these areas, NGA, NRO and USSPACECOM ensure their organizations effectively identify, assess and adapt to threats against commercial imagery collection.

This framework also helps ensure NRO-contracted commercial imagery providers are properly informed of emergent and imminent threats to their space assets, enabling providers to make informed decisions

to best support collection operations and benefit them in their support of U.S. government and non-governmental customers.

Over the next six months, NGA, NRO and USSPACECOM will jointly complete concepts of operations and standard operating procedures for implementing the framework and improving commercial satellite protection going forward.

*“This agreement is additional recognition of how valuable commercial image providers have become in the space environment. Our commercial vendors give us the flexibility to strategically consider all available capabilities — whether government or commercial — to make certain we can get the right data to the right place at the right time.” — **Frank Avila**, Acting Director, Commercial Operations, NGA*

*“Space is an extremely contested environment, and it’s only getting more so. That’s true not only for government systems operating in space, but for our commercial systems as well.” — **Pete Muend**, Director of Commercial Systems Program Office, NRO*

*“This cornerstone agreement advances U.S. Space Command’s space domain awareness through additional, non-traditional sources of information. The lessons learned from implementing this historic framework will enhance the U.S. government’s ability to bi-laterally share time-sensitive threat information with commercial providers..” — **Victor Vigliotti**, Chief of Commercial Integration Branch, U.S. Space Command*



King Cobra

Cobra

Naval Maritime SATCOM

1m Cobra and 2m King Cobra for world leading tracking, reliability and service resilience

- Full extended Ka-Band and simultaneous X-Band coverage
- Designed to access GEO, MEO, HEO and LEO satellite constellations
- Designed in Australia to support Allied Navies with best-in-class MIL SATCOM

Also from EM Solutions:

- X & Ka Band RF Subsystems
- Build to Print and Engineering Services
- Support and Sustainment Services



DISPATCHES

SAS supports MAG Aerospace on million\$\$\$ USSF contract



The quickest way from a billion points of data to a point of view.



SAS and MAG Aerospace are teaming to pursue opportunities from the recently awarded U.S. Space Force Space Systems Command (SSC) \$900 million indefinite delivery, indefinite quantity (IDIQ) contract.

SAS and MAG Aerospace will bring expertise in [AI](#), analytics and **Joint All-Domain Command and Control** to the space realm, enabling the [U.S. Space Force \(USSF\)](#) to analyze and use all the data being delivered by the organization's vast network of radars and sensors.

The Space Systems Command IDIQ contract is in support of Space Command and Control (C2). Space Force tracking radars and other sensors produce incredible amounts of data from thousands of locations. Last year, the Space Command tracked more than 47,000 objects in space.

There is a critical need to convert this proliferation of diverse sensor data accurately and rapidly into usable, real-time intelligence for mission success.

SAS' deep analytical capabilities enable commanders to enhance and accelerate decision making while promoting full network and data integration.

MAG Aerospace has successfully hosted the [SAS® Viya®](#) platform in a secure cloud environment for processing [Internet of Things \(IoT\)](#) data and performing advanced analytics at the tactical edge. SAS Viya — an open, cloud-native AI, analytics and data management platform — supports MAG's **Intelligence, Surveillance and Reconnaissance (ISR)** requirements across the full analytics life cycle, from the edge to analysis of data sets in complex operational environments.

Powered by Viya, SAS Analytics for IoT places the power of insight into users' hands to provide value that is realized from fast-moving, voluminous data in hours and days, not months.

SAS' legacy in aerospace traces back to the Space Race, when **Jim Goodnight**, Co-Founder and CEO of SAS, worked as a programmer on the *Apollo Project*. He later co-developed the SAS programming language and co-founded SAS, building a software industry leader that has been providing AI and analytics solutions to the federal government for nearly 50 years.

*"For nearly 50 years, SAS has been an industry leader in applying AI and analytics to the most complex mission challenges. As Space Force embarks on its burgeoning mission to conduct global space operations, we believe our alliance with MAG Aerospace is uniquely positioned to deliver on Space Systems Command's IDIQ task order opportunities by enabling data and network interoperability across all operating environments." — **Caroline Baldwin**, Director, SAS Federal*

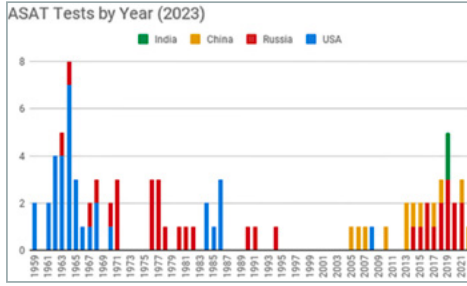
DISPATCHES

Secure World Foundation issues ASAT testing + more...

Secure World Foundation (SWF) has released updated versions of 11 fact sheets related to counterspace capabilities that cover ASAT testing in space, RPOs conducted in Earth orbit, and the X-37B Orbital Test Vehicle.

Together, these activities have generated concerns from many countries about the increasingly contested nature of space. The SWF fact sheets provide updated factual information on the current status of these capabilities and assessments of their impact on space security and sustainability.

The continued proliferation counterspace capabilities and resurgence of *anti-satellite (ASAT)* testing in space and growth in robotic *rendezvous and proximity*



operations (RPOs) conducted for military and intelligence purposes have generated concerns from many countries about the increasingly contested nature of space.

While many RPO activities are not directly aggressive or destructive themselves, they can lead to misconceptions or heightened tensions that could negatively impact space security and stability.

Additionally, destructive ASAT tests have created thousands of pieces of orbital debris over the last several decades, which can pose long-term risks to all space activities.

Each fact sheet summarizes the history of that country's programs in those areas, provides a table listing known tests of those programs in space (including any intercepts and orbital debris created), and a short analysis of the current state of development or operational status.

Additional details and links to the SWF fact sheets are [at this direct link](#). For more information, please contact [Dr. Brian Weeden](#) or [Ms. Victoria Samson](#).

CPI
Experience Innovation

Over 70 years of serving the Satcom markets means that CPI is the trusted supplier for the newest and state-of-the-art solutions.

Experience CPI

[in @cpi](#) [@cpii](#)

Amplifiers/UBCs: satmarketing@cpii.com
Antenna Systems: customercaresat@cpii.com



cpii.com

DISPATCHES

SES Space & Defense awarded AFRL contract



SES Space & Defense, a wholly-owned subsidiary of SES that is focused on delivering satellite network solutions for the U.S. Government (USG), has been awarded a multi-year contract by the U.S. Air Force Research Laboratory (AFRL) to conduct a series of tests to integrate space broadband services across a multi-orbit satellite network in support of the Defense Experimentation Using Commercial Space Internet (DEUCSI) program.

This announcement by AFRL is the third award under the **DEUCSI CALL 003 Program** seeking experimentation for use cases in the Arctic region and airborne comms. The DEUCSI program is intended to establish communications with military platforms via multiple commercial space internet (CSI) constellations

in GEO, MEO and LEO using a common, user terminal, with the ability to alternate between space broadband providers.

SES Space & Defense will demonstrate multi-orbit, multi-band solutions that seamlessly switch among commercial space broadband services in different frequency bands to access

favorable spectrum or failover between constellations. In doing so, SES Space & Defense will leverage common hardware elements to communicate with commercial space broadband constellations and military communications systems to provide greater flexibility in communication paths while minimizing the deployment of constellation-specific hardware.

*“An integrated, multi-orbit, multi-band satellite architecture is a requirement in today’s contested and congested environment for a network-centric military. The DEUCSI program is a great example to showcase SES Space & Defense’s multi-orbit, multi-band holistic approach to deliver seamless interoperability to the U.S. Air Force to achieve unparalleled situation awareness and strategic advances for mission success.” — **Jim Hooper**, Senior Vice President of Space Initiatives, SES Space & Defense*



Shield AI demos V-BATs with AFWERX



Shield AI has successfully completed an autonomous teaming demo that featured three V-BAT Unmanned Aircraft Systems (UAS) — this accomplishment was the final milestone of an AFWERX autonomy effort under their Strategic Funding Increase (STRATFI) program and collaboration with the AFRL Sensors Directorate.

Shield AI showcased their Hivemind AI pilot by launching a team of three V-BATs to monitor and surveil simulated wildfires. The multi-agent, coordinated team conducted ***Detect, Identify, Locate, and Report (DILR)*** missions in a contingency scenario with dual-use applications. This work with AFWERX sets Shield AI on a path to deploy V-BAT teaming capabilities in GPS- and communications-denied environments in the next year.

Hivemind can be trained for a variety of missions and its modular open systems architecture enables

portability to other aircraft. It has flown quadcopters, V-BATs, and jet aircraft. Hivemind can be trained to undertake a broad range of missions, including integrated air defense breach, SCUD missile hunting, zone reconnaissance, counter-air, beyond-visual-range strike, maritime domain awareness, and communications-contested operations.

“Intelligent, affordable mass that can see everything on the battlefield, execute the mission even when GPS and comms are denied or degraded, and put all our adversaries’ military assets at risk at all times is the holy grail of deterrence. This milestone brings us closer to achieving that reality. We had many customers from across the DoD enterprise attend the event and my favorite customer quote was ‘Wait, you’re flying those three aircraft, doing the recon, and at the same time briefing us?!’ The customers genuinely appreciated that this isn’t merely talk, or just computer simulations, or a science project leading nowhere. This represents real autonomy on actual aircraft that, most importantly, will

