

SATCOM for Net-Centric Warfare

MilsatMagazine

2020 Year in Review – Flight 1

December 2020



The SpaceX Falcon 9 launch of the USSF's GPS III SV04 satellite from Cape Canaveral, Florida. Photo is courtesy of SpaceX.



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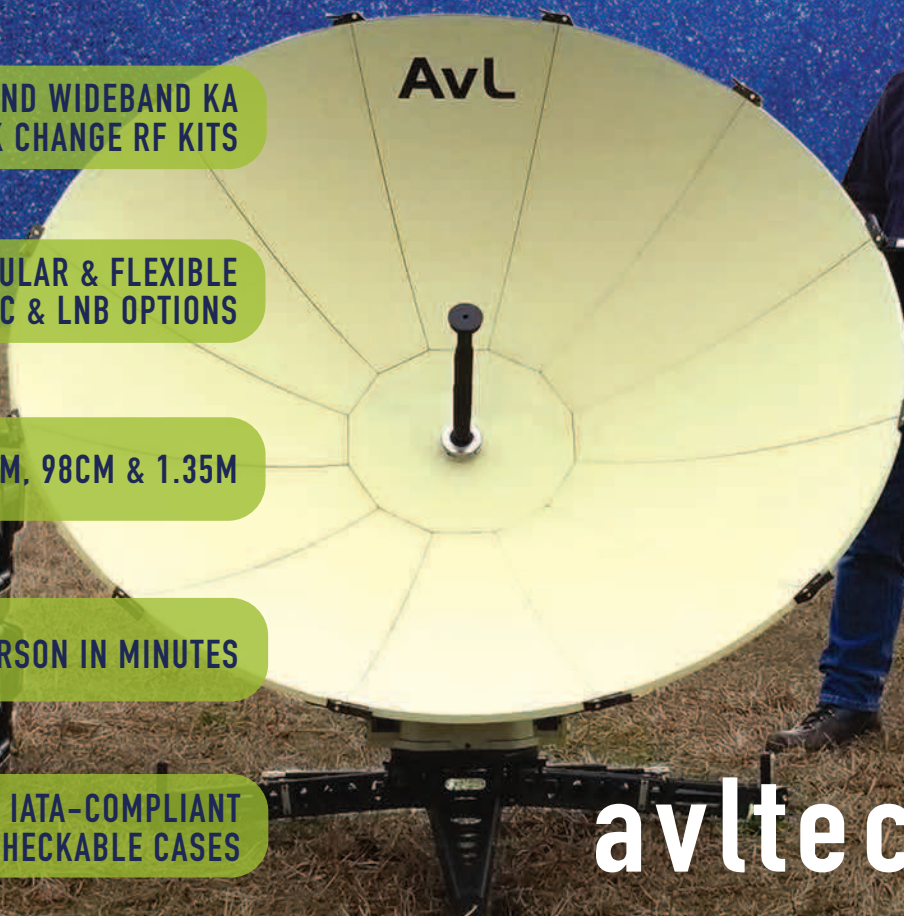
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SCINET SOFTWARE APPLICATION SPEEDS SECURITY ACCESS FOR SPACE PROFESSIONALS AND BEYOND



SMC PARTNERSHIP FUELS INNOVATION

Working on government and military projects often requires obtaining additional security access to handle Sensitive Compartmented Information (SCI) – sensitive information unique to a particular defense project that can take an average of

six months to get through the nomination and arduous manual paper approval process.

A new software application, the SCI Nomination Evaluation Tool, or **SCINET** (pronounced “skynet”) is set to streamline the process, reducing processing time by as much as 80 percent, and potentially saving the Space and Missile Systems Center (SMC) alone as much as \$600 million per year in lost labor expenses. The application also has the potential to be scaled and customized for use at other U.S. Air and Space Force installations – and potentially used across the DoD.

SCINET has been funded, championed and facilitated by the business innovation office within SMC’s *Atlas Corps*. The group, *AtlasX*, works with individuals and teams to increase fluency in analytics, Agile methods, and entrepreneurship at the Center. Its mission is to modernize and transform how SMC conducts business in line with the organization’s vision, “to forge an agile team that delivers innovative, war-winning capabilities.” *AtlasX* has successfully gained advocacy, awareness, and partnerships for SCINET, making it one of the group’s most intriguing projects to date.

SCINET is one of SMC’s fastest software developments to date due to the *Agile DevSecOps* pipeline approach — which implements security decisions and actions at the same scale and speed as development and operations decisions and actions — and a strategic

partnership with the U.S. Department of Defense’s software factory, Platform One.

Joy White, Executive Director of SMC, said, “The SCINET team sought to solve a problem not only suffered here at SMC, but throughout all forces. We supported the team to acquire funding and align with strategic partners. The DoD’s software factory provided a much needed Continuous Authority to Operate that alleviated some of the most critical delay points related to software development.”



Joy White

The *Special Security Office* (SSO) is the function within the United States federal government that oversees administration of the SCI control system. Security responsibilities for use and dissemination of SCI are accomplished through the integrated disciplines of Personnel Security, Information Security, Physical Security, Industrial Security, and Cyber or Information Systems Security.

The nomination process for personnel to receive required access has many moving parts within each of those disciplines, many of which are beyond the SSO span of control, which contributes to the extensive processing timeline. The demand for access is increasing at an average of 8.5 percent per year, and a tool that integrates the moving parts with



full transparency in order to maintain the integrity of the SCI control system is “just what we need and long overdue,” said **Amanda Pulsipher**, Chief, Special Security Office of the Intelligence Directorate at SMC. “Rework, routing errors and an overall lack of transparency with our paper

Amanda Pulsipher systems are just some of the inefficiencies plaguing our current access process,” Pulsipher said. “SCINET will integrate all the moving parts and give us efficiency and transparency throughout the process.”

SMC’s Captain **Dominic Vicino**, SCINET creator and program manager, experienced the backlog first-hand when he was first assigned to SMC in July of 2018, and had to wait four months for his access.

“I couldn’t do my classified work because I didn’t have access to SCI,” Vicino recalled. “I had a stake in it, because I wanted to get to work. What we needed was a force multiplier that could do the job, and the only solution was software.”



Capt. Dominic Vicino

Pulsipher was well aware of the needs and had already secured some initial funding to try to get a customizable tool to improve the process because the commercial off-the-shelf products did not meet SMC’s needs. Vicino and another officer, Captain **Manny Smith**, then secured additional funding from SMC leadership to further develop the project that ultimately became SCINET.



Screenshot of a sample SCINET dashboard.



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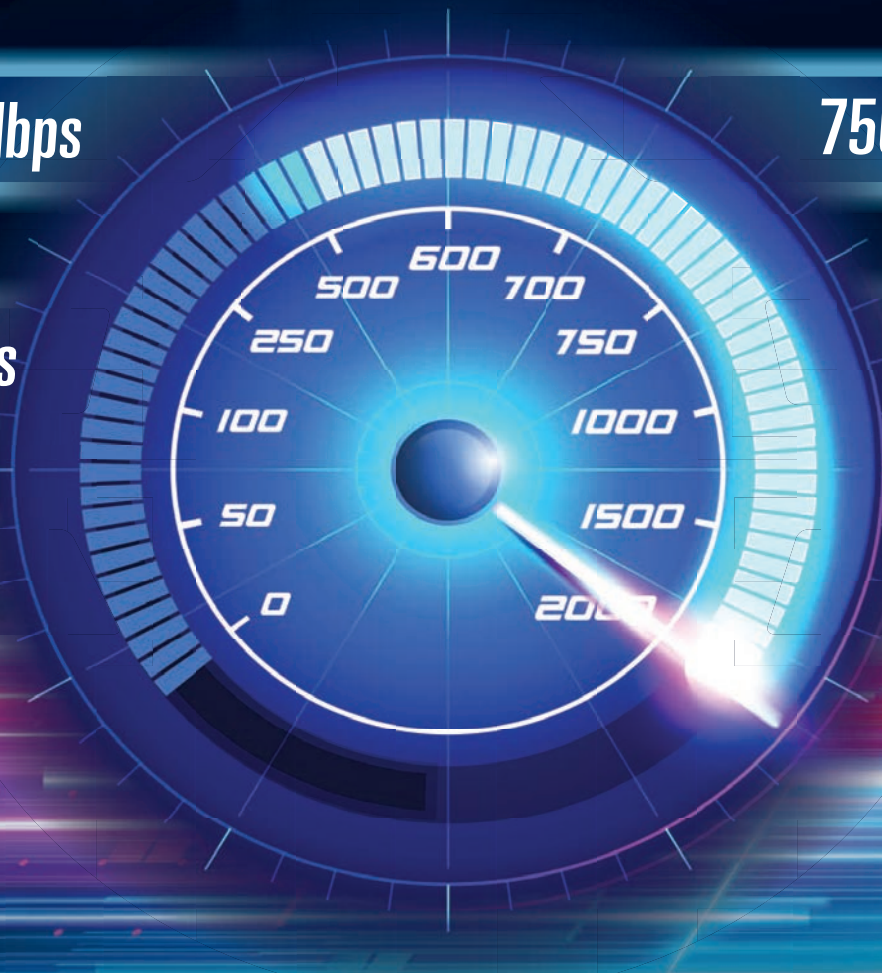
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SCINET launched for SMC in September 2020 as the first in a group of new applications. SCINET is the workflow tool that manages personnel nominations, indoctrinations, debriefs and personnel records and has been shown to decrease processing time from 180 days to 70 days and in Spring 2021, at full rollout, to a mere 60 days. Eventually, the processing time will be only 30 days.

Another application, the **DD254 Database**, which will be rolled out in the spring of 2021, consolidates contractual information and pushes information to SCINET for access validation. It also responds to data inquiries from other authorized systems. The third piece is the **Security Education, Training, and Awareness (SETA)** program, which meets mandated SCI-access training requirements at the lowest possible workload for the SSO.

Another key component is SMC's partnership with a small business, **Elder Tree**, of Norwalk, California, to develop the customized software platform that converts the traditional, paper-bound process into a digital, centralized portal with management dashboards.

This was the first DoD project for Elder Tree, which operated as a subcontractor of **ManTech** of Washington, D.C., for this project, said **Cade Peterson**, the COO of Elder Tree.

"We really enjoy the opportunity to solve problems," said Peterson, MBV (USAF, Ret.), "When we're uniformed service members, there's excellence in all we do — we want to make things better. Sometimes the vehicle for that isn't always through the organic DoD process; sometimes it requires a commercial solution and an outside perspective. Our methodology is to create an interactive solution that renders people compliant with whatever rules they need to follow. You have all of these complex programs and processes and if you can automate all of these functions for them, it's better for everybody. The owning agency can decide how it operates, and the user just operates it. You want to engineer the human error out of the process."



SCINET is designed to help officials track these applications and easily identify bottlenecks, issues and even future needs through predictive analysis, Peterson said. The web application can deliver the current status of any SCI submission, validate data coming into the system, reduce process error and ensure policy compliance.

"The goal here is to give absolute data transparency to enable the user to query all aspects of the process to find out what's going on," Peterson said.

SCINET is fully compliant with DoD SCI regulatory requirements and is customizable to unique processes that might be present at different installations. SCINET also allows senior leaders to prioritize which nominees should be cleared first, *Vicino* said.

The fact that the program name — SCINET — is similar to "Skynet," the name for the fictional, artificial, self-aware neural network that serves as the main villain in the "Terminator" movie franchise, was just a happy accident, *Vicino* said. The full name of the program — **Sensitive Compartmented Information Nomination Evaluation Tool** — made it an easy choice for a name, but also makes it memorable.

With the help of AtlasX, SCINET was recently entered into the annual **U.S. Air Force Spark Tank** innovation competition and is currently holding at third place in voting prior to the semi-finals. *Spark Tank* is patterned after the "Shark Tank" TV show and is designed to encourage airmen to be creative and expose their ideas for funding and to a wider audience.

If the concept wins, SMC will ask for \$10 million to scale the application to five USAF/USSF installations with full implementation in 1.5 years, at an estimated savings of up to \$3 billion over the next five years. Ultimately, SCINET is designed for scalability to be implemented across the USSF, the DoD and other military services, *Vicino* said

If the savings sound high, the average amount the government pays for these highly trained space subject matter experts — the "wrap" rate — which includes salary and overhead costs — can be \$450,000 a year, *Vicino* said. The longer these professionals wait for their SCI clearance, the more money lost when they can't work on the projects they were hired for.

"This is the kind of creative problem-solving our people at SMC are known for," said Ms. White. "The potential for this new application to save time and money and get our highly trained space professionals to work faster is a win for everyone."

The Space and Missile Systems Center is the U.S. Space Force's center of excellence for acquiring and developing military space systems. SMC's portfolio includes space launch, global positioning, military space vehicle communications, defense meteorological space vehicles, range systems, space vehicle control networks, space-based infrared systems and space situational awareness capabilities.



Spark Tank, a collaboration between AFWERX and Deputy Under Secretary of the Air Force, Management, is an annual campaign designed to spur and empower innovative ideas from Airmen to further strengthen Air Force culture and capabilities.
(U.S. Air Force courtesy photo)

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International Space Pitch Day Recruits New Technology Partners for the USSF, DoD from Other Nations

Ten companies were awarded same-day defense contracts at the first International Space Pitch Day, a joint U.S.-U.K. industry competition held 17 Nov. 2020 with the goal of finding, funding and fast-tracking innovation and technology for military space professionals.

Led by the U.S. Space and Missile Systems Center (SMC) and U.K. Defense and Security Accelerator, the U.K. Defense Science and Technology Laboratory Space Program, and on behalf of the U.K. Ministry and the U.S. Department of Defense, the competition was originally to have been held in London. It became a virtual conference due to the global pandemic, using the United Kingdom's Defense Conference as a backdrop.

One-hundred and fifteen start-up companies from 14 different countries made their public pitches, and 10 were offered same-day contracts of up to \$66,000 to cover a three-month period, said Captain Michael Telcide, Space Partnership Program Manager and lead officer in charge of International Space Pitch Day for SMC.

The 10 awardees, which included companies from the United States, the United Kingdom, Australia and India are: 114 AI Innovation Limited (India); Clearbox Systems Pty Ltd (Australia); Clutch Space Systems Ltd (U.K.); Cognitive Space, Inc. (U.S.); Precursor SPC (U.S.); Riskaware Limited and Telespazio Vega UK (U.K.); Rocket Communications (U.S.); Slingshot Aerospace (U.S.); Spire Global UK (U.K.); and Swim.ai, Inc. (U.S.).

"The first-ever International Space Pitch Day was a huge success," Telcide said. "I look forward to continue working with these companies to transition them into the Space Force architecture."

"I am so proud of the work our SMC team has done with our friends in the UK MoD to continue discovering new innovation and technology for the security of space," said Lieutenant General John F. Thompson, SMC Commander and Program Executive Officer for space. "By jointly acquiring innovative and technologically relevant space capabilities, we harness the strength of partnerships between the U.S. Space Force and our allies to rapidly deliver war winning capabilities that outpace threats."

International Space Pitch Day follows the first, successful, domestic Space Pitch Day held November 2019, in San Francisco, which resulted in 30 companies being awarded almost \$40 million in same-day contracts, said Van Espahbodi, CEO of Starburst, a global aerospace and defense accelerator based in El Segundo.

Starburst worked with SMC on the Space Pitch Day last year and the International Space Pitch Day this year, reaching out to its network to help recruit emerging tech companies, providing mentoring to help those companies improve their pitches and also inviting potential investors to participate, Telcide said.

"This is the first time we've ever made it possible for an American program to award a foreign startup a contract," Espahbodi said. "This event and everything leading up to it will culminate in a precedent: a new way of doing business to make sure our defense warfighter has access to the best technologies anywhere in the world."

Companies were invited to propose technology solutions in six challenge areas, Telcide said. Instead of a broad category, such as Artificial Intelligence (AI), the challenge areas focused on a specific problem statement. For example, "Understanding the present and potential impact of space weather on users across all domains," and "Visualization to help a commander in the field to understand satellite systems relevant to their operations."

The International Space Pitch Day contracts are "the discovery phase" that allow the companies to demonstrate their solution to the DoD with the possibility of future, multi-year contracts, Telcide said.

It's a myth that the DoD is only interested in working with large "prime" defense contractors, Telcide said. Pitch Days — of which SMC and the DoD are planning more, domestic as well as international — are an opportunity for even one- or two-person start-ups to connect with government and private investors to help them realize their ideas and grow.

"We give them a lifeline — some of these technologies, without funding, they might not make it," Telcide said. "Events like International Space Pitch Day gives them an opportunity to be discovered and get a contract while early in their journey, and it can be vital to some companies."

"Small businesses are not just disadvantaged R&D; they're on par with Facebook and Uber in the early days," Espahbodi said.

In addition, the DoD isn't solely looking for military use applications, Telcide said. Usually, the department is looking for dual-use technology so not only can a company get a defense contract, but the solutions are usually viable for the commercial sector. Working with the DoD may help those companies attract venture capital for their efforts. Academic institutions and private investors also were invited to hear the pitches, broadening the tech companies' exposure to potential funding.

"You don't need 'exquisite' technology to operate in space anymore and that levels the playing field for a whole new cast of characters," Espahbodi said. "It's important for these new players as well as the existing space innovators to get creative and prioritize ways of working together."

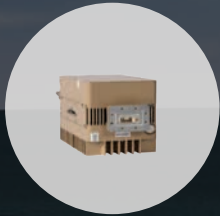
"I think it's important that the space defense acquisition process applies the right level of risk at the right level of engagement," Espahbodi said. "Program Executive Officers have to be able to do business with any foreign entity with same-day contracting and same-day awards. They don't have a choice: if they don't, they miss out. Most [innovative technology companies] can't be bothered with the time frame of doing business with defense. If the DoD wants access to the tech, they have to find ways to make it easier to do business with them."

Dr. William Roper, Assistant Secretary of the Air Force for Acquisition, Technology and Logistics, also stressed the importance of making it easier for technology companies to do business with the DoD during the 26 Oct. 2020 AFWERX "Ask Me Anything: Deep Tech & Skyshots" YouTube live video event. New government partnerships might help the Air and Space Force close the gaps between baby steps and giant leaps, Roper said.

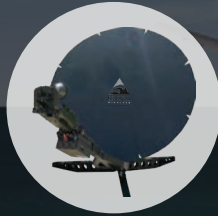
"Tech is global, opportunities are global and if companies around the world aren't working with us, they could easily be working with our competitors," Roper said. "So we need to take the innovation battlefield."



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COMMAND CENTER: FRANK BACKES

SENIOR VICE PRESIDENT, KRATOS SPACE FEDERAL



Frank Backes is the Senior Vice President for Kratos Space Federal. Mr. Backes also serves as the Founder and Chairman of the board of the Space ISAC. He received a BSEE in Semiconductor Physics from the University of California at San Diego.

It has been said that innovation is the new battlefield and moving at digital speed is critical to winning the next war. What has Kratos been up to in terms of innovation and how will it help the U.S. military?

Frank Backes (FB)

One of the innovative ways that Kratos is supporting the military's effort is with a new software-defined satellite ground platform called **OpenSpace™**. This platform is helping lead a digital technology revolution on the ground by allowing almost every piece of the ground station to be turned from hardware to software.

Virtualized software and software-defined networking capabilities are, in turn, giving the ground more power to react dynamically to changing conditions as the ground can be unified to service many U.S. Department of Defense (DoD) programs.

The space industry is undergoing tremendous innovation and is driving change with multi-band, multi-orbit efforts and software-defined payloads providing the military with unprecedented capabilities.

Why now? What has changed?

FB

There has been a technical paradigm shift from proprietary equipment on a bent-pipe satellite link to systems designed for flexibility, enabling users to seamlessly access the combination of multi-constellations and multi-orbit approaches throughout multiple applications and much more.

A shift is needed to new satellite ground architectures that can dynamically and intelligently adapt to continuous changes in demand, performance and threats much like existing terrestrial networks do.

As an example, Kratos' participation in several *Enterprise Management and Control (EM&C)* efforts demonstrated technology that synchronized access to multiple satellites and satellite networks operated by multiple service providers. Kratos and its partners proved control of multiple modem types and software versions were possible from a single terminal.

Connected to a dynamic ground network and informed by a *Situational Awareness Common Operating Picture (SA-COP)*, the system showed comprehensive mission-management ability that rapidly planned, optimized, apportioned, and monitored SATCOM services as well as detected, located, assessed and resolved SATCOM issues for users. EM&C provided the innovative ability for a SATCOM user to roam like a cell phone user.

Many of DoD's approximately 17,000 user terminals can be modified with EM&C capabilities to support an open, multi-vendor architecture to communicate with other terminals or SATCOM gateways.





Photo: Sgt. Dustin Biven.

How will this affect ground system operations and systems?

FB

Virtualization and advanced cloud-processing technologies will allow the ground system and space layer to become part of a broader software-defined network. Instead of lots of hardware manually configured over weeks, service chains can be dynamically configured and deployed in a moment's notice.

There is no longer a need to stitch components and subcomponents every time there's a special mission. As changes in warfighter demand, bandwidth supply and threat occur on the ground, the system dynamically responds. Operations are executed automatically in software with a service running in milliseconds or seconds instead of days, or weeks.

This sounds like new technology... is it?

FB

This is not new technology. It is leveraging how cloud-based providers and the telecom/wireless providers currently manage their network and services. This technology is already deployed and operational in both the terrestrial communication world and some satellite ground systems.

Multi-use satellite ground systems that are servicing the LEO Earth resource and smallsat markets, as well as LEO fleet operators, have already deployed digital infrastructures that include software based modems (not to be confused with software defined modems that are usually FPGA/firmware based).

Is this a proprietary system?

FB

No; anything that assumes a one-vendor solution, or a technical solution that drives lock-in, is not acceptable. This new approach of a more open, standards-based and virtualized ground system supports the DoD's needs and plans.

Shifting from closed, proprietary hardware to a virtualized, standards-based software ground infrastructure allows automatic synchronization with digital assets both on the ground and in space. It changes the paradigm by delivering abilities to re-provision hundreds of satellites, thousands of beams, and millions of services in response to changes in demand, interference and threat.

Is it secure? Does it address the military concerns of scalability and resiliency?

FB

Security is critical to the design of this architecture. How this platform operates, how its software applications operate, how data is secured, encrypted and authenticated is all based on the *Zero Trust Model*. Stove-piped and hardware-based ground systems are security challenged, with upgrading, patching, monitoring and locking down that all require some element of specialized work or technology, and are not scalable.

Flexibility and scalability provide a new level of reliability and resiliency. For example, if a user is being jammed on one antenna, they can quickly and easily connect to another aperture, either of the same or a different satellite. Another option would be to sense the jamming and allow the system (both satellite and ground) to adapt its waveform characteristics. Kratos is currently conducting research in this area.

What capabilities will be possible in the future?

FB

As Kratos progresses with OpenSpace, all ground-based capabilities will move to virtual applications within the platform. Today this is TT&C and EO/Sensing, but in the future, it will include C2, signal monitoring, interference detection, and other advanced capabilities to match the advances occurring at the space layer.

We also see future work with partners of various applications, including scheduling, orchestration, and advanced antenna providers. Kratos also envisions linking space providers with terrestrial providers, as the space layer is an important and at times exclusive provider of capability in a much broader networked world of cloud, telecom and wireless systems.

Has Kratos been working other efforts to help the Warfighter this past year?

FB

Kratos is continuously working on several innovative programs to help the warfighter. One recently announced service will characterize spacecraft in *Geosynchronous Orbit (GEO)*. This provides highly accurate proximity operation data, real-time maneuver detection and accurate ephemeris data.

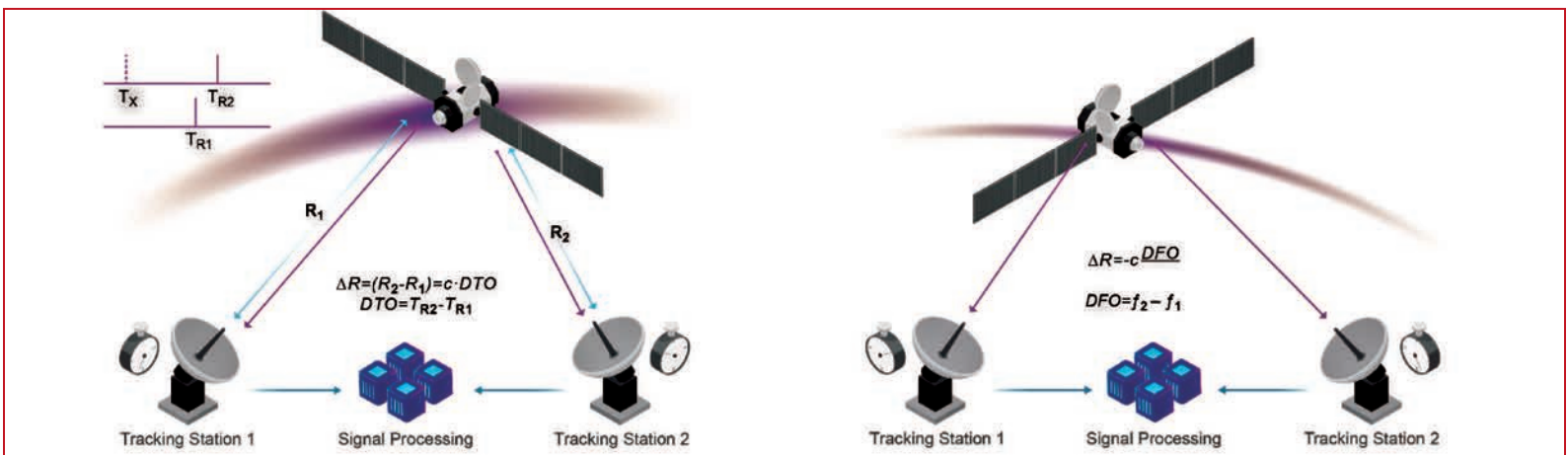
Services offering high rates of refresh for closely tracked spacecraft are also available. These services have high value for *Space Domain Awareness (SDA)* and are accessible to government and commercial organizations internationally.

Kratos can identify and accurately locate spacecraft in GEO using a powerful SDA technique called *Passive RF Ranging*. Traditionally, the ephemeris of a unique spacecraft at GEO is derived from data obtained through ground-based radars and optical telescopes. Oftentimes, these resources cannot correctly differentiate between *Closely Spaced Objects (CSOs)* accurately enough to provide precise measurements, are unavailable during solar or weather exclusions, or are not geographically accessible.