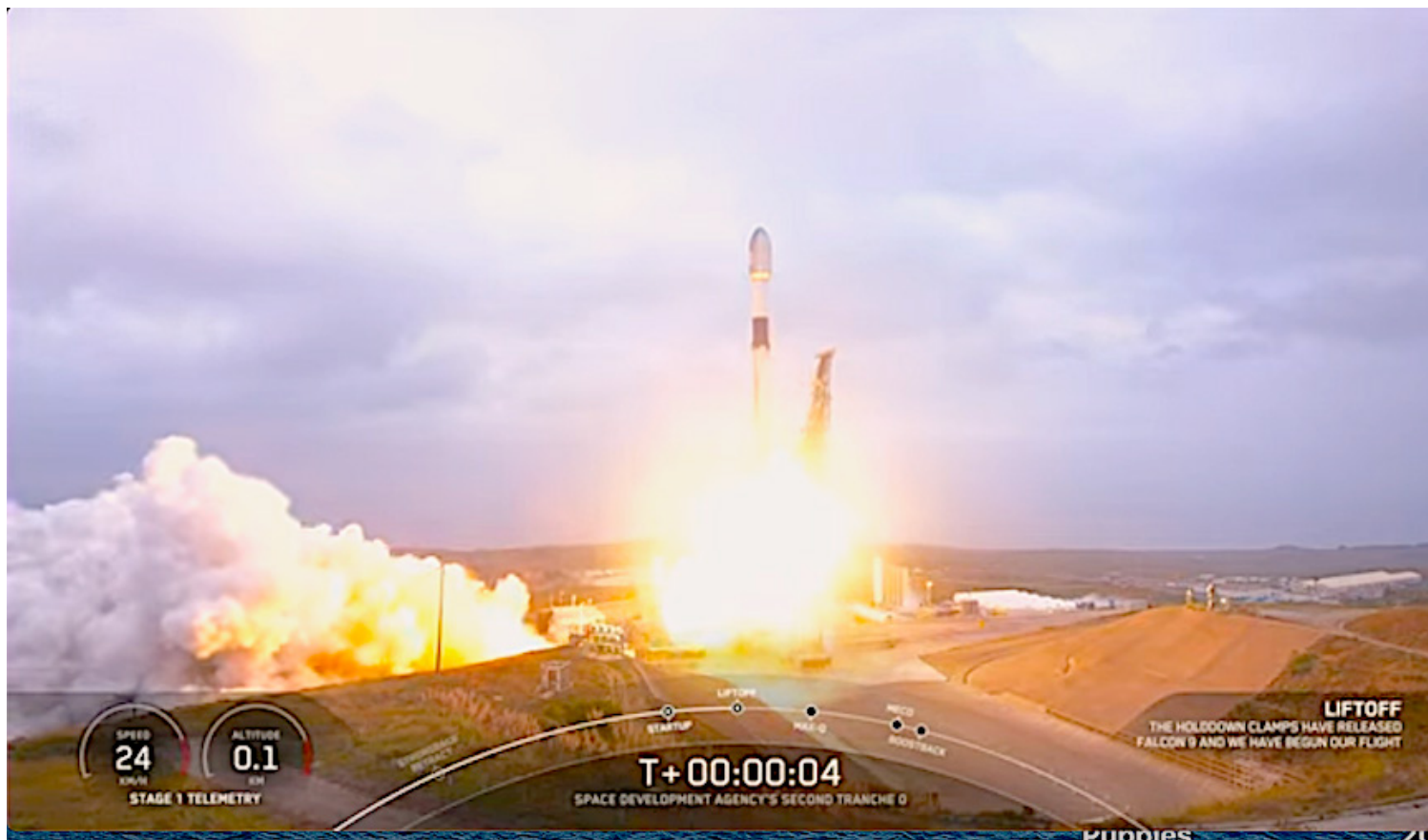
*be deployed imminently.” — **Brandon Tseng**, Shield AI’s President and Co-founder Shield AI (and former U.S. Navy SEAL)*

“Autonomy on V-BAT directly supports our autonomy efforts on uncrewed jet aircraft. Beyond our autonomy stack being leveraged across different aircraft, what sets this autonomy effort apart from others is that it was deployed on a program-of-record aircraft and will be a fielded capability next year. Many DoD-funded efforts, unfortunately, never reach the hands of a warfighter. However, Shield AI and AFWERX decided from the start that we would field this capability within the DoD. The great thing is all our DoD customers — the Army, the Navy, the Marines, SOCOM, and the Air Force — will benefit from this AFWERX effort. Autonomy is a joint capability,” — Ryan Tseng, CEO and Co-founder, Shield AI.

*“What’s exciting to us is not just the capability that teaming V-BATs can bring to the table or how it’s on a great path for fielding with DoD partners, but how autonomy stacks can be leveraged across different aircraft and programs. The continual application of autonomy from small systems, now V-BAT, and onto larger platforms provides paths for industry progression and autonomy maturation. The criticality of autonomous capabilities for future programs of record within the DoD was the driver for this Shield AI – AFWERX effort.” — **Col. Tom Meagher**, Prime Division Chief, AFWERX*

DISPATCHES

Two scrubs for SpaceX... then... success for SDA smallsats



Following two scrubs, a [SpaceX Falcon 9](#) rocket lifted off on schedule with 13 demo satellites for the U.S. [Space Development Agency \(SDA\)](#) at 7:25 a.m. PDT (10:25 a.m. EDT / 1425 UTC) 7:25 a.m. PDT (10:25 a.m. EDT / 1425 UTC) on August 31st from [Vandenberg Space Force Base](#).

The site's location on the California coastline provides customers with access to high inclination and polar orbits, frequently used by satellite communication constellations, defense intelligence and Earth-observing satellites, and some lunar missions. Launches from Vandenberg head straight south and traverse open ocean all the way to the Antarctic, by which time the vehicles have long since reached orbit.

Following two scrubs, SpaceX launched on the third attempt with a batch of 13 communications

and missile tracking satellites from [Space Launch Complex 4 East \(SLC-4E\)](#) at [VSFB](#) on the [Tranche 0 Flight 2 mission](#) for the [Space Development Agency \(SDA\)](#). An issue with engine 4 scrubbed the first attempt and a ground valve issue scrubbed the second attempt.

At the request of the SDA, SpaceX did not provide coverage of the second-stage portion of the flight. This is standard procedure for many national security missions.

The 13 demo satellites launched are for a future constellation of military missile tracking and data relay satellites. Ten satellites for the constellation were launched April 2 on a Falcon 9. Four more satellites are scheduled for launch on a later mission hosted by the Missile Defense Agency, according to an SDA fact sheet.

The Falcon 9 first-stage returned to successfully make a landing at Vandenberg VSFB.

This SDA mission was SpaceX's 50th launch from Vandenberg. After conducting a total of 19 launches from SLC-4E from 2013 through 2021, the pace has picked up recently, with 13 missions in 2022 and 17 flights already completed in 2023. This launch came after SpaceX launched the company's [Starlink Group 6-13](#) mission..

SpaceX designs and builds its reusable rockets and spacecraft at its headquarters in Hawthorne, California. As a company, SpaceX is vertically integrated, building the vast majority of the vehicle on the Hawthorne campus.

All's well that ends well...and it did.

RTX connects new platforms as battlefied nodes



The Raytheon Multi-Program Testbed takes off during exercise Northern Edge 23-2 at Kadena Air Base in Japan.

RTX (NYSE:RTX) has demo'd advanced AI-enabled communications systems to rapidly distribute data to coalition partners during the second round of the [U.S. Indo-Pacific Command's Northern Edge 2023](#) exercise series at Kadena Air Base in Okinawa, Japan.

[Collins Aerospace](#), an RTX business, expanded upon the airborne, platform-agnostic data hotspot that the company debuted during the first Northern Edge exercise in Alaska earlier this year.

Leveraging the company's cross domain solution, advanced AI-enabled communications, and intelligent gateway technology, Collins connected partners from [The Five Eyes alliance](#) and others to the data network, expanding joint force capabilities during the demonstration.

RTX's [Raytheon](#) business unit contributed to accelerating decision-making timelines, with an integrated team demonstrating how AI-enabled machine-to-machine communications rapidly delivered threat awareness data from the [U.S. Space Force's Unified Data Library](#) to multiple aircraft, demonstrating how they can be used as connectivity nodes on the battlefield.

RTX's suite of technologies is flexible, allowing integration into a variety of platforms. The company's focus on open systems architecture development aims to support the evolving needs of the customer and the battlefield and its technologies enable synchronized operational capabilities available in every domain.

Expanded connectivity to [U.S. Air Force Mobility Command](#) assets was facilitated through an ongoing [Cooperative Research and Development Agreement \(CRADA\)](#) between Collins Aerospace and the Utah Air National Guard. The agreement is focused on extending the utility and survivability of the

KC-135 by expanding the role the KC-135 can play on the battlefield as an airborne refueling and connectivity node.

"This was a critical demonstration to prove our solutions can facilitate and enable connectivity for a large and growing joint force network," said. "It's important to understand that the joint fires data our systems processed and distributed came from

a large network of platforms that weren't originally designed to connect and share data like this. Not only did our gateway and cross domain solution connect those platforms, they also automated the distribution of that data to the right partner at the right security level." — **Elaine Bitonti**, Vice President, Connected Battlespace & Emerging Capabilities, Collins Aerospace

"Our automated communications powered by AI securely provided mission data to a number of platforms including C17s, C-130s and the KC-135 in a realistic combat scenario. Northern Edge TAC-2 has been a vital proving ground to demonstrate how enabling JADC2 technologies can strengthen the Joint Force and its allies and partners' readiness to fight and win." — **Conn Doherty**, vice president of Battle Management Command & Control & Autonomy Solutions at Collins Aerospace.



SILICON VALLEY SPACE WEEK: PART I



SATELLITE INNOVATION

THE MEETING PLACE FOR SATELLITE INDUSTRY LEADERS

Featured Speakers



Steve Jurvetson
Co Founder
Future Ventures



Jessica Rosenworcel
Chairwoman
FCC Commission



Ken Peterman
Chairman & CEO
Comtech



Marc Bell
Executive Chairman and
Co-Founder
Terran Orbital

Exhibitors & Sponsors

SATINNOVATION.COM
OCTOBER 17 - 18, 2023



2023 MILSAT SYMPOSIUM

NEXT-GENERATION SPACE DEFENSE

Featured Speakers



Lt. Gen. Michael Guetlein
Commander, Space Systems Command
U.S. Space Force



Dr. Derek M. Tournear
Director
Space Development Agency (SDA)



Dr. Claire Leon
Director, Space Systems Integration Office, Space Systems Command
U.S. Space Force



Brig. Gen. Steven Butow
Space Portfolio Director
Defense Innovation Unit - DIU

Exhibitors & Sponsors



OCTOBER 19 – 20, 2023

MILSATSHOW.COM

GOVERNMENT SATELLITE REPORT

U.S. Space Command Deputy Commander: There have been three, distinct, space ages

Author: David Pesgraves



When the U.S. Space Force and the second incarnation of the U.S. Space Command were stood up in 2019, it was a monumental step forward for the defense and security of America's critical space systems and capabilities that either reside in or rely on the domain.

However, for Lieutenant General **John E. Shaw**, Deputy Commander of the U.S. Space Command, 2019 was not the beginning of a new era in space, but rather a benchmark within what he refers to as "**The Third Space Age**."

During a recent **Mitchell Institute Schreiver Spacepower Forum**, Gen. Shaw sat down with Gen. **Kevin P. Chilton** (Ret.) to examine the three, distinct, Space Ages that the **U.S. Government (USG)** and military have operated within.

They also discussed the role that commercial space has played during the most recent **Third Space Age** where the domain has become contested by adversarial actions and threats.

The Three Space Ages

From Gen. Shaw's viewpoint, there have been three Space Ages so far. He explained that the first Space Age began at the start of the Cold War and was primarily focused on national security and scientific exploration through the **Apollo** missions.

Gen. Shaw noted that during this era there was little to no commercial presence. The commercial space industry would not be involved until cable television took off during the tail end, which represented industry's initial footprint in the domain.