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Passive Ranging is a method using a satellite's own RF Signals for locating exactly where the satellite is in space. It uses Time Difference of Arrival (TDOA) and Frequency difference of Arrival (FDOA) and is available as long as a satellite is transmitting - in all weather conditions, as well as night and day.

www.kratosdefense.com



Passive Ranging is a method using a satellite's own RF Signals for locating exactly where the satellite is in space. It uses Time Difference of Arrival (TDOA) and Frequency difference of Arrival (FDOA) and is available as long as a satellite is transmitting - in all weather conditions, as well as night and day.

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RECON: SPACE FOUNDATION

SECURING HIGHER GROUND FOR BOLDER PURPOSE

By Tom Zelibor, Chief Executive Officer, Space Foundation

For as long as history has recorded military efforts, holding the high ground has always been one of the keys to success. Scouting teams, aircraft, radar and satellites — these capabilities allow us to look ahead to inform the next strategic move. While times and technology have changed, the formulation of holding higher ground has not, and it was one of the guideposts for Space Foundation's 2020 actions.

In a year where a microscopic virus inflicted tremendous cost in terms of lives, economies and operations (including the postponement of our annual Space Symposium), the global space community marched on, particularly in the defense and intelligence space sector. Launches and satellite deployments proceeded with minimal interruptions, and in 2020, six nations deployed 60 military satellites (United States, China, Russia, India, Japan and Mexico), according to *"The Space Report."*

The U.S. Space Force began to take shape, prompting countries such as France and Canada to explore similar military models. The Artemis Accords united international partners for future lunar missions, and America returned its astronauts to space from home soil aboard commercial spacecraft. At the same time, *world powers continued developing a range of weapons* capable of disrupting critical space infrastructure.

Space is the high ground, and it is evident that more countries than ever are staking their claim in what is an increasingly contested and congested arena. Critical to the success and security of space are developing and sustaining relationships, partnerships and collaborations that respect the national and economic security needs each nation has for space.





There are challenges inherent in securing national and

That is one reason Space Foundation launched **Space Symposium**



economic security, and Space Foundation is determined to help address them. Perhaps most important, success in any endeavor hinges on talent — people with the knowledge and skills to turn lofty goals into operational realities.

Securing the necessary talent is among the greatest challenges the space community faces, particularly given that all space sectors are growing simultaneously. The workforce demands in civil and commercial space compete with the demands in defense and intelligence. Not surprisingly, statistics and analysis from several U.S. agencies, as well as the Organization for Economic Co-operation and Development (OECD), forecast significant shortages in workers and needed skills.

Put simply, we need more space professionals than the world currently has available. More people are needed to drive technology development, enhance cybersecurity practices, advance AI and machine learning, and support and secure other space-dependent critical infrastructures.

To inspire and cultivate the talent we need, in 2020, Space Foundation launched the **Center for Innovation and Education** to drive workforce development and expand economic opportunity.

The Center works with organizations with the greatest talent demands — private industry, civil space, military services, infrastructure owner/operators, international organizations, educators and more — to build partnerships and programing that enhance, expand and diversify the talent pool.

It is designed and focused on investing in and growing the foundation for a multisector space workforce — the talented people we will depend on to serve strategically, economically and operationally in countless ways.

Driving workforce development and connections requires an open platform for members of the space community to learn, discuss, plan and collaborate. The fast pace of developments and advances, particularly in the national security space sector, demand a constant flow of information and dialog.

365. The digital engagement platform delivers a way to extend dialogues, share research and data, and identify challenges and opportunities as they emerge.

Space Symposium 365 gives subscribers access to exclusive content, including presentations and interviews with space leaders, mission

IT'S TIME TO CUT OUT THE INTERFERENCE

iDirect Government introduces CSIR™ (Communications Signal Interference Removal) NOW embedded in our 9-Series Satellite Modems, protecting your critical communications from jamming with INTERFERENCE MITIGATION.

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briefings, space economy data, panel discussions, and workforce perspectives for the next generation of professionals and business leaders. The virtual platform allows us to reach globally to support the space community. In 2020, Space Symposium 365 featured prominent leaders in defense, space policy and commerce, including from the U.S. Air Force, the Department of Defense (DoD), NASA, NOAA and the FAA.

Meanwhile, Space Foundation leadership is active throughout the space sectors. For my part, in September, I was sworn in as a member of the Defense Innovation Board Space Advisory Committee (DIB SAC). Our task is to deliver advice and recommendations to the secretary of defense and DoD leadership on emerging space technologies and the innovative steps DoD should adopt to maintain technological and military dominance in space. After a 30-year career in the U.S. Navy, it is an honor to continue serving the United States on advancing its security and unfettered access to space.

As we look to 2021 and beyond, the activity in the national security space sector will only accelerate. We are reminded that even as we cultivate a strong current space workforce, we must also consider the future space professionals. The first men and women to walk on Mars are likely students right now. We are, in part, holding the high ground for them — tomorrow's space leaders who will take us to new places, conceive new technologies, and serve their nations as stewards of a peaceful space environment.

To this end, Space Foundation's work in the year ahead will include growing that younger workforce. The Center for Innovation and Education will expand programs for young professionals, educators and students as well as for entrepreneurs and small businesses. The Center's **Space Commerce Entrepreneurship Program** will continue to enrich and support today's generation of space professionals, but just as important, the **Junior Space Entrepreneur Program** will provide educational resources and opportunities for young people. This will include materials for teachers, virtual visits to the Colorado Springs



Space Symposium



Space Certification



Space Technology Hall of Fame



Government & Policy



The Space Report



New Generation Space Leaders



Space Foundation Awards



Corporate Membership



Women's Global Gathering

Discovery Center, and eventually, when health safety permits, the full suite of in-person programs that inspire students to think about careers in STEM and the space economy. All this while we continue growing our cadre of **Teacher Liaisons** who take the excitement and wonder of space and use it to train other teachers to inspire young people.

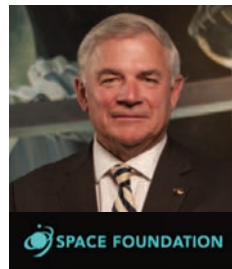
Building workforce capacity requires a long roadmap of building awareness, creating access, offering training, forging connections and providing mentorship. This essential work does not have an end date. We are instilling a lifelong worldwide cultural shift that continually builds more and more capacity, while enabling more people to be a part of the space community. For a resilient, sustainable trillion-dollar space economy to come into fruition, it must expand its practices as well as its practitioners.

To fulfill that vision, Space Foundation is building the network of practitioners, partners, programs and endowment, the last of which is essential for delivering educational programming for free to advance broader inclusion in the growing global space community.

Today's satellite industry, cybersecurity community, and national security providers have the most pressing talent needs given the dynamic threats and demands they face. They cannot serve, protect or hold higher ground without capable reinforcements. Realizing that, we hear a call to action that must be answered boldly.

Space Foundation has taken its first steps to answer that call, and we invite others to join us. Holding higher ground offers not just a superior view but a shared opportunity. Together, we can secure a future in space where all people can participate, all nations are welcome, and we enjoy the confidence that space access and growth is assured because the available talent is so great.

Tom Zelibor is the CEO for Space Foundation, a 501(c)(3) global space advocate. Headquartered in Colorado Springs, Colorado, Zelibor manages a national staff with a worldwide impact across the business, government, education and local communities. Before joining Space Foundation in April 2017, Zelibor served as chairman and chief executive officer for Lightwave Logic Inc., among other executive roles in commercial enterprises. Prior to his leadership tenure in the private sector, Zelibor had a distinguished 30-year career in the United States Navy, retiring as a Rear Admiral in 2006.



www.spacefoundation.org

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EM Solutions is an innovative Australian company with a global focus that provides future-proof, next generation technologies.

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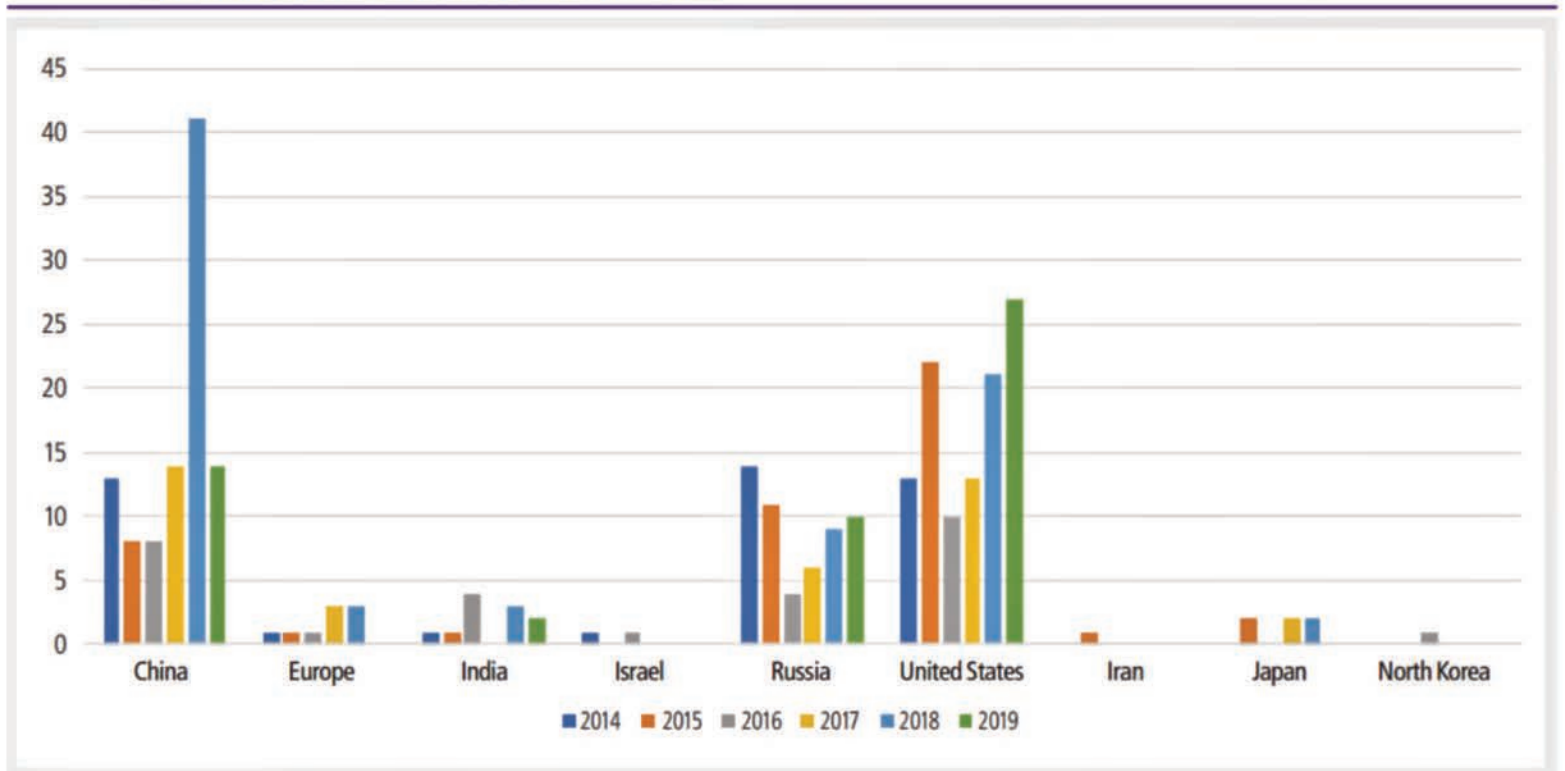
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SPACE FOUNDATION: SHIFTING TRENDS IN 2019 MILITARY SATELLITE LAUNCHES

Missions from the commercial and civil space sectors inspire the general public with the excitement of exploration and experimentation. Yet, those sectors can only do so while enjoying unfettered, guaranteed access to space. More so than decades past, space is a contested domain, and the proof is in the data.

Reviewing numbers from 2019 shows where the highest levels of military spacecraft deployment are taking place. Data analyzed in *The Space Report* shows that even as more nations are exploring how military satellites aid national defense, three nations account for the majority of military spacecraft in orbit: the United States, Russia and China. These nations are those that aspire to geopolitical hegemony and also possess robust indigenous launch systems and space programs.

Military Spacecraft by Deployment, 2014-2019



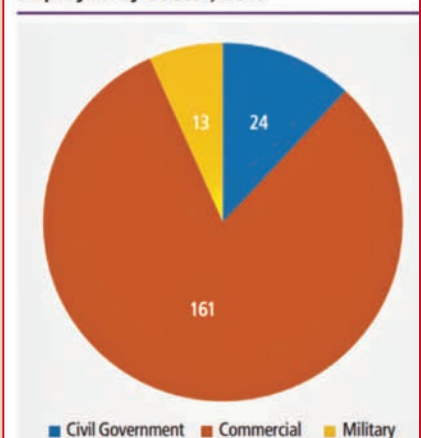
Source: Space Foundation Database

In 2019, the United States, Russia and China accounted for 71% of all spacecraft deployed (466), and the military mission segment was the smallest share among sectors. Last year, just 11% of spacecraft deployed owed to military missions. This is a decrease from 2018, which showed 17% of spacecraft deployments for military missions.

Six nations deployed 60 military satellites: the United States, China, Russia, India, Japan and Mexico. (Note that of these, only Mexico lacks an indigenous launch system.) The United States deployed 47% (28) of 2019 military satellites, of which U.S. Air Force missions represented the largest share (20%). China was second most active, deploying 14 military satellites (23%), and Russia was third with 12% of all military satellite launches.