"[Commercial space] was very nascent in that time," said Gen. Shaw. "We all wanted our MTV."

Toward the closing of the Cold War, there was an inflection point that Gen. Shaw attributes to the dawn of the Second Space Age.

"What had been our adversaries in the space domain ended up partnering with us to do the **International Space Station**," said Gen. Shaw.



Those collaborations represented the Second Space Age from a civil standpoint, but from a national security standpoint, it wasn't until the Gulf War that space was truly leveraged for military missions.

"The Gulf War happened right at that inflection point," said Gen. Shaw. *"That was also where I began and spent most of my career delivering space capabilities to the tactical level: GPS, ISR, missile warning, etc."*

According to Gen. Shaw, this era also saw a spike in commercial space activity. Commercial companies already had been doing work in **Geosynchronous Orbit (GEO)** by then, but during this period, they began to experiment in **Low Earth Orbit (LEO)**, as well.

"But the government capabilities were still sort of the premier capabilities that we knew of and used," said Gen. Shaw. *"We leverage... commercial activity and capabilities across the spectrum – SATCOM, space domain awareness, and imaging – in ways that we never really did earlier... There's a dependence that we have on them now that is part of our broader force set that we bring."*

The Third Space Age, according to Gen. Shaw, began around 2015 when commercial space companies began to test and demonstrate extraordinary capabilities that had never been seen before. This was a time when the world saw its first operational large-scale satellite proliferation in LEO.

Another major marker of this Third Space Age was the realization that the space domain was no longer a benign environment.

"It was in 2015 that we first started talking publicly...that there were now threats in the domain," said Gen. Shaw.

The Contested Space Domain

Though space as a warfighting domain may not have been publicly discussed until 2015, there was plenty of evidence of that fact before then.

"In 2007, we had the Chinese do an ASAT test," said Gen. Chilton. *"But it takes us eight years to finally come to admit that, yes, it is indeed a warfighting domain?"*

And adversarial actions in the space arena have only escalated since that time. As Gen. Chilton also pointed out, U.S. adversaries and near-peer competitors in recent years are demonstrating aggressive capabilities that could jeopardize the security and safety of American assets in space.

“Today, U.S. Space Command now operates in a domain where threats are on the rise,” said Gen. Chilton. *“Adversaries like China are increasingly seeking to contest this domain. Their capabilities include everything from ground-based direct ascent missiles, to electronic warfare, jamming, and co-orbital rendezvous satellites. The impact on U.S. national security interests is significant.”*

Gen. Shaw explained that the realization that the U.S. needed to be prepared to defend against adversarial threats in space led to the creation of the U.S. Space Force and U.S. Space Command. During the forum, he addressed some of the pessimistic viewpoints surrounding the creation of the Space Force in 2019.

“There were a lot of naysayers at the time,” he said. *“Was this a good idea? But looking back, it was a brilliant move.”*

“Today, U.S. Space Command operates in a domain where threats are on the rise. Adversaries like China are increasingly seeking to contest this domain. Their capabilities include everything from ground-based direct ascent missiles, to electronic warfare, jamming, and co-orbital rendezvous satellites. The impact on U.S. national security interests is significant,” said Gen. Chilton (Ret.).

According to Gen. Shaw, all of the challenges that the government acknowledged in 2015 have only continued to advance and grow.

“If we were trying to stand up the Space Command and Space Force now, four years later, we would be much further behind in addressing these threats, making the environment more secure for all the participants that are going to be there, and strengthening all those partnerships across all the sectors,” said Gen. Shaw.

Commercial Space In The Third Space Age

Gen. Shaw noted that the Third Space Age has really brought all of the space sectors together in a unique way that was never before witnessed in the first two Space Ages.

“Another interesting dynamic in this Third Space Age... is all of those sectors – civil, scientific, commercial, and national security – are now interdependent in ways they certainly weren’t in the First Space Age, and mostly not in the Second Space Age,” said Gen. Shaw. *“We leveraged from a national security perspective, commercial activity and capabilities across the spectrum – SATCOM, space domain awareness, and imaging – in ways that we never really did earlier, to a greater degree. There’s a dependence that we have on them now that is part of our broader force set that we bring.”*

As for the specific relationship the USG and military have with the commercial space industry, Gen. Shaw describes it as a solid partnership.

“We’re in a symbiotic relationship with commercial space today,” he said. *“We support them and their operations to operate safely and securely, but they also provide capabilities to us.”*

He explained that the SATCOM, imagery and **Space Domain Awareness (SDA)** capabilities that industry provides to the government and military are extremely critical.

“We rely on commercial imagery now more than we ever have,” said Gen. Shaw. *“In those early days of the Ukraine conflict, I think we all watched the news stations that were showing imagery of that Russian convoy that was stalled outside Kyiv... Was that declassified NRO government imagery that we were seeing on the news? That was not. It was commercial, and it was pretty timely.”*

Gen. Shaw went on to say that the advancements coming out of the commercial space industry are not only impressive, but they are promoting global transparency among the world governments.

“It was achieving more than just a news need,” said Gen. Shaw. *“It was actually achieving an international awareness need.”*

*This article first appeared in
Government Satellite Report
and is republished with permission of
GSR and SES Space & Defense.*



Author David Pesgraves is a Staff Writer for GovSat Report, in addition to several other online publications dedicated to defense, military, and federal government agency technologies.

DISPATCHES

USSF awards Viasat contract for pLEO satellite services

Viasat, Inc. (NASDAQ: VSAT) has announced that [Inmarsat Government](#), now part of Viasat, was awarded a Proliferated Low Earth Orbit (PLEO) Satellite-Based Services (SBS) contract by the U.S. Defense Information Systems Agency (DISA) on behalf of the [U.S. Space Force's \(USSF\) Space Systems Command \(SSC\)](#) – Inmarsat Government is one of 16 companies selected for the \$900 million ceiling, 10 year, Indefinite Delivery, Indefinite Quantity (IDIQ) contract.

Proliferated LEO (pLEO) constellations are part of a Department of Defense (DoD) strategy to provide additional resilience for [satellite](#)

communications (SATCOM), remote sensing and other capabilities by diversifying orbits.

Viasat plans to leverage smallsat technology, reduced costs and increased launch service competition, facilitating the ability for pLEO constellations to provide persistent, global coverage with reduced transmission latency. The company will provide a suite of fully-managed pLEO satellite-based services and capabilities, to include space relay services, supplemented by GEO and NGSO satellites, supporting all domains – space, air, land, maritime and cyber.

Viasat will aim to achieve this with a reliable, resilient low

latency global pLEO offering that flexibly supports the needs of combatant commands, defense agencies, other federal government organizations and international coalition partners. It will provide a comprehensive managed end-to-end SATCOM solution via a multi-band, multi-orbit constellation of satellites. Furthermore, its new, hyper-intelligent ***software-defined wide area network (SD-WAN)*** is designed to orchestrate and provide priority routing across mixed networks, enabling an automated ***primary, alternate, contingency and emergency (PACE)*** solution to deliver the flexibility and responsiveness required to meet customers' needs today and in the future.

AvL
TECHNOLOGIES
avltech.com

HARSH WEATHER?
Communicate through extremes



**1.6m Manual Point Tri-Band Terminal ✦ Operational winds to 60 mph
MIL-STD-810G certified ✦ MIL-STD-188-164C & SKYNET compliant**

Let's talk harsh weather comms @ Sat Innovation & MilSat Symposium ✦ Booth 15

SPACE SYSTEMS COMMAND (SSC)

The A B Cs of Orbital Mechanics

Author: Lisa Sidders, Space Systems Command

Find Out Why 'Rocket Science' is so Complex – and how space acquirers and operators work together to do the job.

Space is hard.

There's a reason why becoming a space professional requires specialized training and, sometimes, multiple degrees. For one thing, the laws of physics cause satellites to behave quite differently 100 kilometers above the planet's surface and in the vacuum of space.

Orbital mechanics is the study of the motion of man-made objects in space that are influenced by natural and artificial forces, said Dr. **Ryan Coder**, senior engineer in the **Astrodynamics** department at **The Aerospace Corporation**, an independent, nonprofit corporation operating the only federally-funded research and development center for the space enterprise.

“Where does space start?” Coder said. “Hilariously, there’s not a uniform definition of that. There’s no clean line where air molecules cease to exist. There’s no hard-and-fast, universally agreed-on number for ‘where does space start?’ In the United States, to get an astronaut badge, you have to fly higher than 80 kilometers; some international organizations use references — such as the Kármán line — at 100 kilometers.”



Dr. Ryan Coder

Humans have been studying the motions of celestial bodies for centuries, long before space travel was even possible, Coder noted, which means even the vocabulary used to describe scientific terms relating to orbital mechanics is derived from many different languages.

“For example: apoapsis and periapsis — the first is the point in a satellite’s orbit farthest from a planetary body, and the second is the nearest point,” Coder explained. “‘Apo’ from the Greek, meaning farthest, and ‘peri’ meaning closest. If you’re orbiting around the sun, it’s aphelion, and if it’s about the Earth, it’s apogee.”

This comes in handy when you remember that orbits tend to be elliptical — not perfectly spherical — and, as a result, objects orbiting a planet don’t move at a constant speed but go faster at the point nearest to the planet, and travel more slowly at the farthest point in their orbit.

Satellites are moving at very high speeds in order to maintain their orbits. In **Low Earth Orbit (LEO)**, a satellite might travel 17,500 miles an hour, or 3 kilometers per second. In **Geosynchronous Orbit (GEO)**, it might travel 6,700 m.p.h., or 8 kilometers per second, Coder said.

“That means the slowest GEO orbit is going three times faster than a speeding bullet,” Coder said.

Understanding the various forces that affect objects in space — Earth’s gravity, the gravitational pull of other planets, drag from atmospheric forces in LEO, solar radiation pressure — can complicate what might appear to be a simple problem.

“Let’s say you’re a resupply mission to the International Space Station and you need to catch up to the ISS,” Coder said. “If you were an airplane, you would apply more thrust to go faster to catch up to the ISS. But in space, you wouldn’t apply thrust in the same direction. If you want to increase speed, that means you need to go

lower, so you’d apply the thrust opposite your motion to drop your vehicle down in altitude. Applying the thrust to propel yourself forward, means you would raise your altitude, and you’d go slower, increasing the distance, rather than catching up to it.”

Space professionals also need to understand the scale they’re working in.

“Space is really big,” Coder said. “The volume of space between a LEO and a GEO is about 75 trillion cubic miles — that’s 288 times bigger than the volume of the Earth itself. That’s part of what makes tracking objects in space so difficult; it’s such a vast region to search.”

“It’s so frequent that the thing you want to know, you cannot directly measure,” Coder said. “There’s a lot of statistical inference going on — ‘I found this new piece of debris that I haven’t tracked before. Wonder where that came from? Maybe from this new mission’ — but trying to prove that can be extremely difficult. Many questions surrounding a new piece of debris — what mission did that come from, what payload, what country did it come from — none of those things are elements you can directly measure.”

Stacie Glazier, a member of **Space Systems Command’s (SSC) Pivot Space Domain Awareness** team, was previously assigned to the **18th Space Defense Squadron (SDS)** at **Vandenberg Space Force Base** and offered a few perspectives on orbital mechanics.



“Space, or the Space Domain Awareness mission, is hard from the SSC perspective for different reasons than just the orbital mechanics,” Glazier said. “Beyond the physics, the problem set is really consolidating all the available data and resources and integrating it all together in a system that responds to what the operators at the 18th and 19th Space Defense Squadron need.”

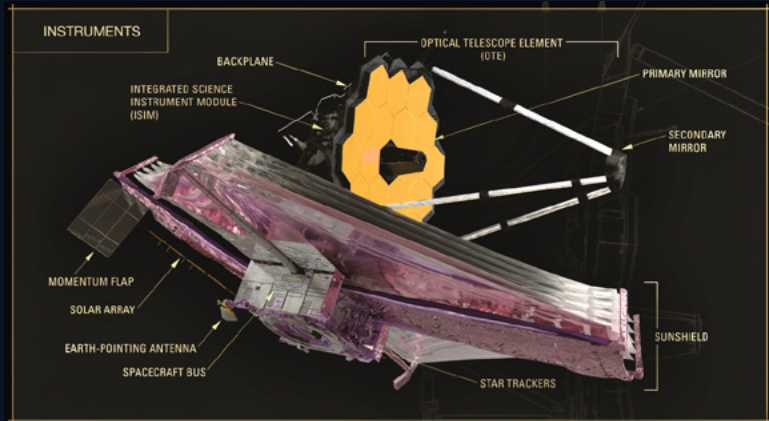
The 18th SDS integrates data from the **Space Surveillance Network (SSN)**, maintaining the **resident space object (RSO)** database and managing the **U.S.**



Space Based Surveillance

Space Command's space domain awareness (SDA) sharing program to United States, foreign allies as well as commercial and academic entities.

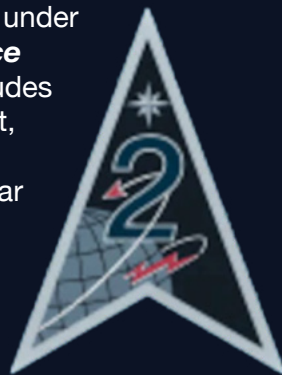
The 19th SDS looks beyond GEO orbit to cislunar missions and objects, such as the [James Webb Space Telescope](#), which orbits a Lagrange point midway between the Earth and the Sun.



The instruments aboard the James Webb Space Telescope. Image is courtesy of NASA.

To accomplish this task, these units, under Space Operations Command's **Space Delta 2**, rely on the SSN, which includes ground- and space-based equipment, including telescopes, electro-optical, passive radio frequency (RF) and radar to track objects in LEO, GEO and cislunar space.

"One of the things that makes the U.S. excel at space surveillance and space tracking is that starting in the 1960s we had these missile warning / missile tracking



in the

radars," Glazier said. "These defense radars provided a lot of data for tracking objects in LEO. Really, any country entering space operations had to have surveillance support to those missions, so we've built and iterated our network for many decades.

"Navy systems, NASA telescopes, and NORAD all fused to make early versions of what became the 18th and 19th SDS units today. And now we've got commercial companies with space surveillance capabilities as well to integrate. That is something I work on in my current role with SSC.

"Somewhere between 600,000 to 900,000 observations per day will flow to the 18th SDS. Their systems then take all the individual observations of objects in space, consolidate it and use that information to update the authoritative catalog that they use, the resident space object database," Glazier noted.

This catalog lists objects by a five-digit international designator and its Keplerian elements, including the shape of the orbit, the degree of eccentricity and mean motion, Glazier said. No numbers are reused; the first two objects in the catalog are **Sputnik's** rocket body and Sputnik itself, even though both burned up when they reentered Earth's atmosphere a mere three months after they launched in 1957.

NORAD CATEG	SATNAME	INTLDES	TYPE	COUNTRY	LAUNCH	SITE	DECAY	PERIOD	INCL	APOGEE	PERGEE	RCS	LAUNCH
1	SL-1 RB	1957-001A	ROCKET BODY	USSR	1957-10-04	TMRT	1957-12-01	96.19	63.10	336	214	LARGE	TLE CORN
2	SPUTNIK 1	1957-001B	PAYLOAD	USSR	1957-10-04	TMRT	1958-01-09	96.19	63.00	1900	44		TLE CORN
3	SPUTNIK 2	1957-002A	PAYLOAD	USSR	1957-11-03	TMRT	1958-04-14	103.74	63.30	1628	211	SMALL	TLE CORN
4	EXPLORER 1	1958-001A	PAYLOAD	USA	1958-03-01	AFETR	1975-03-21	86.40	33.15	815	183		TLE CORN
5	WANGUARD 1	1958-002A	PAYLOAD	USA	1958-03-17	AFETR	1958-03-28	132.71	34.25	3811	649	SMALL	TLE CORN
6	EXPLORER 3	1958-003A	PAYLOAD	USA	1958-03-26	AFETR	1958-06-28	102.60	33.30	1738	117		TLE CORN
7	SL-1 RB	1958-004A	ROCKET BODY	USSR	1958-05-15	TMRT	1958-12-03	102.74	65.14	1571	206		TLE CORN
8	SPUTNIK 3	1958-004B	PAYLOAD	USSR	1958-05-15	TMRT	1958-04-06	88.43	63.96	330	139	LARGE	TLE CORN
9	EXPLORER 4	1958-005A	PAYLOAD	USA	1958-07-26	AFETR	1959-10-23	92.91	30.25	885	239		TLE CORN
10	SCORE	1958-006A	PAYLOAD	USA	1958-12-18	AFETR	1959-01-21	98.21	32.29	1187	189		TLE CORN
11	WANGUARD 2	1958-001A	PAYLOAD	USA	1958-02-17	AFETR	1959-01-21	121.29	32.88	2905	362	MEDIUM	TLE CORN
12	WANGUARD 4B	1958-001B	ROCKET BODY	USA	1958-02-17	AFETR	1958-03-03	125.68	32.90	3313	684	MEDIUM	TLE CORN
13	DISCOVERER 1	1959-002A	PAYLOAD	USA	1959-03-28	AFETR	1959-03-03	92.70	30.90	637	144		TLE CORN
14	DISCOVERER 2	1959-003A	PAYLOAD	USA	1959-04-13	AFETR	1959-04-26	90.40	30.90	546	239		TLE CORN
15	EXPLORER 5	1959-004A	PAYLOAD	USA	1959-08-07	AFETR	1961-06-30	102.25	40.90	4070	201		TLE CORN
16	WANGUARD 3B	1958-002A	ROCKET BODY	USA	1958-03-17	AFETR	1958-03-17	137.29	34.25	3739	636	MEDIUM	TLE CORN

People can log into [Space-track.org](#) and see much of this data for themselves, Glazier said. Nearly 60,000 objects are listed, but the number of items actually on-orbit currently is closer to 30,000 and includes debris as well as man-made items.

"It's a U.S. Space Command (USSC) funded and run website, which the SDS populates with orbital information," Glazier said. "USSC has a mission to share data for the purposes of safety of flight and collision avoidance. One of the fun things to look at is the space ops tempo – you can see the count of objects on orbit, the number of payloads that have been launched, and understand the rapid growth in the space domain."

Sensor Optimization

Sensor optimization is another important task for building accurate orbits, Glazier said. Each sensor does its own calibration, but the 18th also has “truth” data that comes from a handful of calibration satellites to correct for any biases in observational data.

“Our sensors are passively sending out radar or collecting light in our optical sensors to build,” Glazier said. “We only have a handful of objects that will tell us their true data — where they really are — so we can use that to calibrate our sensors, so we can correct for bias.

“Most of the objects that are orbiting the earth are not payloads that are actively telling us exactly where they are located. Most of the objects are pieces of debris, rocket bodies, or non-functional items that either have reached end of life or were bits and pieces of primary payloads that break away from that parent object,” she added.

The vast majority of the objects tracked through the U.S. Space Force are in LEO, where they are subject to gravity and atmospheric drag that will cause their orbits to decay and pull them down to Earth; most of them will burn up in the atmosphere, but it’s important to track these objects in case they are not destroyed.

“This is why there’s a lot of discussion and concern when it comes to mega-constellations such as Starlink, that these constellations do self-management where they bring down their exhausted payloads to reenter the atmosphere in a controlled way, so that their discarded payloads aren’t just floating up there for decades and decades,” Glazier said, noting that the international community has been having numerous discussions on what constitutes responsible use of outer space.

Human Spaceflight Support

The systems SSC develops and sustains for the 18th SDS must also include the ability to support the International Space Station, Glazier said. Mission Control at NASA Johnson Space Center in Houston has a **trajectory operations and planning officer**, or **TOPO**, who provides the 18th SDS with trajectory information on the **International Space Station (ISS)** and visiting space vehicles, such as **Dragon** capsules. **NASA** can contact a dedicated member of the 18th SDS on duty at all times to do special screenings just to protect the on board astronauts.

“That trajectory and screening for objects in the path of the ISS is very important for NASA,” Glazier said. “Most of the focus is to ensure good orbital states for all of the other objects that are in orbit around the ISS — those are human spaceflight threat objects. It could be a discarded camera lens or a fleck of paint that is in the path of the ISS. When you’ve got two objects travelling at extreme rates, the implications of a collision with a bolt could be catastrophic.

“The ISS travels at an extremely low altitude to avoid much of the denser LEO population,” Glazier said. “One benefit of that orbital range is that objects that are starting to decay, once they reach that orbital altitude, will start decaying much more rapidly — it’s a much less populated zone.”

Reentry/Break-up Assessment

Another challenge for SSC with SDA systems design is accounting for the **decay and deorbit of RSOs** and the associated orbital challenges specific to the mission area.

“Highly eccentric orbits will start to rapidly circularize, and in extreme cases could just terminate into the Earth’s atmosphere very quickly,” Glazier said. “It’s a challenge to re-acquire objects with the SSN when their orbits are changing dramatically, but essential to have systems capable of doing this to provide reentry assessment information.”

Reentry assessment is top-tier analysis that is typically only initiated for large objects, payloads or for items that are radioactive or might contain human remains.