Looking at satellite purpose, for 2019 deployments, 13 satellites were launched for military communications missions. China's Academy of Space Technology deployed one, sending a TJS-4 satellite to geostationary orbit (GEO) for use in signals intelligence, communications and data relay. Russia launched two military communications satellites. Its Ministry of Defense deployed a Cosmos 2539 communications satellite to GEO, and Roscosmos deployed a Cosmos 2541 communications satellite into a highly elliptical orbit.

Communications Satellites Deployed by Sector, 2019

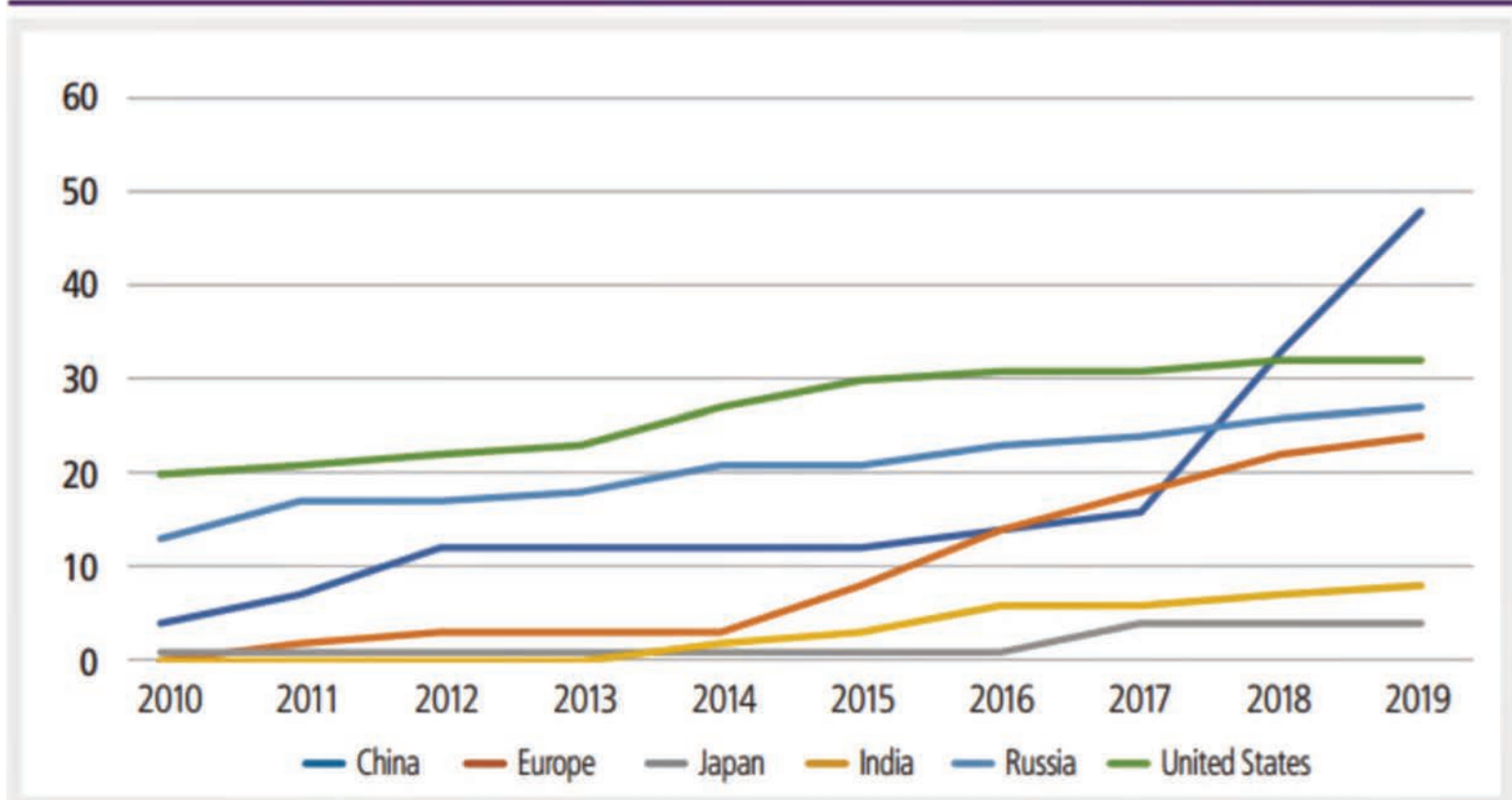


Source: Space Foundation Database

The United States deployed 10 military communications satellites. To GEO, the U.S. Air Force launched a global wideband communications satellite, and the U.S. Air Force Space and Missile Systems Center deployed a communications satellite as well. The remaining eight deployments were all to Low Earth Orbit (LEO).

Even as positioning, navigation and timing (PNT) constellations benefit the public in countless ways, the six existing PNT constellations composed of 195 satellites all provide distinct national security advantages for the nations operating them. In 2019, China seized the highest share of operational PNT satellites, 30% (43), with its BeiDou Navigation constellation. The U.S. Global Positioning System (GPS) held the second highest share with 22% (31) of the operational satellites. Russia's Glonass moved to third with a 17% (24) share. The EU's Galileo ranked fourth in 2019, with a 15% (22) share, and India and Japan held less than a 6% share each.

Positioning, Navigation, and Timing Constellation Size, 2010–2019



Source: Space Foundation Database

Finally, there was a dramatic decrease in the number of Earth observation/remote sensing (EO/RS) spacecraft deployed (down 57% from 2018), and of these, the military segment accounted for the smallest share (just 6%). Four nations deployed six EO/RS spacecraft for military purposes in 2019, a large decrease from the 27 EO/RS spacecraft deployed for military use in 2018. China deployed three spacecraft, and India, the United States and Mexico each deployed one EO/RS satellite.

With so much activity in the national security space sector and across the space economy, the only certainty is change. Space Foundation, through its quarterly installments of *"The Space Report,"* supplies the space community with definitive, timely and comprehensive information on the scope of space industry activities. As the space sectors come roaring out of a difficult year, Space Foundation will track the trajectory and deliver the insight and analysis to help fuel the global space economy.

www.spacefoundation.org

Is 2020 over yet? From a business perspective, 2020 has been a reasonably good year. From a personal perspective, it's been a year of unknowns, sweeping changes and never-ending uncertainty.

Many of us were attending the Washington, DC, satellite trade show when the Covid-19 pandemic was declared and large-scale events came to a grinding halt. The show ended a day early and left exhibitors scrambling; however, we figured things out. We packed our antennas and shipped them back to North Carolina and then flew back to the company headquarters to determine how to operate in the "new normal."

AvL Technologies has remained open during Covid — the company is a recognized member of the *Defense Industrial Base* (DIB), which is a part of the *Critical Infrastructure Sector*, as determined by the *Department of Homeland Security* (DHS). As a member of the DIB, AvL Technologies is exempted from mandatory closures brought on by the pandemic. Manufacturing production has continued throughout the crisis and AvL has maintained the firm's commitments to our clients.

Though we remained open, many things changed. First and foremost, our operations were dramatically altered to ensure the health and safety of all employees. Some personnel began working remotely and employees who work in our production facilities started observing strict safety measures that included wearing face covers, frequent handwashing, maintaining six-foot distances from each other at all times, frequent sanitizing of shared equipment and holding meetings via phone calls or outside with distancing.

This was our *new normal* — the company remained efficient and productive thanks to the collective, positive attitudes of the firm's employees and their commitment to keeping themselves and others safe.

AvL's growth continued during 2020, though it slowed a bit. By the end of the year, the company had grown to 260 employees and this growth was reflected in new engineering capabilities, new prototyping capabilities, a new program management team, expansion of the information technology team, expansion of the electrical systems team, and expansion of the customer service team, to include a depot for a key customer.





We added two executives to the leadership team — **Larry Watts**, VP of Programs who's developing and building a strong Program Management office with a focus on customer satisfaction, and Dr. **Hamad Alsawaha**, Senior Antenna Systems Engineer, who is leading AvL's design and development efforts on many antenna products, including electronically steerable array (ESA) antennas.

AvL's continued growth sparked the need for additional information technologies expertise and we added **David Cox**, a network engineer, and **Andrew Cartwright**, a cyber security specialist.

We were excited and proud to complete the new 2.5m **Model 2510** ruggedized, low-PIM (passive intermodulation) and high-wind operations trailer-mount antenna. The antenna supports Ku-, Ka- and X-band and is certified Low-PIM (multi-carrier) for X-band at 2 x 200 Watts.

The antenna's many certifications include **MIL-STD-461 CE102 Conducted Emissions Compliance**, **MIL-STD-461 RE102 Radiated Emissions Compliance**, **MIL-STD-461 RS103 Radiated Susceptibility Compliance**, **IEC 61000-4-2, Part 4.2, Test Level 4 Electrostatic Discharge compliance**, **MIL-STD-810G Compliance**, **Munson Road Tested**, **Intelsat IESS Type Approved**, and **ARSTRAT Compliance**.

Under an accelerated customer schedule, AvL completed this antenna with a full spectrum of enhanced, certified military communications capabilities that are additionally certified to support mission requirements designated for the most challenging and hostile environments. These capabilities can be provided ala carte, tailored to unique customer needs.

We also rolled out several new products during the DC show, including AvL's new **Model 2015**, 2.4m axi-symmetric antenna that is ultra-lightweight and packs into two lightweight cases plus RF kits. The 14 piece carbon fiber reflector is designed to operate in X-, Ku- and Ka-band, with new quick-change feeds and RF kits. The antenna is modular and flexible with numerous RF equipment options, and it supports RF or modem peaking.

This manual operation antenna functions on an aluminum space frame, which enables quick set-up and pack-up. Once the antenna is set-up, a simple, user interface computer assisted pointing assist tool is available for satellite acquisition.

The updated 1.35m **Flexible Integrated Terminal (FIT)** received **ARSTRAT** certification this year and offers a small package with big gain. This flexible, user-defined terminal



AvL Technologies' Model 2015 2.4 meter axi-symmetric antenna.



AvL Technologies' updated 1.3 meter Flexible Integrated Terminal

platform has a 12-petal reflector and an integral tripod for a small pack-up in two IATA-compliant checkable cases. This antenna can be operated manually or upgraded to motorized operation with auto-acquisition. The terminals operate in X-, Ku- and Ka-band with new bayonet-style feeds and feed kits for quick RF changes. The terminals have a built-in receiver, are scalable with 75cm, 98cm and 1.35m reflectors, and flexible with modem, BUC and LNB options.

This new, ruggedized, 1.35m FIT platform was developed at the request of several customers looking for high wind auto-acquisition applications. This terminal has a rugged positioner paired with a high-stiffness 6-petal reflector and reinforced tripod. This terminal can be delivered in a compact, IATA-compliant, two case pack-up, and can be assembled by one person in five minutes. The terminal operates manually or with auto-acquire in X-, Ku- or Ka-band and is designed to operate in strong winds without additional wind stiffening. It offers a new bayonet-style feed mount, quick-change RF kits, an optional terminal control module with a spectrum display, BUC and LNB options, and RF or modem peaking.

The motorized auto-acquire models operate with the AvL AAQ antenna controller, which has an optional module with a spectrum display. Manually operated terminals point with new manual point computer assisted user interface.

The new 1.2m 1030-T is a new take on an antenna AvL has been producing for many years. This ruggedized terminal operates on a lightweight one-piece tripod that easily unfolds and anchors for a quick set-up. Once the tripod is in place the positioner attaches quickly with hooks and locks, and the positioner includes an I/O panel with connectors.

The offset 1.2m reflector flexible removes from the positioner to enable a compact pack-up as the antenna packs into two IATA-compliant airline checkable cases. This antenna is used by FirstNet civil emergency management agencies at both federal and local levels to support emergency communications.

AvL's 85cm 830-T FlyAway is a rugged, yet lightweight, antenna designed for rigorous use by military operators. The antenna packs into two, IATA-compliant airline checkable cases and can be assembled by one person in five minutes. The antenna is configurable with multiple modem, BUC and LNB options.

Considering the immense changes and challenges we've all faced in 2020, AvL has remained as rugged and reliable as its products. We were excited to continue

growing during 2020 and add important team members and capabilities.



AvL Technologies' 1.2 meter 1030-T ruggedized terminal



AvL Technologies' 85CM 830-T Flyaway antenna.

Our engineers immersed themselves in product development and enabled the launch of many great new antennas. We're proud to be a member of the DIB — now more than ever — and a valued supplier to the U.S. Department of Defense (DoD).

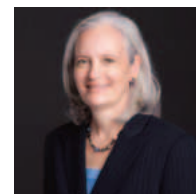
Tough 2020 has been a year of challenges, everyone at AvL is looking forward to 2021 and the return to face-to-face meetings and events, and we anticipate spending time with our valued customers.

AvL's new product and new technology roadmaps for the next few years include several tactical LEO/MEO tracking terminals, fully electronically steered array antennas and numerous small yet rugged flyaway antennas now going through ARSTRAT certifications.

We don't expect 2021 to be without challenges, but the AvL team is committed to supplying our customers with much needed and high-quality SATCOM products.

www.avltech.com/

Author Krystal Dredge is the Marketing Director for AvL Technologies



2020 will be remembered as a time of momentous change and acceleration in satellite communications. The impact of COVID-19 generating an unprecedented demand for high performing bandwidth, both on land and out at sea, with businesses forced to digitalize operations and people seeking new means of communications to connect with loved ones amidst global lockdowns.

The rocketing demand has in turn increased the urgency of those at the forefront of the space race — with thousands of satellites being designed and launched this year to enable the new mega constellations to come online in 2022 and 2023.

Likewise, the COVID-19 pandemic has highlighted societies' ability to adapt at a remarkable pace. The prospect of decarbonizing global infrastructures, in line with impending environmental regulation, appearing to be less of a concept and more of a reality.

With this in mind, and with climate change being acknowledged as a priority by authorities globally, sustainability is increasingly at the forefront of business decisions and viewed as a critical element in ensuring the longevity of supplier and manufacturer operations.

This year's social, political and environmental climate has impacted the requirements of hard-pressed governments, as they prioritize the most affordable, sustainable and futureproof connectivity solutions for their militaries. More specifically, we have seen an increase from governments' in regard to the current and future expectations of connectivity solutions.

With many expressing the desire to be able to easily roam between LEO, MEO and GEO networks once mega constellations come online, to enable uninterrupted communications across military operations, among other things. Our team has anticipated such evolutions in the market and risen to the challenge of meeting our user's needs through the continued development of our industry-leading tracking antennas and radome technology.

STAYING AHEAD OF AN EVOLVING MARKET

With demand for high performing connectivity soaring, and the satellite communications' industry evolving at an unprecedented pace, 2020 has been one of our strongest years in terms of growth. This is in part due to the capabilities of our industry leading tracking antennas.

More than 40 years of development, design, and testing in the world's harshest environments, has resulted in our tracking antenna technology being the first choice for those in defence and government. This is due to them being not only the most affordable and cost effective in the market, but because our tracking antennas are compatible with new mega constellations; allowing almost instant access to new networks as soon as they come online. Therefore, it is increasingly vital that governments looking to futureproof operations are able to invest in tracking antennas that are compatible with future constellations and last the lifespan of satellites.

By way of one of our additional successes this year, and relating to this year's market trends, we have seen the military increasingly look to integrate the current LEO network into their architecture. We are, therefore, continuing to deploy antennas to military bases that enable and utilize existing LEO networks and provide first responders with reliable mission critical connectivity in rural areas.

More specifically, we have found the ease of installing our ground terminals, unique to Cobham SATCOM, and the minimal number of personnel required to facilitate installation, to be of particular value this year, with COVID-19 rules restricting the physical contact of groups of people.

THE IMPORTANCE OF GOING GREEN

At Cobham SATCOM, we pride ourselves on developing the most sustainable connectivity solutions that help facilitate green initiatives. In light of impending environmental regulations, we have seen an increase in enquiries for futureproof, reliable and energy efficient connectivity solutions.



Cobham SATCOM land mobile comms solutions.



Cobham SATCOM maritime comms solutions.



The Sea Tel ST94 is Cobham SATCOM's next generation 2.4m (94") TV-at-Sea™ system. The reflector, radome design, RF components and the pedestal are based on our well proven 9497B system.

One of our successes for this year has been the ability to meet our user's requests for energy efficient technology, with the continued deployment of our market leading radome technology.

While protecting the tracking antenna, the radome reduces the huge amounts of energy typically used by similar size antennas not under a radome that include large motors to hold the antenna in place and maintain connectivity when operating in volatile weather conditions.

The radome enables market leading power savings of up to 90 percent, increasing energy efficiencies and reducing costs for hard pressed governments. Likewise, the radome increases the reliability and longevity of the tracking antenna, and expensive amplifier electronics, which is essential for military personnel operating in remote locations across the globe.

As sustainability is prioritized across all operations, by the government and military, we see reliability and longevity as fundamental considerations in driving purchase decisions over the next decade by the government and military.

With this in mind, we aim to take our technology to the next level, through continuing to work closely with proprietors and by further developing the materials used in our systems.

2021 AND BEYOND

In terms of further developments, we are anticipating some exciting announcements for 2021. We are very far in the development of advanced flat panel technology, which will be implemented in multiple bands, enabling both LEO and GEO network connectivity to provide even higher performing bandwidth.

The flat panel hybrid antenna will require low power consumption to operate, making it both cost effective and energy efficient. We look forward to being able to share more on this exciting technology - watch this space and please reach out if this has your specific interest.

LOOKING TO THE FUTURE

Whether it be on land or out at sea, ensuring our users are supported wherever they are in the world, and receiving the highest levels of connectivity in all conditions, is at the heart of our operations. We know that access to rapid and reliable connectivity can be the difference between life and death on mission critical projects and therefore continue to work alongside governments to enable safer and more sustainable operations for those working in the world's toughest conditions.

Likewise, our teams are busy on the ground, trialing new technologies and working with both new and existing satellite providers to maintain our position as best placed to harness new LEO, MEO and GEO networks.

From tracking antennas to highly developed radomes, we aim to continue this year's trajectory and believe the next two to five years will be pivotal in the evolution of our organization and in satellite communications worldwide.

www.cobhamsatcom.com

Author Kevin McMahon is the Director of Sales, land Tracker Products and Solutions for Cobham SATCOM.



Doubtless, history will record 2020 as the year of Coronavirus, the year in which Covid wreaked havoc on communities, economies and the overall health of the world.

EM Solutions, although fortunate to have a large pipeline of product orders booked at the start of the year, was challenged by the international travel restrictions that began in March. The team had to fall back on the relationship credit they had built up with customers over many years, when freedom to travel was a right that was taken for granted.

Unable to meet in person, EM Solutions' customers throughout the world continued to trust us to build and deliver quality satellite terminals and subsystems to exacting military specifications.



Trusted relationships and proven commitment have been the keystones that have enabled EM Solutions to not only survive, but once again grow, during the Covid crisis.

EM Solutions' **Cobra** maritime terminals (*Figure 1, next column*) continued to underpin the company's growing business. Covering three frequency bands (military Ka-, commercial Ka-, and X-bands), and with superior tracking and pointing capability, these terminals are now on order or in use with six of the world's greatest navies.

These maritime terminals are **WGS** and **Inmarsat GX** certified and have been delivered for installation on the *Royal Australian Navy's* newest *Offshore Patrol Vessels*, having already proven themselves on their Cape, Supply, and Anzac class vessels.



Figure 1. EM Solutions Cobra terminals.

Others are on their way to some of the leading European navies, as well.

The company also released its new *Antenna Diversity System (ADS)* (*see Figure 2 on the following page*). The ADS enables single-look or dual-look operation to satellites from a pair of ground terminals, by switching between them when the ship or vehicle orientation blocks visibility from one of the pair.

The ADS is a highly sophisticated system that brings resilience in satellite communications to a new level.



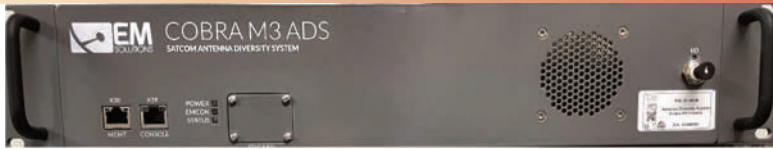


Figure 2.

Reaching the final design stage of its new 2 meter Fleet maritime terminal— already pre-ordered by three navies, for build and delivery in 2021 — was another milestone for the company. This new terminal is unique; it is a full Mil-Spec satellite terminal that simultaneously covers both X-band and the entire (commercial and military) Ka-band spectrum.

With features such as optical fiber interconnect and built-in redundancy options, the Fleet terminal will be an exciting new addition to the communications portfolio of many naval customers.

EM Solutions is renowned for its technical expertise and the seamless, vertical integration of its terminals. In 2020, the company continued to develop and deliver its receivers (LNBS) and transmitters (BUCs) to various customer specifications, and with its new broadband Ka-band transceiver, won a several hundred-piece order late in the year for a US manpack terminal.

The frequency coverage and ability to meet demanding WGS specifications made EM Solutions a natural choice for this customer.

Two of EM Solutions’ biggest advantages have been its flexibility and innovation and these haven’t waned. Innovation occurs by building on the shoulders of giants that have gone before... The real giants in the innovation puzzle are those customers who embrace innovation and are prepared to fund its development. Such customers push the technology envelope and drive innovation by demanding specialized requirements, new features, and performance improvements.

As a difficult 2020 draws to a close, EM Solutions salutes its customers — they are the real heroes!



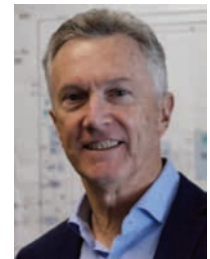
EMS Cobra Terminal.



EMS Taipan Terminal.



Rowan Gilmore
is CEO of EM
Solutions, a



Brisbane, Australian based technology developer of mobile satellite communications subsystems and terminals. Rowan graduated from the University of Queensland (UQ) and later earned his doctorate in electrical engineering from Washington University in St Louis, Missouri. Since joining EM Solutions in 2011, the company has quadrupled its revenues and won a number of prestigious awards, including the 2016 Brisbane Lord Mayor’s Business Award for Innovation and the 2018 Australian CASG Defence SME of Year Award. The company exports over half its products, which are in use by customers including six of the world’s leading navies in Australia, North America, and Europe.



EMS Taipan 48 Land Terminal.

Building on our 2019 acquisition of Mountain View, CA-based Glowlink Technologies, 2020 can be summed up for us as “sleight of hand.” The term is most associated with mastering moves for performance before an audience where the movements of the hands are precise and well-studied to bring about success in coin tricks and card tricks.

Although sleight of hand brings “magic” and tricking of the audience, there is no trick to *iDirectGov*'s 2020 product innovations for our customers. Similar to the learned characteristics of sleight of hand, the studying, engineering, preciseness and mastering of incorporating *Glowlink* technology with *iDirectGov* technology is our 2020 success story.

This story began with integrating Glowlink's technology and assimilating the Glowlink team into a new culture while maintaining their existing values.



The seamless integration into the *iDirect Government* products and family happened successfully this year.

This acquisition endowed us with a team of engineers on the west coast. Together with our existing east coast engineering team, we delivered a significant software release to our customers with enhanced security features — our *Evolution™* 4.2.2.0. This was no small feat on several fronts.

Protect your network
with *iDirect* **GOVERNMENT**



iDirectGov's 9350 modem.

First, our engineers on both coasts needed to understand and learn the combined technology capabilities to build products to suit our customers' needs for secure SATCOM.

Second, this path of learning came in the middle of a pandemic with travel bans and closures that required virtual collaboration. The iDirectGov engineers came together virtually and seamlessly, and their collaborative efforts included superb engineering in mastering the integration of two high-level and technical advancements.

Despite these challenges, our team delivered software with the most advanced security features available to the government SATCOM market, including information assurance (IA) and cybersecurity as a part of a multi-layered approach to security. This was a proud moment for us and the engineering team.

Evolution 4.2.2.0 integrates the *Communication Signal Interference Removal (CSIR™)* technology into our **9-Series** modem. The CSIR technology integration and its capability to mitigate interference from a SATCOM network are game changers.

Although we have integrated CSIR into our own modems, we are continuing to explore incorporating this technology into other modems, HF radios, GPS antennas and many other potential use cases where this interference mitigation technology can benefit the U.S. Department of Defense (DoD). The possibilities are endless.

Evolution 4.2.2.0 is a security-feature-rich release. In addition to CSIR technology, it includes SHIELD Information Assurance (IA) that provides IA protection on our 9-Series satellite

modems, augmenting the existing IA packages available on our servers through our SCAP offering. SHIELD is available through individual remote licenses or as part of our Premium iSupport offering.

To have a truly global and secure SATCOM network, our defense, homeland security, first responders and other government users need the capability to control the beams on which they are operating, along with the satellites. We addressed this requirement through the new beam selection tool and dual-mode offerings.

IT'S TIME TO CUT OUT THE INTERFERENCE

iDirect Government introduces CSIR™ (Communications Signal Interference Removal) NOW embedded in our 9-Series Satellite Modems, protecting your critical communications from jamming with INTERFERENCE MITIGATION.

www.idirectgov.com





Now, satellite operators can select automatic beam selection or manual operation based on signal strength. The dual-mode feature enhances global coverage with the capability to operate on both government and commercially owned satellites. This gives our customers options for SATCOM selection and use.

COVID-19 IMPACT

In light of the pandemic, we have seen a shift in our market and among our customers. Security concerns have increased with people moving to more remote environments and, with this, the abilities of hacker opportunities have increased. This scenario made our latest software release timely as it included enhanced security features.

Relative to the world market, we are fortunate. The pandemic caused a global slowdown, and in many parts, a shutdown to various parts of the economy. We had a three-month slowdown before the U.S. government was able to pick back up.

In relation to our products, there has been pent-up demand for some time and closures due to the pandemic had an impact on us. The current 9-Series product line, available in the last two years, is replacing our 8-Series modems, which were available for just more than 10 years. The government is now upgrading to the 9-Series and implementing the new features available, including increased security, speed and network flexibility.

We were concerned in the beginning of the year about supply and shipping logistics for our products, considering the tremendous amount of closures. The majority of our products are made as they are ordered here in the United States, and we don't prefer to have a large backstock because of the ever-evolving market. When we saw the shutdown of the economy, we throttled back the supply chain. The main problem we confronted was that our material supply chain — and that manufacture our products — went through a series of closures as virus cases popped up. However, the factories we use have done a great job at protecting their employees, which allowed us to ramp up manufacturing in June and July and have products deliver based on our need.

Our company's success this year relates to how quickly we have responded and adapted to the new normal during the ongoing pandemic. This year has brought about a collaborative effort—our employees have banded together and worked seamlessly, even when remote, to rise to the challenge at hand with impressive results.