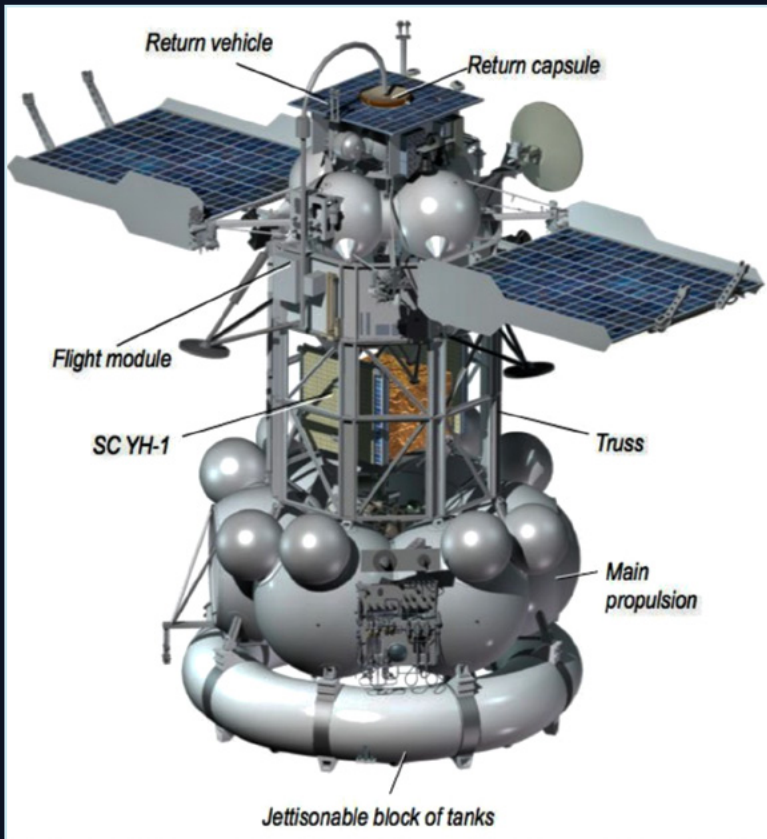
“The idea is, if it is suspected of surviving reentry and making it to the ground, the 18th SDS needs to be able to provide a prediction impact report for it,” Glazier said.

“The Tracking and Impact Prediction reports will give you the object’s catalog ID, it’ll give you the time the message was created, the predicted time the decay will occur — in Zulu time (Greenwich Mean Time) — which orbital revolution we’re predicting that it’s going to decay on, and then the latitude, longitude and inclination and that indicates the atmospheric impact of the object.

“When the 18th SDS publishes predicted reentries, they’re not predicting Earth impact,” Glazier said. “These are saying, ‘This is where we predict this object will be terminally entering Earth’s atmosphere; it will not persist in orbit around the Earth.’”

These TIP reports are regularly updated and are of great interest to emergency management agencies in many countries, Glazier said.

For example, when the Russian-Chinese *Phobos-Grunt* space probe failed shortly after launching in November of 2011, it was stranded in LEO for two months before reentering the Earth's atmosphere. The probe's fate was of concern as it had toxic chemicals on board and no one was certain whether it would burn up on reentry, or if pieces would survive the plunge and contaminate areas, Glazier said.



Phobos-Grunt (alternatively Fobos-Grunt) was a Russian mission designed to land on the martian moon Phobos and return a sample to Earth. Image is courtesy of NASA.

Conjunction Assessment

Conjunction Assessment is predicting the trajectories of objects on-orbit to assess if they will have a close approach, or conjunction, and is “orbital mechanics on steroids,” according to Glazier.

“Not only do you have to build the most accurate orbital state you possibly can, then you have to build out the state of that orbit days into the future accounting for atmospheric and solar impacts, lunar gravitational forces — it’s a physics cornucopia,” Glazier said.

“SSC has programs in sustainment performing this function with the 18th and 19th SDS today, however the research, analysis and tuning going into this mission area is never done,” Glazier added, noting that SSC and the ops units partner with multiple agencies, including NASA, in the continual research of the accuracy of conjunction assessment processes.

According to Glazier, conjunction assessment “was not a huge focus area getting much resourcing up until 2009, when the COSMO-Iridium collision occurred.”

Cosmos 2251 was an inactive Russian communications satellite that collided with an active commercial satellite operated by U.S. based **Iridium Satellite**. That impact created more than 2,000 pieces of debris and was the first-ever collision of two satellites in space.

“It was February; I remember going off the Ops floor for an hour, but when I returned, about 50 extra people were buzzing about and the General’s conference room was up and running — never a good sign,” Glazier recalled. “Two satellites collided in orbit and suddenly our debris counts from the SNN were skyrocketing and the day you hoped, or thought, wouldn’t ever come was actually happening.” Since 2009, the resources and personnel dedicated to the mission area of conjunction assessment have expanded and now includes work the **U.S. Department of Defense (DoD)** and **U.S. Department of Commerce (DoC)** are undertaking to transfer civil spaceflight safety from DoD to DoC, Glazier said.

Constant monitoring is crucial because space is not a static environment. Parts fall off discarded rocket bodies. Paint degrades and flakes away. And, sometimes, satellites drift out of their regular orbit.

“We’ve got gravity wells because the Earth is not perfectly spherical,” Glazier said. “It’s got kind of bulgy bits that stick out and there are places where the Earth is more dense and generates a gravitational well out to the GEO (orbital) regime, so if you’re trying to keep an orbit aligned with an orbital plot that was assigned to you by the ITU (the International Telecommunications Union), you have to stay put in it. But if you happen to be parked near the Himalayas or over the Rockies, well, your satellite is going to want to drift towards the center of that gravity well, so you’re going to have to perform station keeping.”

“You’ve got to keep your GEO payload in your box. And people do drift out of their box, and it’s a whole, dramatic environment... especially when you’re (flying) a communications satellite and you start drifting and you didn’t — or couldn’t, due to an anomaly — turn off your payload. So now you’re drifting and you’re also broadcasting over everyone you’re passing by and that leads to real problems for folks on the ground who depend on those links being continuously operational.”

Despite all of the complex physics and math involved, working with orbital mechanics can be deeply satisfying, Glazier said.

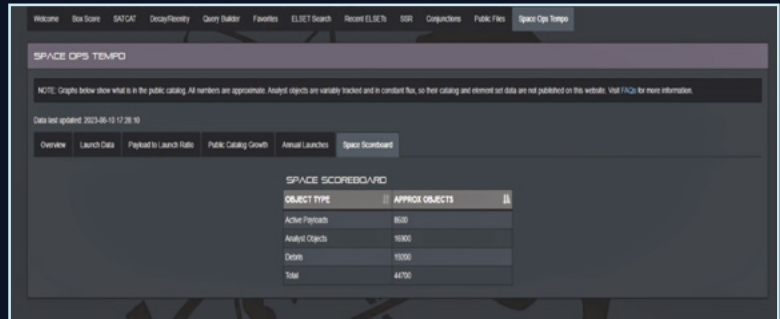
“Every day, there’s a new problem to solve,” Glazier said. “The Air Force picked this career path for me many years ago, but I couldn’t imagine doing anything else.”

Space Systems Command (SSC) is the U.S. Space Force Field Command responsible for acquiring and delivering resilient war fighting capabilities to protect our nation’s strategic advantage in and from space. SSC manages a \$15 billion space acquisition budget for the Department of Defense and works in partnership with joint forces, industry, government agencies, academic and allied organizations to accelerate innovation and outpace emerging threats. Our actions today are making the world a better space for tomorrow.

Contact Space Systems Command at SSC@spaceforce.mil and/or follow on [LinkedIn](#).

Would you like to learn more about the objects the U.S. Space Force is tracking? People can set up an account at Space-Track.org and view a variety of statistics including the current number and type of objects being tracked.

People can find details of the first satellite, Sputnik, to the latest cubesat, on Space-Track.org.



Out of this world vocabulary

Apoapsis — The point at which an orbiting object is farthest away from the body it is orbiting.

Periapsis — The point at which an orbiting object is nearest to the body it is orbiting.

Aphelion — the point in the orbit of a planet, asteroid, or comet at which it is furthest from the Sun.

Perihelion — the point in the orbit of a planet, asteroid, or comet at which it is nearest to the sun.

Perigee — the point in the orbit of the moon or a satellite at which it is nearest to the Earth.

Apogee — the point in the orbit of the moon or a satellite at which it is farthest from the Earth.

Station keeping — keeping a spacecraft at a fixed distance from another spacecraft or celestial body, usually through a series of thruster burns.

Orbital eccentricity — a measure of the amount an elliptical orbit deviates from a circle.

Perturbation — a disturbance of the regular and usually elliptical course of motion of a celestial body that is produced by some force additional to that which causes its regular motion, such as solar radiation pressure, gravitational forces or atmospheric drag.

Lagrange point — positions in space where the gravitational forces of a two-body system like the Sun and Earth produce enhanced regions of attraction and repulsion. These can be used by spacecraft as “parking spots” in space to remain in a fixed position with minimal fuel consumption.

Kepler’s Laws of Planetary Motion — describes the orbits of planets around the Sun.

THE WORK OF THE 18TH SPACE DEFENSE SQUADRON



Lt. Col. Tyler Eske, 18th Space Defense Squadron (fka 18th Space Control Squadron) director of operations, provides space operators from German Space Situational Awareness Centre a tour of the 18 SDS operations floor. The GSSAC is a civil-military facility that provides space situational awareness for the German government. It uses national and commercial capabilities to create a situational view of space.



Cpl. Mitchell Astbury and Sgt. Michael Fuller, 18th Space Defense Squadron space operators on exchange from the Royal Air Force and Canadian NORAD Space Detachment respectively, monitor orbital data on the Space Defense Operations Center weapons system on the 18 SDS operations floor. SPADOC was established at Cheyenne Mountain, Colorado, to command and control the space surveillance network. SPADOC was later renamed the Space Control Center. A decade later, the Air Force developed CAVENet to augment SPADOC, allowing for higher accuracy collision analysis and threat assessments.



SpC. 3 Damaje Benjamin, 18th Space Defense Squadron orbital analyst, discusses orbital mechanics with along with Cpl. Mitchell Astbury, 18 SDS space operator on exchange from the Royal Air Force. 18 SDS has exchange officers with the United Kingdom to promote partnership, information exchange, and interoperability in Space Domain Awareness.



Capt. Kim Garcia, 18th Space Defense Squadron operations flight commander, monitors orbital data on the Astrodynamics Support Workstation data on the 18 SDS operations floor. The ASW was first adopted as an operational system in 1998 and currently maintains the Special Perturbations Catalog used for launch detection and tracking, conjunction assessment and collision avoidance, human spaceflight support, maneuver detection, breakup identification, and reentry assessment.