I worried the most about our engineering team because their work entails constant collaboration; however, the team has done an outstanding job at continuing to move the needle forward on our many ongoing projects, even remotely.

BEST PLACES TO WORK 2020

For the second consecutive year, we have been named one of *Washington Business Journal's Best Places to Work 2020*. In my opinion, this is an impressive win, as it is entirely employee-feedback driven and companies are ranked according to that feedback.

For iDirectGov, the achievement validates that we focus and care greatly about our customers, but we care about our employees also, and this is what allows us to obtain and retain the best employees. Our organization focuses on hiring people who are good at what they do, and then we provide them the opportunity to have a solid life-work balance.

AHEAD FOR 2021 AND BEYOND

In 2021, we will increase our engineering staff, which will be a huge asset. Our focus will be on our new Revolution modems, which will be dramatically smaller and flexible in design, can be mounted in many configurations and will boast size weight and power (SWaP) enhancements. They are intended to be ideally suited for airborne, drones and embedded into antennas. Additionally, we expect it will be a paradigm shift in technology, and its release is just a few years away.

We also plan to integrate Glowlink's other flagship products, such as the geolocation and spectrum monitoring tools, into our existing products. Our talented engineers are reviewing the product roadmap for these solutions as well as new innovative ways for their use beyond the traditional uses.

We are also looking at potentially providing a geolocation service. This would be an annuity for which our customers would pay a monthly or annual subscription fee. We would place antennas around the world to provide information and have a dedicated network operations center that could provide the location of an interference, based on subscribing customer requests.

These products are still in play, and the market can continue to expect innovative solutions from iDirectGov.

The year of 2021 will display big moves for iDirectGov as the industry leader in government satellite communications. We plan to provide fresh and innovative products that solve the security challenges being faced in the government sector and beyond.

Our ever-evolving product portfolio and enhancements will bring security, flexibility, agility, transmission security and efficiency to warfighters, first responders, disaster recovery personnel and field operators.

idirectgov.com

Author John Ratigan serves as President of iDirect Government, Herndon, Virginia.



iDirect **GOVERNMENT**

With the company's in-house R&D, innovation is part of ND SATCOM's DNA. The goals achieved this year include: the SKYWAN 5G Release 2.0, the MFT1500 FLYAWAY, a new HPA product series and new powerful controllers — all highlight the company's drive and dedication to offer the latest technologies.

SKYWAN 5G RELEASE 2.0

Through its ongoing commitment to innovation and customer satisfaction, ND SATCOM launched a new release of its flagship product, **SKYWAN 5G**, in November of 2020. This



SKYWAN 5G

version has been integrated into the new FLYAWAY Terminal **MFT 1500** that pushes functional boundaries and features the pioneering ingenuity of *Adaptive Coding and Modulation* (ACM) for meshed, hub-less networks and also for its new SCPC feature, all using the same SKYWAN modem box. Additional customer-driven product improvements with the new release bring SKYWAN 5G to the next level of usability and reliability.

MULTI-BAND FLYAWAY TERMINAL MFT 1500

According to the company's goal, "Make Missions Possible," the new Multi-band FLYAWAY Terminal MFT 1500 with integrated SKYWAN 5G technology revolutionizes the market with its unique robust design. The terminal is built to withstand and function in whole gale conditions where the user can "send and receive" during very high wind speeds and in severe storms, thereby surpassing competitive products that



are limited to wind speeds of 50 to 70 km/h. This terminal is extremely reliable and ready for immediate action. The FLYAWAY terminal consists of light and durable components that enable easy transport and a long product life.

Of course, there were certain challenges the company faced during development and testing of the FLYAWAY. Based on market analysis and customer needs, the goal was to design and develop a robust, wind-resistant terminal that, despite its robustness, would be light, durable, and easy to transport. This was a big task, one that ND SATCOM's in-house teams met head on and successfully accomplished. The first customers for the unit are impressed by the quality of the MFT1500 and ND SATCOM is proud of this achievement.

4TH GEN HIGH POWER AMPLIFIER HPA WITH TOUCH SCREEN

In 2020, the ND SATCOM R&D teams tackled another major activity on the firm's roadmap to business success — the company modified the TWT amplifiers, which have a large customer base. User experience was one major driver; however, technically demanding improvements were also applied to refresh all HPAs with this 4th generation technology, leading to a more competitive TWT amplifier portfolio for the coming years.

In total, ND SATCOM released **40 variants** with its many combinations of power classes, RF bands, RF options and chassis types that are for sale now.

REDUNDANT CONTROL UNIT RCU 6000

With the new 4th generation of HPAs, ND SATCOM developed, in parallel, a new controller platform. With its large touch screen, the controller platform initially serves to control the precious amplifiers in fixed ground stations (pre-integrated in ND SATCOM waveguide switching systems). Its powerful new processing core will allow ND SATCOM to add more functionality up to M&C applications or to integrate the antenna control functions needed to drive the larger SNG antenna with redundant HPAs.

SATCOM-ON-THE-MOVE SOTM TESTS + DEMOS

Many ND SATCOM solution tests used SKYWAN technology to integrate the SATCOM-on-the-Move (SOTM)-enhanced modem with many on-the-move antennas. In mid-2019, the company demonstrated the first SOTM solution to visitors at the company's Factory Event in Immenstaad. This triggered more customer activities with all manner of antennas in 2020.



ND SATCOM transmitted live video from its BMW SOTM reference car on rough roads to military end-users. Another successful project was video surveillance from an airborne camera via a SOTM vehicle to a control center. ND SATCOM supported a military customer with its systems expertise and several SOTM reference systems to compare different SOTM solutions. ND SATCOM engineers were proud to help all customers with these various technologies.

BIG ACCOLADE FOR ND SATCOM

In order to adapt to ever-changing market conditions, ND SATCOM launched a brand new identity and logo during 2020. Based on this repositioning, a new image plus brand campaign was developed and disseminated through all relevant touch points: *"A NEW DIMENSION IN SATELLITE COMMUNICATION."* The campaign idea was staged in a unique way: those who dive into space is the striking, key visual for all campaigns.



This award is a reflection of how well ND SATCOM's brand strategy has been received by its customers and partners, as well as the entire industry. The company's new brand identity and logo better reflect ND SATCOM's market-leading position and clearly demonstrate its promise to its global customers to provide total reliability and trustworthiness throughout any product's lifecycle.

THE WAY OUT OF THIS CRISIS — ND SATCOM'S EXPECTATIONS FOR 2021

ND SATCOM is in the fortunate position of being able to continue its business during this unprecedented global crisis and the firm's outlook is positive for the future. For example, ND SATCOM teams are currently working hard toward a highly-anticipated product launch for the military sector.

The company will continue to give priority to the health of



its employees and their safe working conditions. The firm's flexible workplace adaptations during this period have taught the company that it is on the correct digitalization path.

ND SATCOM will invest more in new technologies in the near future to ensure seamless interaction with all of the firm's stakeholders, regardless of their location or circumstance.

The number of deals being made with ND SATCOM are increasing again. This is not necessarily back to what the order queue was before Covid-19 — organic growth is still being sought. ND SATCOM expects business to pick up again based on the company's specific, target markets and with the deals that have already closed, certainly a positive trend to follow.

www.ndsatcom.com

While 2020 clearly presented numerous challenges, Paradigm has, nevertheless, used the situation effectively and strengthened their position as a provider of simple, state-of-the-art, SATCOM solutions. In spite of fewer opportunities for face to face contact with new and existing customers, the Paradigm team has adapted well to implementing COVID-safe working practices. These have included a hefty schedule of regular webinars, live bespoke demonstrations for customers, a library of new product videos, a bank of online training sessions, remote training support, the shipping of equipment for customer approval testing as well as some actual meetings being conducted at safe distances.

From this array of options, customers have been able to find something which has met their needs and in a number of instances, thanks to Paradigm's engineering expertise, Paradigm has been able to also provide support for users where their requirements have been over and above the original specification for the product.

2020 has been significant in terms of increased network approvals and certifications for **Paradigm's PIM-powered terminals**. Just in the last six months, network certifications for

various terminals have been approved on more and more satellite networks, expanding our reach and adding to existing qualifications and usage of our terminals.

These approval processes are hugely facilitated by having the PIM, Paradigm's intelligent terminal control interface, as the common denominator across all terminals; once one PIM-powered terminal is operational on a network the procedure for subsequent terminals becomes largely an administrative, box-ticking exercise. This advantage also applies when the PIM is integrated with other manufacturer's terminals, providing a quick route to market for terminal manufacturers and another example of how Paradigm is making SATCOM simpler.

iDirect's 950mp modem has long been assimilated into Paradigm's PIM to create the **PIM950** which opens up even more options for PIM-powered terminals. The PIM950 today operates with services on Mil-Ka-, Ka-, Ku- and X-Band for worldwide operations and can support other frequency bands and constellations as situational requirements demand. The PIM950 is lightweight, power-efficient and industrialized to MIL-STD in order to meet the most rigorous military and government demands for mobile, tactical terminals providing security and always-on broadband capabilities.

SWARM950

PIM[®] 950
Paradigm Interface Module

TRANSEC ✓

PIM^{POWERED}
Paradigm Interface Module V

SWARM[®]

The PIM950 integrated into Paradigm's successful **SWARM** terminal to create the **SWARM950** provides yet another facet to this world-leading and rugged carry-on terminal. The high-speed SWARM offers unrivalled global connectivity and has consistently outperformed other hand carry flat panel terminals, with the 950mp modem together with this year's type approval on Global Xpress it is now a tough option to beat for high throughput and flexibility wherever it is being used.

The 950mp modem alongside a Mil-Ka capable, higher power BUC now enables the end user to use **GX** anywhere in the world while also accessing their own national MILSATCOM systems on the same device. The PIM950 with the SWARM is providing this network with flexibility and intelligent operation as well as providing military grade security by having the ability to operate in **TRANSEC** mode and being **FIPS 140-2** encryption compliant.

Customers have found it invaluable that any PIM-powered terminal can incorporate the PIM950 to provide this same level of flexibility, security and enhanced power.

During 2020, Paradigm has seen significant uptake of their compact and rugged **HORNET** terminal that offers an interchangeable modular system operational on Ka-, Mil-Ka-, Ku- and X-Band frequencies. The HORNET terminal is extremely rugged and weatherproof with low power

consumption. It provides a single case solution which is **IATA** compliant for easy transportation and, because it integrates the PIM, it is modem agnostic, supporting all high performance modems. It provides a highly flexible solution for users needing to configure antenna size and frequency bands, either in the field or at the planning stage and is operational on all major satellite networks. Customers have been overwhelmingly impressed with the flexibility of the HORNET and its capacity to provide the correct solution for a number of different use scenarios.

2020 also witnessed some interesting use case applications for Paradigm's terminals, one of which has been in the area of backhaul communication networks in the Peacekeeping and Conflict Resolution arena. Body-worn **POV (Point of View)** video cameras and health capturing devices are now frequently being used in this environment to feed real time, vital data to Command Centers. This has arisen from the need for rapidly delivered accurate and up-to-date situational information to give immediate oversight, as well as from the concern and value placed on the lives of those placed in harm's way.

The problem arises when it comes to delivering this information to those who know what to do with it and who are in an environment that is some distance away from the field of conflict, allowing them to think more clearly and make more effective decisions. Personnel sensors, camera feeds and local mesh radio networks can't truly deliver their full capability until the network is expanded out and beyond the immediate area of conflict.

While local cellular networks can be used, it is often the case that in some areas they bring an inherent lack of security, availability and, as such, reliability, operating as they do on the model of sharing the network with other cellular users. Consequently, the commonly witnessed fluctuations of a terrestrial network's performance and signal coverage means users are gearing toward adopting SATCOM to complement or provide an alternative path to the cellular option. Data can then be reliably and securely transmitted and received in extreme environments to levels that have never been reached before, opening up a new world of field personnel protection.

The types of satellite terminals used in these kinds of operations must have low





SWaP characteristics, good operational agility, fast setups and, above all, be simple to use. If cost can also be kept down, then it becomes a winning formula. Paradigm's SWARM® is designed for rapid transport and setup and multiple network capability and the firm's **MANTA**® for zero-interaction "just add power" operation have both been adopted as key edge devices for these scenarios. The simplicity of operation of these terminals means that the personnel on the ground know that

the wide area network connections they need will be possible and will also be uninterrupted, whether stationary or on the move, while also maintaining a covert-level of operation.

2020 has also seen more and more Border Patrol Units adding Paradigm's simple-to-use satellite terminals to their updated operations communication equipment list and represent another interesting use case scenario. Increasingly these units are now also recognising the significant advantages



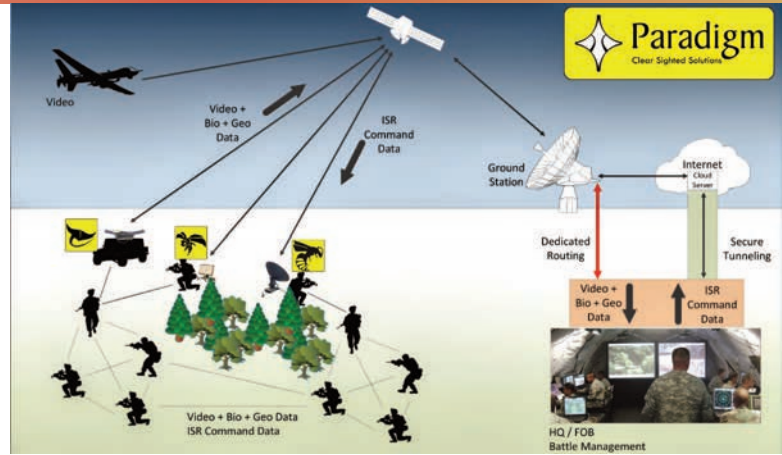
Paradigm Outdoor PIM common terminal interface

of communicating over satellite, both from the perspective of maintaining secure connectivity and staying one step ahead of the ever more sophisticated levels of border incursions. Keeping a border secure requires the means to relay high definition camera feeds, voice communications and geo-location data all with minimal latency and across land, sea and air.