Cpl. Mitchell Astbury, 18th Space Defense Squadron space operator on exchange from the Royal Air Force, discusses satellite positional data with SP2 Damaje Benjamin, 18 SDS orbital analyst, on the 18 SDS operations floor. 18 SDS processes space surveillance network data to monitor all activity to, in, and from space, and maintains custody of all resident space objects to provide and advance a continuous, comprehensive, and combat-relevant understanding of the space situation.

DISPATCHES

IARPA launches micro space debris tracking program

[The Intelligence Advanced Research Projects Activity \(IARPA\)](#) – the advanced research and development arm of the [Office of the Director of National Intelligence](#) – has launched a program that aims to revolutionize the nation's ability to detect, track, and characterize miniature, orbital, space debris.

The [Space Debris Identification and Tracking \(SINTRA\)](#) program represents the Intelligence Community's first effort to track small space debris. Resulting technologies hold the potential to protect manned spacecraft and other valuable space assets from these compact threats, which are difficult to detect and track and can cause significant damage,

making space missions safer for all countries and industries using Earth's orbit.

SINTRA aims to create innovations that...

- Bridge gaps in current space debris-monitoring systems, which currently only track and monitor debris greater than 10 cm in size or model the distribution of debris less than 1 mm in size

- Enhance small debris-tracking capabilities with existing sensors, such as ground-based radar, tracking satellites, and optical sensors.

Through a competitive Broad Agency Announcement, IARPA

awarded SINTRA research contracts to four, prime contractors, which together with sub-contractors, bring a group of 12 academic and private-sector organizations into the program. The SINTRA program is anticipated to be a four-year effort.

"The global economy, telecommunications, and security rely on constant satellite connectivity. Discovering new ways to understand the millions of man-made debris objects orbiting the earth, especially since they are ever-increasing in number, has never been more critical to everyday life." –

Dr. Alexis Truitt,
Program Manager, SINTRA



Celebrate the Future of the Space & Satellite Industry with SSPI

Meet and network with the future of the industry this fall in Silicon Valley

October 18 in Mountain View

Learn More at www.satfuture.com

MILSATCOM INNOVATION FOR COMMS-ON-THE-MOVE



Author: Tim Hillner, Chief Technology Officer +
Co-Founder, Fairwinds Technologies

Supporting Communications-on-the-Move (COTM) is an intricate and crucial process, but when attempting to maintain communications while mounted in an armored vehicle, the challenges multiply.

Using GEO satellites requires a larger antenna. This presents difficulties in mechanically maintaining the antenna's pointing toward the satellite without interfering with neighboring satellites, all the while simultaneously experiencing enhanced, vehicle dynamics.

In COTM situations, there is a typical misconception that large bumps or hilly terrain present the biggest hardships for a satellite antenna. In actuality, the most challenging condition for the antenna is what is known as a washboard effect. This effect is a larger version of the rumble strips you might encounter on the sides of highways today. Encountering such terrain is disruptive to large antenna performance.

However, terrain is not the only challenge to large vehicle-mounted antennas. Weapons and other equipment on the vehicle all have the potential to block significant portions of the antenna's view of the sky. The reverse is also true — with limited space, a large antenna has the potential to interfere with the weapons systems, giving the soldier a larger chance of unintentionally taking out their antenna — and their communications.

With limited space and power inherent in a COTM situation, a vehicle must be able to deploy its weapons without sacrificing the ability to maintain communications. Neither the antenna nor the weapons systems should interfere with each other to avoid jeopardizing the crew and the mission.

In 2013, researchers from the U.S. Army sought suggestions from industry around an open-standard system that would enable them to purchase distributed aperture SATCOM antennas, specifically for vehicles in COTM situations. The initiative was called **DESSTA**. (*Distributed and Embedded Standard SATCOM On-The-Move Terminal Architecture*). Ultimately, DESSTA failed because of the significant *size, weight and power (SWaP)* constraints encountered with vehicle integration.

Since 2013, digital signal processing and integrated RF circuit technologies, together with the advent of 5G cellular, millimeter wave and LEO SATCOM antennas have advanced to the point where these constraints can now be solved.

One approach to solving these challenges is to use split array technology to distribute antennas around the vehicle to optimize a COTM situation. This solution allows both the weapons and communications systems to operate independently and effectively without blocking the view of the sky or the enemy, all while providing a significant increase in integration flexibility.

By using distributed antenna panels around the vehicle, the antennas coordinate digitally and do not require the same, signal timing references. Also — no longer is there the risk of weapons and comms systems interfering with one another.

Furthermore, the panels can be disguised as armor to blend in with the rest of the vehicle's armor plates. By moving to a phased array-based system from a dish-based GEO system, support for LEO/MEO/GEO satellite communications is enabled. Finally, using multiple antennas inherently provides resiliency from local interference.

Fairwinds Technologies has developed [Global Link](#) to be used as an **RF Signal Processing System** that enables the routing and management of multiple antennas/beams and modems in addition to providing the ability to distribute antennas around a platform and function as a single terminal. By incorporating distributed panels with Global Link, each of the antennas can operate either as separate antennas or as one combined antenna.

The most challenging aspect encountered when communicating with satellites is reception — the only way to truly increase this capability is through a larger, signal collector. By combining separate, smaller, distributed antennas, a larger collector can be enabled without a single, larger integration challenging footprint.

Significant integration flexibility is enabled by distributing small antennas around the vehicle and away from the weapons systems. From a cost standpoint, four small terminals are far more cost-effective than a single terminal.

Embedded in Global Link are multiple patents pending that are considered key enabling technology as they empower multiple capabilities. This system digitizes and provides **Mil-Std 188-164C** compliant equalization on up to 800 MHz. of spectrum on each of the terminals that are connected, and routes and switches between modems and antennas to enable multiple, simultaneous satellite communications links. This system essentially provides any connected satellite waveform on any antenna beam or antenna.

This digitization of spectrum could also be leveraged by signal intelligence processing systems that effectively turn any connected antenna or terminals into instant RF sensors. Additional Global Link innovations could be integrated into other products to enable *Distributed Antennas, Digital Beamforming Antennas, Analog/Digital Hybrid Phased Arrays, Scalable Modular Antenna systems, Digital Signal Optimization/Enhancement, diversity receive systems (both cellular and MiMO based) Software Defined Waveforms, Signal Routing and Switching, Wideband channel equalization (1+ GHz), Interference Cancellation, and Signal Intelligence Systems.*

Global Link is satellite modem and antenna vendor technology agnostic, enabling the use of the terminal with existing and future terminals without having to rip and replace any existing modems. Also provided is a significant, future-proofing capability, as it is possible to easily add new modems and terminals as they become available, without having to reintegrate the RF cabling within the mobile platform.

Fairwinds is also developing multiple modem APIs that add the capability to monitor, control, and manage modems that are connected to the Global Link.

Currently, Fairwinds already has multiple software API's available for the [Comtech DMD-50](#), [DMD-2050e](#) and [CDM-760](#) modems. This capability is enabled through SNMP interfaces. Fairwinds is currently in development of additional APIs for **iDirect** modems and is open to considering additional modem support as requested.

While COTM has always been a challenge for the military, innovations such as digital signal processing and integrated RF circuit technologies, as well as 5G cellular millimeter wave and LEO SATCOM antenna, are improving the situation. The new technologies enhance operations on the move by securing communications, the warfighter and the mission.



Fairwinds Technologies GlobalLink.

www.fairwinds-tech.com/products/global-link/



Tim Hillner is the Chief Technology Officer and Co-Founder at Fairwinds Technologies where he leads all the strategic technical aspects of the business including new product development, innovative research & development, and pre-sales engineering. Prior to Fairwinds Technologies, he was a C4ISR solutions architect and DoD account manager at Comtech Command & Control Technologies. He also worked at the Army as a Team Lead – Senior Engineer managing multiple tactical wireless telecommunication solutions. He is a graduate of Messiah University and holds a Master of Electrical Engineering, Wireless Communications from Stevens Institute of Technology.



Tim Hillner

NEXGEN MILSATCOM

Exploring emerging trends +
innovations in SDRs

Author: Brandon Malatest, Chief Operations Officer and
Co-Founder, Per Vices

Military Satellite Communications (MILSATCOM) plays a critical role in ensuring secure and reliable communication for defense operations. With the advancement of technology, Software-Defined Radios (SDRs) have emerged as a revolutionary solution in the field of MILSATCOM.

SDRs are versatile devices that use software algorithms to perform a wide range of communication functions traditionally carried out by dedicated hardware. In the context of MILSATCOM, SDRs provide increased flexibility, adaptability, and efficiency compared to traditional radio systems. They enable dynamic reconfiguration, improved spectrum utilization, and simplified upgrades, making them indispensable in military communication systems.

In the dynamic landscape of MILSATCOM, SDRs have emerged as game-changers, bringing unprecedented capabilities and transforming the way military operations are conducted. Two key advancements in SDR technology, namely high bandwidth and high channel count, have garnered significant attention due to their potential to revolutionize MILSATCOM. These innovations offer a new era of possibilities, providing military personnel with enhanced communication capabilities, rapid data transmission speeds, and improved coordination across diverse units.

High Bandwidth SDRs revolutionize data transmission and reception, significantly reducing timeframes for handling large data volumes. Through their use of advanced modulation schemes, wider frequency ranges, and efficient signal processing techniques, these high bandwidth SDRs achieve accelerated data rates, proving invaluable in MILSATCOM scenarios. Their implementation facilitates the rapid dissemination of critical information, empowering military personnel with real-time intelligence and bolstering situational awareness.

Furthermore, high bandwidth SDRs play a pivotal role in optimizing command and control capabilities, facilitating prompt decision-making processes.

A prime example of their effectiveness can be witnessed in tactical military vehicles, where high bandwidth SDRs enable real-time video streaming, data-intensive applications, and high-speed file transfers.

This deployment equips military personnel with vital information, enabling them to make well-informed decisions swiftly. High bandwidth SDRs provide a powerful advantage in various military applications, bringing efficiency and speed to data communication and ultimately enhancing operational effectiveness.

High Channel Count SDRs prove indispensable in addressing the intricate communication demands of the MILSATCOM landscape. Their ability to handle multiple communication channels simultaneously becomes a vital requirement, given the diverse purposes encompassing voice communication, data transmission, and video conferencing. By efficiently managing numerous channels at once, high channel count SDRs effectively streamline communication operations enabling seamless coordination across various military units.

The true power of high channel count SDRs comes to the forefront in military command centers, where they establish secure, real-time communication channels with multiple units on the ground, in the air, and at sea. This enhanced communication capability fosters synchronized actions, coordinated responses, and improved interoperability between different military branches, ultimately amplifying the overall effectiveness of joint operations.