As with the Conflict Resolution arenas outlined above, using existing local terrestrial networks isn't always possible or desirable, but the need to confirm local infrastructure before deployment is now removed with the advent of dual-bearer satellite communication equipment. These terminals combine multiple network options. The combination of LTE/4G/5G cellular paired with a satellite network option is a popular choice. While available, the unit's backhaul data connection is provided by the local cellular networks, capable of delivering the data bandwidth required when live streaming multiple HD camera streams. In the background, the satellite terminal has located and connected to the satellite network to provide a fallback connection.

These sorts of requirements from the patrol units have been met by Paradigm's SWARM and MANTA terminals. For ground based operations that use a temporary stationary communications node to provide mesh network and satellite backhaul connectivity, the SWARM and SWARM950 have become the ideal choices. Small, lightweight and carried in a backpack, the SWARM terminal is easily grabbed for helicopter transport and setup quickly when on location. Capable of being powered by either on-site AC power or battery DC power, and assembled in under 90 seconds, the SWARM also provides the units with the easy to use integrated pointing tool. Combined with a high throughput satellite service, the SWARM terminal delivered rugged and reliable lightweight satellite communication.

For mobile vehicle operations and marine-based fast response boat operations, the MANTA terminal fits the bill perfectly. The MANTA has the option of a quick deploy vehicle and boat mount, meaning the mount can be installed and the MANTA terminal added for either environment. The hardware



can be redeployed rapidly between the vehicle options, and even used as a stationary ground terminal if needed. The self-pointing, no-moving-parts satellite terminal allows users to connect over secure Wi-Fi connections, providing either a 4G/LTE cellular bearer network connection or a high throughput satellite connection, seamlessly switching between the two when operations are on the move.

Of course, both terminals contain the PIM (Paradigm Interface Module), to provide users with a common, simple to use interface to terminal pointing, configuration and status monitoring, reducing training requirements and cost across the terminals.

Overall, Paradigm's continuing aim of making satcom simple has been strengthened and progressed in 2020. Going forward the company will continue to work closely with partners and key customers to understand their needs and to deliver terminal enhancements and flexible solutions in order to meet them.

paracomm.co.uk



Author Jon Godfrey has been working



for Paradigm since 2000, based in Paradigm's head office in the UK. He currently manages all of Paradigm's activities in the UK. Prior to joining Paradigm, Jon had a background in electronic engineering and radio communications engineering. After obtaining his BEng Hons degree in Electronic Engineering, he started his career in the Oil and Gas exploration sector where he travelled the world extensively, supporting exploration vessels with their sub-surface exploration, navigation and communication electronic equipment before moving exclusively into the communication electronics industry.

2020 will forever be remembered as being hugely challenging on a number of fronts but also for the way that connectivity became seen to be even more vital than ever before. SatADSL has met those challenges head on and its vision of offering continent-to-continent satellite connectivity services has never been more relevant than now.

Being able to stay connected during operations is clearly vital for the armed services. But military bases also require telecommunications infrastructure for the wellbeing of soldiers on-site, from calls to family to connecting on social networks.

This year, SatADSL has improved and advanced its flagship, Cloud-based, *Service Delivery Platform (C-SDP)*, which enables hubs and teleports worldwide to interconnect, whatever the technology, so it can provide the higher levels of security needed when military, corporate and governmental organizations around the world need to transmit sensitive information across long distances.

Across the past year, the company has also extended its reach and influence through global *Points of Presence (PoPs)* that make the platform accessible to wider markets and which replicate SatADSL's European and African models. This has broadened the reach to the commercial market (mainly ISPs and large organizations), with a unique portfolio of connectivity services such as contended services, the software based VNOFlex, pre-paid vouchers, and congestion-based services.

ADDED SECURITY + RESILIENCE TO ADDRESS DEMAND

To address new markets in 2021 and beyond, SatADSL has secured funding further from the *European Space Agency (ESA)* to support its own enhancement of the C-SDP. ESA's **ARTES** program enables European companies to explore innovative concepts to produce leading-edge SATCOM products and services.

The '*Competitiveness & Growth*' element is dedicated to the development, qualification and demonstration of products, systems and/ or applications.

As an aggregator of high-end satellite services, SatADSL can offer a competitive advantage to European teleports by giving them an unique secured and resilient *Platform-as-a-Service (PaaS)* service that they can use for improving their service offering to their own customers, while at the same time monetizing their unused satellite capacity with new customers.

Through SatADSL's platform, service providers can also offer their own branded vouchers, allowing customers to buy access as and when they need and can afford it, and allocating bandwidth accordingly.

Corporate and governmental organizations around the world are increasingly requiring higher levels of security when transmitting sensitive information, either through permanent or on-demand connections.

Throughout 2020, SatADSL has been working to address increasing demands from its customers for it to respond to growing cyber-threats and natural/ human hazards. Thanks to



funding provided by the ESA under the **4S (Space Systems for Safety and Security)** Strategic Line of its ARTES program, SatADSL has embarked on a project which will increase levels of resilience, cybersecurity and quality on its C-SDP.

ESA's support will enable SatADSL to develop, test and validate security upgrades to its flagship cloud PaaS offer. The project consists mostly of system design, software developments and service demonstration with the objective of improving the existing C-SDP by adding security, service quality, resilience features to the platform. Furthermore, **Value Added-Services (VAS)** and a secured website will be developed for partner Teleports and ISPs in order to facilitate their access to the platform. The activity will also support the positioning of SatADSL in the high-end satellite service business by increasing the resilience and quality levels of its service delivery platform as well as the consolidation of SatADSL as an aggregator of high-end satellite services. It will also give a competitive advantage to teleports by offering them a unique secured and resilient PaaS service that they can use for improving their own service offering to their customers while at the same time monetizing their unused satellite capacity with new customers.

CONTINUED GLOBAL EXPANSION

When it started, SatADSL focused on providing services to Africa, where much of the population lack terrestrial services and rely on satellite-based options. For four years, SatADSL has also targeted satellite and teleport operators and proposed access to its platform in the form of PaaS to offer them all the embedded advantages of the technology.

SatADSL's mission to evolve as a continent-to-continent satellite services provider was propelled forward this year through its expansion into the Americas this year — the company established a new PoP in Orlando, Florida and partnered with teleport operator **Andesat** in the LATAM region.

The PoP unlocks range of benefits, such as accelerating operators' go-to-market time, thanks to the complete suite of ready-to-use tools available on the C-SDP at all levels of the value chain. A **Marlink** teleport in South America was the first to be connected to the Florida PoP, using a **SES 4** satellite with **ST Engineering Dialog®** technology, and integrated with SatADSL's C-SDP.

Another major step forward was SatADSL's strategic partnership with the teleport operator Andesat this year. The agreement opened new avenues for satellite services providers to access Spanish speaking markets throughout South America. The exciting new alliance has created a wealth of opportunities for bringing enhanced connectivity services to the region.

Partnering with Andesat will bring high-performance, reliable IP access services to parts of the continent where the COVID-19 pandemic has highlighted a real need for connectivity. Connecting to the **Eutelsat 117W** satellite, SatADSL is combining capacity from Andesat with its C-SDP to provide a full range of flexible satellite services across Argentina, Uruguay, Chile, Paraguay and parts of South Bolivia via Andesat's teleports.

The alliance also represents a significant landmark in SatADSL's efforts to eradicate digital divides around the world and reinforces the company's commitment to stimulating social and economic growth via the provision of cost-effective internet access.

2021 & BEYOND

The satellite communications sector still needs to break out of operating in individual silos. This lack of ability to bridge and to operate in a structurally collaborative system creates a fragile system that will struggle to survive major technological changes, such as the introduction of Low Earth Orbit (LEO) satellites.

It's important, even vital to the existence of the SATCOM sector, for disruptive technologies, such as the cloud, to be brought together and into the fold to deliver monetizable services. SatADSL's vision is to become the first company to apply the concepts of the new digital collaborative economy to the conservative, CAPEX-intensive world of satellite services, and become a facilitator by providing a PaaS to other operators willing to offer new services and to transact business with each other.

SatADSL is proposing a drastic change by interconnecting all teleports around the world with its platform. The platform will allow each teleport to resell services to whom it wants — including other teleports — at a price they decide upon. This allows each teleport to focus on offering its most efficient services and markets and avoid having to make significant and risky investments for customers or services that they have less control over.

SatADSL's plan is to become a "marketplace" (not owning any satellite, teleport nor hub infrastructure), making use of bandwidth coming from several competing sources and offering a complete portfolio of satellite services to its demanding customers. The approach will create a collaborative syndicate that is structurally more robust and efficient.

www.satadsl.net



This year has been unexpected and unique for industries, companies and individuals alike. At the start of the year, Spaceflight was scheduled to execute the most missions the company had ever done in one year, with several scheduled for the spring of 2020. To no one's surprise, the year didn't exactly unfold as expected.

However, despite the challenges and sometimes unbelievable global circumstances, this has been a significant year for Spaceflight. In 2020, Spaceflight achieved key business milestones, including the completion of the Mitsui acquisition, and debuted innovative programs and services, such as the Sherpa-NG (next generation) program and the Book My Launch online portal, both of which will benefit customers and provide unmatched launch flexibility.

SPACEFLIGHT INC. ACQUIRED BY MITSUI

At the beginning of this year, Spaceflight Inc.'s parent company, Spaceflight Industries, signed a definitive share purchase agreement with **Mitsui & Co., Ltd.**, in partnership with **Yamasa Co., Ltd.** to sell its satellite rideshare launch business. Following regulatory clearance in June of 2020, the acquisition of Spaceflight Inc. was finalized.

This acquisition presented an important opportunity for Spaceflight to further invest and expand our commercial and governmental rideshare launch services. The new autonomy and support from an established, global business provides our company with the independence and resources to focus on innovating and creating new service offerings that will improve our customers' launch experience. Spaceflight is dedicated to providing comprehensive launch services and providing smallsat companies with unmatched flexibility through its rideshare and mission management services.

THE DEBUT OF SHERPA-NG

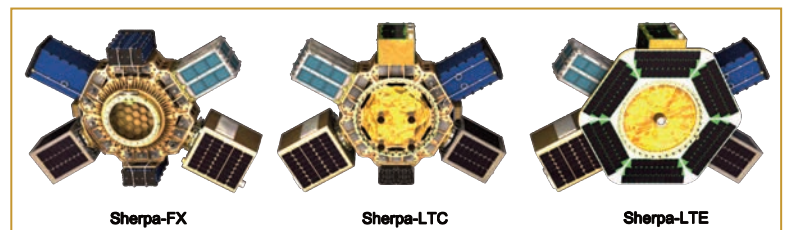
A key initiative for Spaceflight in 2020 was the debut of our Sherpa-NG program. This is one of the many flexibility initiatives we launched and were able to direct our attention to following the acquisition.

In-space transportation is essential to getting spacecraft delivered to orbit exactly when and where they need to be. However, more often than not, an ideal launch might not exist for smallsat companies. We saw an opportunity to offer customers a truly unique and valuable launch service by creating an OTV program with a portfolio of vehicles.

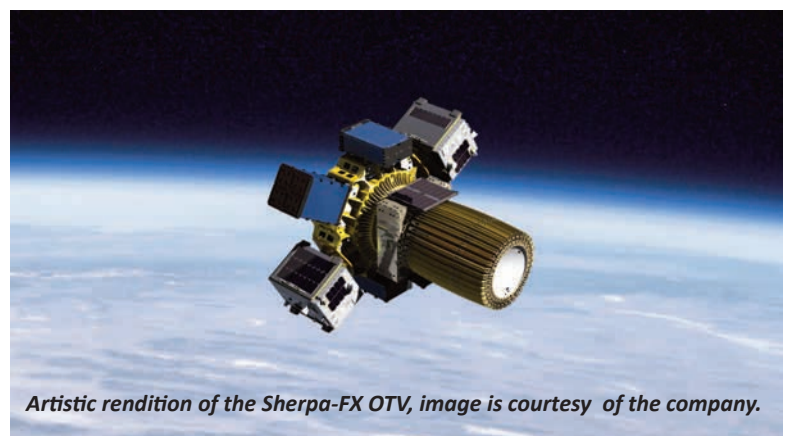
Sherpa vehicles take advantage of low cost rideshare launch options available in the market and drop the cost per port even lower by integrating multiple spacecraft onto one port. The vehicle also provides unique benefits, including high-definition telemetry data to support the identification process, increased

flexibility with the ability to easily move the entire OTV from one launch vehicle to another or remanifest individual satellites. Finally, it offers the ability to execute in-space transport to deliver customer spacecraft to an exact orbital destination. To meet the various needs of smallsat companies, the Sherpa-NG program contains three different vehicles.