SDRs optimize spectrum use by dynamically adapting to changing communication requirements and frequency bands. This flexibility is crucial in MILSATCOM, where frequency bands may be subject to interference or regulation. SDRs enable efficient use of available spectrum resources, minimizing signal degradation and enhancing overall communication reliability. Furthermore, the ability to reconfigure SDRs remotely allows for swift adaptation to evolving mission needs and changing operational environments.

While high bandwidth and high channel count SDRs offer immense benefits, their implementation in MILSATCOM is not without challenges. Technological limitations, hardware requirements, and cost considerations, must be addressed to ensure successful integration and

deployment of these advanced systems. Furthermore, interoperability with existing communication infrastructure and compatibility with legacy systems may pose additional challenges.

Luckily, high performance SDRs, such as **Per Vices Cyan SDR**, are specifically designed to address and mitigate the challenges associated with implementing high bandwidth and high channel count SDRs in MILSATCOM scenarios.



These advanced systems leverage cutting-edge technologies and innovative solutions to overcome the challenges observed when utilizing lower performance SDRs. This is accomplished through the following:

Technological Limitations

High performance SDRs are engineered with state-of-the-art hardware and signal processing capabilities, pushing the boundaries of what is technically achievable. They incorporate the latest modulation schemes and frequency range adaptability to optimize data rates and overcome bandwidth limitations. By harnessing the power of advanced hardware components, these SDRs can efficiently handle complex communication tasks, ensuring seamless transmission and reception of data across multiple channels.

Hardware Requirements

To address concerns about hardware requirements and compatibility, high performance SDRs are designed with flexibility in mind. These systems offer modular architectures, allowing for customizable configurations that can adapt to different MILSATCOM needs and integrate with existing infrastructure. This modular approach ensures cost-effectiveness by enabling users to upgrade specific components instead of replacing entire systems when technological advancements occur.

Cost Considerations

Many vendors may offer different product lines to specifically strike a balance between cutting-edge technology and cost-effectiveness. By optimizing the use of hardware and adopting efficient signal processing techniques, these

SDRs are designed to offer best performance in different classes along with the best value for each class. As a result, the overall cost of ownership and deployment is reduced, making them more accessible to military organizations with budget constraints.

Interoperability and Legacy Systems

To address interoperability challenges with existing communication infrastructure and compatibility with legacy systems, high performance SDRs support a wide range of communication protocols and standards. They are designed to seamlessly integrate into diverse communication networks, bridging the gap between legacy systems and modern technologies. Additionally, high performance SDRs offer backward compatibility to ensure smooth migration and coexistence with older equipment.

As the next generation of MILSATCOM unfolds, the significance of high bandwidth and high channel count SDRs cannot be overstated. These innovations empower military organizations with enhanced communication capabilities, faster data transmission speeds, increased capacity for simultaneous channels, and improved spectrum efficiency.

By embracing these emerging trends, defense forces can leverage the power of SDR technology to strengthen their communication infrastructure, optimize operational efficiency, and achieve mission success in the ever-evolving landscape of modern warfare. While challenges exist, high performance SDRs can offer an excellent solution for the current and future needs of MILSATCOM and aim to revolutionize military communications.

www.pervices.com



Author Brandon Malatest is the COO and co-founder of Per Vices Corporation, a leader in Software Defined Radio technology. Brandon has an honour's degree in Physics with a specialization in Experimental Physics from the University of Waterloo in Ontario, Canada. On graduating, Brandon started his career as a research analyst and statistician at one of the largest market research firms in Canada and later joined Victor Wollesen to co-found Per Vices. Since starting Per Vices, Brandon has authored many thought leadership articles based on software defined radio (SDR) technology.



Brandon Malatest

A QUICK BRIEFING WITH EMILIA DOBEK, GISS, + ANDREW BOND, ETL SYSTEMS

Fueling Innovation

Owing to the evolution of warfare, governments cannot stand still when it comes to deploying new technology to help maintain strategic advantage.

From improving intelligence gathering to helping the personnel on the ground remain connected — even when operating in the most hostile of environments, satellites play an essential role. **Emilia Dobek**, R&D Manager at [GISS](#), and **Andrew Bond**, Sales and Marketing Director at [ETL Systems](#), offered their thoughts regarding their work together on a recent, innovative project for the military.

How is the MILCOM landscape changing?

Andrew Bond

“While continuous development has always been important, the ongoing war in Ukraine and escalating geo-political tensions are making it even more important for governments around the world to be on high alert. Similarly, the growth of IoT enabled devices has created an opportunity for those who seek to do harm. With access to the network, they can gather highly sensitive information regarding the location of personnel, military bases or battle tactics. It’s not difficult to imagine the damage that could be done, should location data or information of this nature get into the hands of hostile forces. It’s paramount that anything touching the network — including the IoT-enabled devices worn by soldiers — is secure.”

How important is product reliability on the battlefield for warfighters?

Emilia Dobek

“Critically important — if products fail during warfighter interaction with hostile actors, missions fail and lives are lost. After gaining broad experience in developing communication and navigation solutions for airports and militaries, [Global Infrastructure and Security Solutions \(GISS\)](#) decided to expand this offering in 2016 to encompass SATCOM. As an established player in the market, we sought to upgrade the reliability and connectivity capabilities of the SatPack L-band manpack terminal that was initially designed for the Polish MOD.

“GISS commissioned ETL Systems in 2022 to custom design and manufacture a set of semi-rigid RF cables that would fit inside the terminal. GISS identified the need for this upgrade, but it was ETL’s technical expertise that ensured that the assembly was designed according to

GISS’ needs, allowing them to optimize and customize the terminal. Having worked with ETL on a number of different projects in the past, including custom L-band splitters and combiners for a Defence application, we knew that ETL’s capabilities aligned with their needs and — more importantly — the needs of customers.”

What was the outcome of the project?

Andrew Bond

“Working in partnership, ETL and GISS developed a more lightweight and compact design, and that was imperative as the specification for this terminal was specifically for a manpack unit. The [SatPack L-band](#) manpack weighs only 19 kg. and is ready to work in less than 10 minutes, allowing personnel working in remote regions to connect and communicate efficiently and securely. The modular design allows the terminal to be used as a complete VSAT system and as an RF—L-band interface for a modem of the customer’s choice.”

Emilia Dobek

“Boasting enhanced connectivity capabilities, the entire SatPack family can transmit up to 31 GHz. and receive up to 22.20 GHz.

on multiple frequencies, including X-, Ku- and Ka-band. An intuitive antenna pointing support has been developed that, when using a 100 cm. antenna, allows users to use a Tx signal of up to 47.5 d.Bi, meaning the terminal can reach defence personnel working in remote areas.”



Photo of the SatPack L-band manpack.

SatNews

CONNECTIONS ON EARTH FOR CONNECTIONS IN SPACE

**JOIN US
ONLINE!**
Free subscriptions and access
Timely news and editorials
Complete archives
satnews.com/reg



SatMagazine | MilsatMagazine | SatNews.com

GROUND TACTICAL RADIOS

Spreading the word

Author: Aniket Roy, Senior Business Analyst, Stratview Research

Have you ever heard of the Battle of Marathon that occurred between Greece and Persia in 490 BC? The conflict where a messenger named Pheidippides had to run ~26 miles, to deliver the news of victory to the city of Athens?

Then there's *World War I* (WW-I)— the global conflict during which soldiers had to carry radios weighing anywhere between 18 to 25 kilograms on their backs, in order to maintain a communication link with the base station or other units.

From the era of having to run on foot, for delivering messages, to a time when soldiers can securely communicate over several miles in a matter of seconds using a hand-held device, military communication devices have seen a fair share of development and the era of smoke signals, semaphores, and so on in military communication has finally been brought to close, thanks to by tactical radios.

The use of tactical radios in the military has a history that dates back to as early as WW-I and, although the operating principles have remained consistent, tactical radios have themselves become much far more advanced since their initial days of use. From spark transmitters (used during WW-I) that required horses for transportation to the battlefield, to hand-held devices that barely weigh half a kilogram, tactical radios have penetrated all three horizons of warfare, those being ground, marine, and airborne.

Though equally important in land, marine and airborne operations, the demand generated for tactical radios is higher from the ground forces as compared to the other two environments and that can be attributed to the following factors.

First, for every major military power save for the United States, the number of armed personnel in the Army is several orders higher than that of the Navy and the Airforce. Secondly, in times present and the past, land forces have had to engage in war-like events more frequently than the other two fronts.

The difference in demand can also be better understood by looking at some numbers from a report on [*ground tactical radios market*](#), published by [*Stratview Research*](#), that states more than 65% of the demand

for tactical radios in terms of volume is derived from ground-based platforms.

Another reason why numbers are higher for ground-based platforms is due to ground tactical radios also possessing fixed communication systems that are installed at different base stations on land, as opposed to airborne and naval applications where the systems must either be deployed in a vessel or an aircraft.

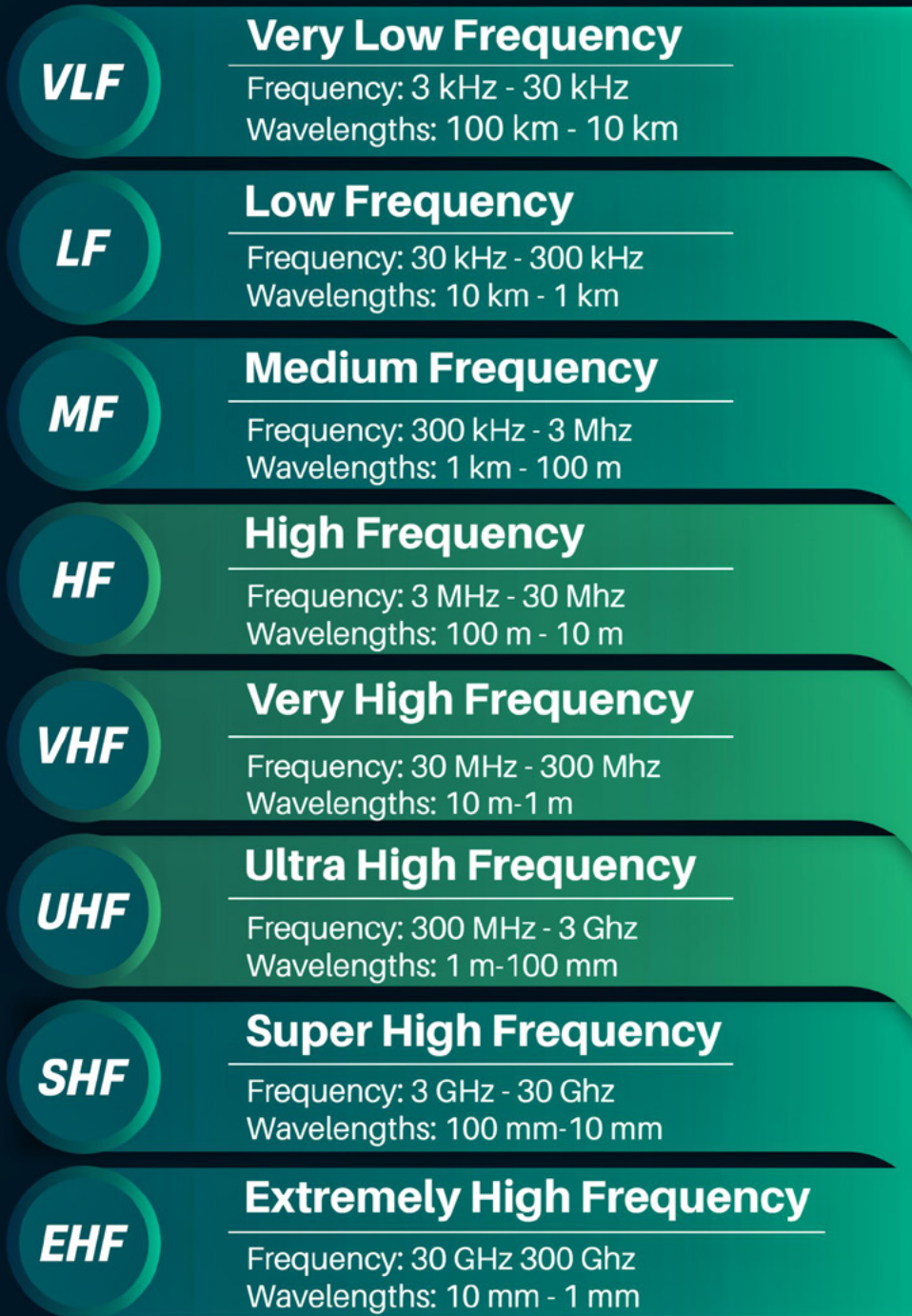
The Frequency Palette For Tactical Radio

Despite the differences in operational requirements, the preferred band for all three tactical radio platforms is the VHF/UHF band. As known already, the radio spectrum ranges from as low as - .003.MHz. (*Very Low Frequency — VLF*) to as high as - 300,000 MHz. (*Extra High Frequency — EHF*), and is segmented into several different frequency bands.

Directly in the middle of this spectrum are the high frequency (*HF -3 - 30 MHz.*), very high frequency (*VHF - 30 - 300 MHz.*), and ultra-high frequency (*UHF - 300 - 3,000 MHz.*) bands, which are also the three most

Radio Frequency Bands

Radio Frequency Spectrum



Ground
Tactical
Radios

Figure 1. Radio spectrum and preferred bands for tactical radios.

common bands used in tactical radios. Each of the suitable bands for tactical radio communication has its own perks. HF radios, for example, are vital for base station comms with each other over vast distances in the hundreds to 1,000s of kilometers.

Despite the ability to operate over the longest distance among the suitable bands, the HF band is not the preferred choice for ground-based tactical radio operations because of a number of reasons.

As ground-to-ground tactical operations are usually limited to a handful of closely, situated units, *Line-Of-Sight (LOS)* communication is considered more reliable. Even for longer-range applications, such as ground-to-air communication, HF waves are not the preferred solution as they are more susceptible to atmospheric absorption. The VHF/UHF band on the other hand, though considered ideal for short-to-medium range operations, prevails because of the ability to operate in LOS. Additionally, the shorter wavelengths also make them less vulnerable to induced interference and jamming, especially when combined with *Frequency-Hopping Spread Spectrum (FHSS)* methods.

With the aim of providing armed personnel with the most reliable and secure equipment, leading defense contractors are currently focused on the following areas:

Software Defined Radios(SDRs)

To make tactical radios even more flexible and adaptable to changing mission requirements, the military has been implementing software to process various modulations, demodulation, and decoding, etc. for several decades in the form of 'Software-Defined Radios' SDRs. As a result, SDRs have now become commonly used, unlike previously, owing to their high-performance, low-cost hardware and software, reduced size, increased bandwidth, and much more. Leading economies such as the U.S. are aware of such innovations and have been investing heavily in maintaining an up-to-date arsenal. For instance, the U.S. Army awarded an indefinite delivery (indefinite quantity) for the new Combat Net Radio (CNR) to L3 Harris Technologies in 2022 to modernize and secure the army's network.

Integrated Tactical Networks (ITN)

The transmission of data and communications for hostile missions will see a step-change with the introduction of Integrated Tactical Networks (ITN). The function of ITNs is to incorporate the current tactical network environment with Commercial-Off-The-Shelf (COTS) components and transport capabilities, which will then provide numerous vital benefits to military forces, including improved situational awareness, decision-making, and survivability.

Among the early adopters of this technology is the U.S. Army. That organization is building an ITN by starting to integrate an existing enterprise network with other networks (tactical) to create a unified network. The network is expected to be operational by 2025.

Size, weight, and power(SWaP) modifications The ongoing need for reduced SWaP is driving the development of innovative tactical radios for use the battlefield. These radios demand increased functionality in smaller packages, even in body-worn equipment, on-field IoT sensors, or wireless sensors on unmanned aerial or ground vehicles.

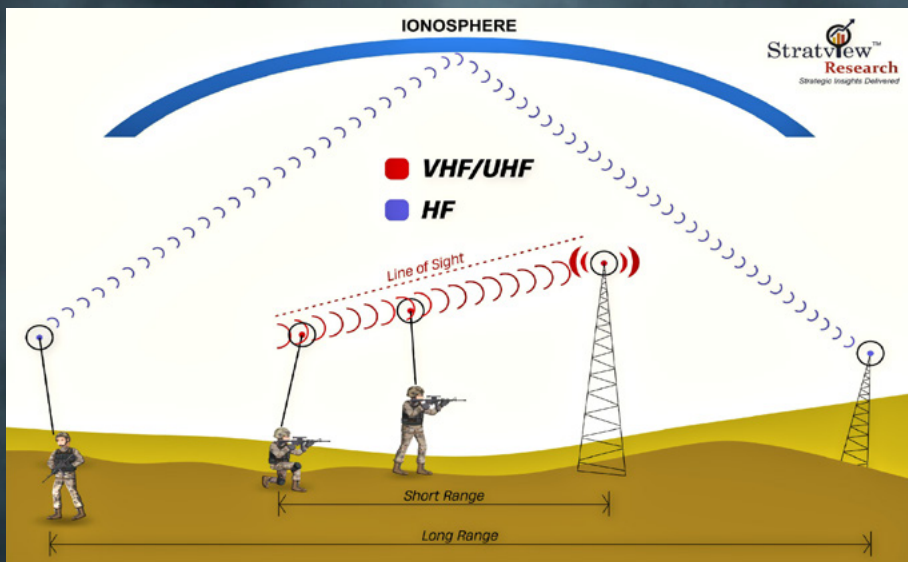


Figure 2. VHF/UHF and HF operations.

The prevalence of the VHF/UHF bands is extremely broad among tactical radio systems — more than 70% of the tactical radio equipment are designed to operate in this band.

There are however, a few downsides to selecting VHF/UHF waves and one of the most problematic of them is reduced battery performance. The higher the frequency, the more intense the energy usage, and this implies that VHF/UHF devices are prone to shorter battery life when compared to HF devices.

Propagating Toward Improved Capabilities

Innovations and R&D in the field of defense are ceaseless. This is especially true when discussing equipment as crucial as tactical radios, which are responsible for, more or less, the overall communication on a battlefield. The price for outdated technology use by warfighters might be as disastrous as a lost mission or battle.

One recent example of such equipment is the L3 Harris AN/PRC-158 radio, a unit that is compact, powerful, and modular and covers the full 30-2500 MHz. frequency range and is 30% smaller than similar products, according to the company.

Other disruptions

Moving quickly requires trust and moving forward with technology requires disruption. Additionally, disruptive technologies such as Artificial Intelligence (AI), Digital Twins, and so on, are shaping the future of defense systems. Governments are adapting these technologies to develop AI-powered radios and digital twins of radio systems. Giant firms such as L3Harris, Thales and others are already developing AI and digital-twin-technology integrated radios. 5G technology is another disruption. Though the applications of 5G in the military are not well defined as of this writing, the advent of 5G technology certainly opens many new doors.

Note that in terms of both military expenditures, as well as the pace of adapting new and advanced technologies, the U.S. is far ahead of all other countries. The gap is so huge that for the year 2022, the U.S. military expenditure (\$877 billion) alone, is more than the expenditure of the next, top nine countries combined.

The presence of leading tactical radio manufacturers such as L3 Harris Technologies and Collins Aerospace also reduce the U.S. on other countries for technology or product. In the area of defense, the U.S. has already launched several initiatives to modernize radio systems via the *Special Operations Forces (SOF) Tactical Communications* initiative and the *C3 (Command, Control, and Communications) Modernization Strategy* by the *Department of Defense (DoD)*.

Reports also suggest that the U.S. DoD is likely to purchase more than 100,000, two-channel, leader radios and 65,000 HMS Manpack radios, worth approximately \$16 billion during the coming decade and that the U.S. currently owns >40% of the ground, tactical radios market.

What Do The Signals Suggest For The Future?

Ever since Russia's invasion of Ukraine, many countries are now on high alert. The possibility of war has forced nation's hands into increasing their annual defense expenditures and, as a result, in 2022, global military expenditures saw an all-time high of \$2.2 trillion for product acquisition.

Communication equipment, such as tactical radios that are at the core of any country's military capabilities, are bound to witness uninterrupted growth in the coming years as the nations of the world enhance their military capabilities.

SDRs and disruptive technologies such as 5G will unlock advancements in the field. In a time when armed forces across the world are focusing as much on electronic warfare techniques as they are on conventional warfare methods, one of the next significant challenges for defense manufacturers will be the development of *Electronic Counter Measure (ECM)* immune communication systems.

The journey of ensuring proper connectivity for the armed forces on the modern battlefield will be a most interesting one to observe. **Over and out!**

www.stratviewresearch.com



Author Aniket Roy is the Senior Business Analyst for Stratview Research

Stratview Research is a global market intelligence firm offering a wide range of services including syndicated market reports, consulting, sourcing intelligence, and customer research. The company has a strong, experienced team of industry veterans and research analysts that possess a perfect blend of wisdom, knowledge and positive attitude. StratView Research has been serving multiple clients across a wide array of industries. The firm's services cover a broad spectrum of industries that include Defense, Aerospace, Advanced Materials, Energy Chemicals and the Automotive industry. Research services at the global, regional as well as country level are offered as well as key regions that include Europe, APAC, NA, MEA, ROW. The company is a trusted brand in the research industry with the capability of commissioning complex projects within a short span of time with high level of accuracy. At Stratview, building long term relations with our clients is the key to success.