- *Sherpa-FX is capable of executing multiple deployments, providing independent and detailed deployment telemetry, and flexible interfaces to accommodate different separation systems, minimizing development timelines while maximizing flight and schedule reliability and mission assurance. This is scheduled to debut on a SpaceX rideshare mission no earlier than December 2020.*
- *Sherpa-LTC features a high-thrust, high specific impulse (LSP) bi-propellant, green propulsion subsystem integrated seamlessly within the available space of the original free flyer. This propulsion technology from Benchmark Space Systems provides a low cost, rapid orbital transfer for many sizes of small spacecraft. This Sherpa is scheduled to fly the second half of 2021.*
- *Sherpa-LTE will include a low thrust, long duration propulsion system from Apollo Fusion, improving radiation tolerance, with the capability to deliver customers to a GEO, Cislunar or Earth-escape orbits. This vehicle provides a low-cost alternative to purchasing full direct-inject launch vehicles. The Sherpa-LTE is targeted to fly mid-2021.*



The Sherpa-NG program is poised to become a key element of our launch service offering by enabling increased flexibility,



Artistic rendition of the Sherpa-FX OTV, image is courtesy of the company.



Launch photo is courtesy of SpaceX

low-cost launch options and a variety of capabilities to support customers' mission needs.

ESTABLISHED KEY PARTNERSHIPS

Driven by our commitment to offer the most launch options to smallsat customers across the industry, we signed multi-launch agreements (MLA) with **SpaceX** and **Firefly Aerospace**. The SpaceX agreement secures capacity for Spaceflight on SpaceX missions through 2021, providing launch schedule assurance to smallsat customers needing frequent, reliable, and cost-effective launches to Sun-Synchronous Orbit (SSO). Additionally, we signed a MLA with our return customer, **Hawkeye 360**. Under the agreement, we will provide capacity, engineering, and mission management services to launch HawkEye 360's Cluster 4, 5, and 6 of its radio frequency mapping satellites.

Spaceflight also secured key partnerships with **Benchmark Space Systems** and **Apollo Fusion Inc.** to provide propulsion systems for the Sherpa-LTC and the Sherpa-LTE vehicles. These partners provide Spaceflight with reliable, trusted propulsion systems to deliver on-orbit transportation to customers.

NEW CUSTOMER PLATFORMS INTRODUCED

While the majority of Spaceflight's work is focused on the process of integration and launching satellites, we are always seeking opportunities to improve our customers' experience throughout the launch process. As such, we created several online initiatives to provide a seamless and simple customer launch process, including a reservation portal and a mission management platform.

Book My Launch allows customers to book a satellite launch completely online much like booking an airplane flight, while Mission Control provides customers with real-time status updates and milestone progress of their missions so they have easy access to information at every step of the launch campaign.

LEANING INTO 2021

Despite many schedule changes in 2020, Spaceflight has executed five missions already this year (with another planned) on four different launch vehicles in four different countries, taking nearly 50 smallsats to orbit. And, as the industry begins to see launch cadence pick up and a degree of normalcy return, we anticipate 2021 will be an even more active year for us, with several Sherpa launches.

While the year was unconventional and challenging in many ways, the accomplishments our team at Spaceflight achieved in 2020 will provide a strong foundation for the coming year and enable us to deliver unprecedented launch flexibility to smallsat customers.

spaceflight.com



Author Curt Blake is the Chief Executive Officer and President



of Spaceflight. He has more than 25 years of executive experience in high-growth technology industries. Under Curt's leadership, Spaceflight has successfully negotiated the launch of more than 300 satellites across 34 missions on behalf of its customers. Since the acquisition by Mitsui, and under Curt's leadership, Spaceflight introduced a wide array of flexible launch initiatives, including its Sherpa-NG (next-generation) program, new web portals to simplify the booking process and an identification program. Additionally in 2020, Curt led the company's efforts to secure a Multi-Launch Agreement with SpaceX, adding capacity and launch options to Spaceflight's already diverse launch portfolio. In 2019, the Spaceflight team executed nine successful launches, the most rideshare launches Spaceflight had performed in one year. Prior to moving into his role as CEO and president, Curt served as Senior Vice President and General Counsel for Spaceflight.

To say that 2020 has been unique would be a true understatement. At the beginning of the year, no one could have predicted the impact that a global pandemic could have on every aspect of our lives and the markets that the satellite industry serves.

However, despite the challenges that COVID-19 has thrown at every company this year, it's been an extremely busy and rewarding one for *ST Engineering iDirect* during which we have worked together with our partners to ensure our joint success in these challenging times. The year began with the exciting prospect of bringing two companies together and integrating our talent and portfolios and we are emerging from 2020 having achieved milestones in technology innovation. We know more change is coming — and we are ready for it.

In this article, we'd like to take you through just a few of the accomplishments of 2020 and the great things that have been achieved with our customers all over the world. Though COVID-19 may have forced us physically apart this year, the ties with our partners and customers are stronger than ever.



Connecting Remote Places on Earth

Working with our long-term partner, Peruvian service provider, *Andesat*, we enabled a regional *Mobile Network Operator (MNO)* to extend its reach to remote and rural

regions of the country. Known as 'Te *Connectamos Peru*,' this project is benefiting a universe of 60,000 towns and villages and a total of more than three million people. Using *Andesat's* already-installed multi-service *Evolution* hub, the requirement for any new services or hardware was eliminated and the



ST Engineering iDirect's Evolution 15100 Hub.

company was able to move rapidly into a new market, providing Wi-Fi and 4G services to villages and allowing residents to access voice, data and video via computer or mobile device. The timing of the project was crucial, given that connectivity to these remote locations is particularly important to stay connected against the backdrop of COVID-19. Satellite plays an integral role in delivery of vital services such as education and healthcare to these remote villages.

As a leader in satellite ground infrastructure and solutions for the cellular backhaul and trunking markets, it's critical that we collaborate with leading, like-minded players to continue to develop solutions for MNOs to extend their reach and solve the growing connectivity issues. Our work with the *Telecom Infrastructure Project*, or *TIP*, is a great example of the amazing work that can be done when we partner together. *TIP* helps accelerate the development and deployment of open, disaggregated, standards-based solutions with the goal of delivering high quality connectivity on a global scale.



Earlier this year our Head of Cellular Backhaul and Trunking, *Semir Hassanaly*, presented during their *Plugfest* event on the importance of establishing the right business case for satellite-based cellular backhaul.

CRITICAL CONNECTIVITY FOR GOVERNMENT

Satellite technology has been a critical enabler for government agencies in the worldwide response to the pandemic. Our customers stepped up to the challenge deploying highly available, reliable connectivity solutions to enable first responders and the healthcare providers across the globe.

For example, *Global Radiodata Communications* used the *iQ 200* modem for its *Satcube* solution that has been deployed to provide high-bandwidth, secure voice and data to medical teams. The lightweight terminal is online in less than a minute and is as simple as using a smartphone. It's this kind of instant access to connectivity that has been so critical at this time.





The **iQ LTE** is also having an impact in the first responder sector and has been integrated by **IP Access** into its **FUSION** range to create a converged solution that automatically finds and connects to all available networks, including LTE, 4G/5G and multiple satellite networks, without user intervention. As a result, it delivers reliable data communication for several use cases where the physical path redundancy is critical.



We have also supported those deployed to natural disasters that have occurred this year such as wildfires and hurricanes in the United States. The **Dialog** platform played an integral role in **Verizon's** response to **Hurricane Laura** earlier this year and enabled the re-establishment of connectivity to fuel the efforts of first responder and aid agencies to help rebuild and restore the community.

INNOVATION IN THE DEFENSE SECTOR

The **MDM9000** modem received **Wideband Global SATCOM** (WGS) Certification earlier in the year which expands our portfolio of WGS-certified solutions, including the **iDirect Evolution Defense** platform, **Tactical Hub**, and **9-Series** family of modems. Designed to support a wide range of fixed and mobile government and defense applications, the field-proven MDM9000 modem is now one of the most powerful DVB-S2X modems operating on the WGS constellation. Its flexibility and efficiency open up new capabilities for high-speed data links, complementing existing WGS-certified Evolution Defense Solutions.



The defense sector is a prime target for both cybersecurity threats and intentional and unintentional signal interference. With the digitalization of the battlefield has come increased risk. Security systems must therefore have the capability to predict, detect, prevent and mitigate the mix of threats that could hamper operations. Our latest **Evolution 4.2.2.0** release introduces **Communication Signal Interference Removal (CSIR™)** technology to effectively remove signal

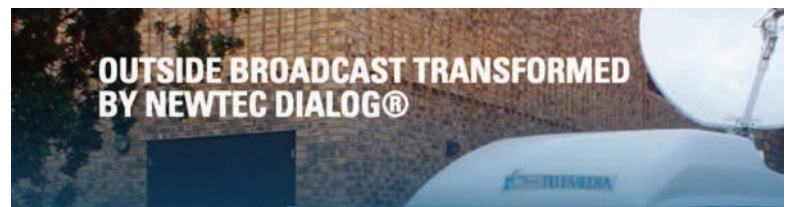
interference and reduce noise of satellite signal emitters in real time. This can help Defense customers to predict, detect, prevent and mitigate threats and vulnerabilities.

AGILITY IN BROADCASTING

We further strengthened our long-standing relationship with leading telecom provider **VIVACOM** with a new agreement to supply our **MCX7000** modulators to facilitate additional broadcast offerings in Eastern Europe and Africa. VIVACOM, the largest telecommunications provider in Bulgaria, will use the **MCX7000**, a dense DVB-S2X, multi-carrier, satellite gateway, to launch new video services in Africa, in partnership with a global satellite operator. The modulators will also provide enhanced services for an existing **Direct-to-Home (DTH)** operator across Eastern Europe.



Evolution 4.2.2.0 is the company's latest defense-grade release that enhances the Evolution Defense platform with information assurance (IA) and cybersecurity.



With the pandemic affecting live events broadcasters and **SNG (Satellite News Gathering)** operators were forced to learn to adapt and operate in very different circumstances. We supported our customers in their creative approaches to re-purpose SNG trucks, outfitted with our solutions, to turn them into mobile communication centers. These trucks can offer full IP capabilities and travel to wherever they are required for on-the-spot connectivity providing much needed help for aid agencies, medical staff and first responders.

We saw new interest in satellite's ability to provide OTT services this year. There was a dramatic increase in demand for video streaming and networks were hit with massive congestion as a result of home working and business closures, negatively impacting **Quality of Experience (QoE)**. Our solutions were used to facilitate offloading of traffic from the terrestrial backbone and to feed the **Content Delivery Networks (CDNs)**.

EXCELLING IN MARITIME CAPABILITIES

Mobility is set to be an even bigger theme in 2021 due to an inexorable rise in demand for connectivity anywhere — and we have bolstered our position on the high seas with some significant agreements. Our leading mobility position and

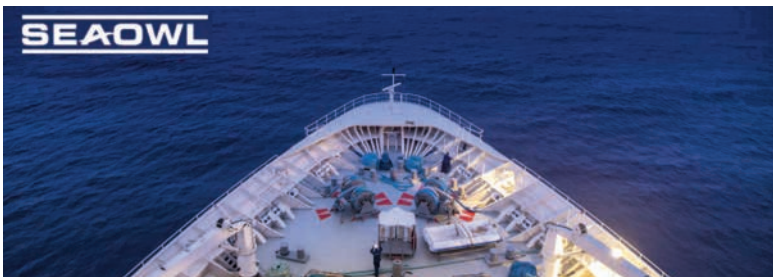


solutions that empower our customers across all mobility segments was recognized through the *MSUA Company to Watch* award. This was also a nod to our future vision and passion to facilitate seamless connectivity as new constellations, applications and markets emerge.

Speedcast has deployed the WTA Award-winning **Newtec** Dialog® platform to provide worldwide satellite broadband services for its customers. The deployment enables the service provider to respond to the rising requirement for high-speed connectivity on board cruise ships and may also be used for other vertical market segments with increasing bandwidth requirements, such as yachting, oil and gas and the enterprise market.

Already facing a daunting task of converting more than 100 maritime sites to this new technology, the team was confronted with a new challenge when COVID-19 prevented or delayed the dispatch of field engineers to some remote sites. The team came up with an innovative remote installation plan to move the project forward quickly, maintain the project plan timeline and support customer needs.

Marlink is also rolling out its deployment of Dialog that will help enable the company to deliver advanced solutions to their customers, further strengthening its maritime and enterprise offerings. This will enhance capabilities across additional market segments including shipping and tanker companies, cruise lines, ferries, yachts and fishing boats, all of



which have increasing throughput demands due to digital transformation. Our technology enables Marlink's special purpose highly resilient satellite network solution for the *Remotely Operated Service at Sea (ROSS)* project developed by offshore services operator **SeaOwl**.

In Africa, our long-term customer, **Paratus**, a pan-African telecommunications group, is leveraging our Evolution platform alongside modems with marine antenna from manufacturer and integrator **KNS**, to provide reliable, high-speed connectivity to mining ships based in Guinea. With ships essentially becoming offices at sea, we anticipate more demand for high speed, highly reliable marine connectivity in the future.



A MOVE INTO IOT

As everyone and everything becomes more connected than ever before our customers will gain first-mover advantage with our flexible IoT enablement solutions, enabling them to deliver an IoT solution whilst leveraging their existing infrastructure investments and capacity. The offering entails a complete connectivity solution for Service Providers to procure the IoT terminals from a single trusted source, and flexible Service enablement options easing the entry into the IoT market.



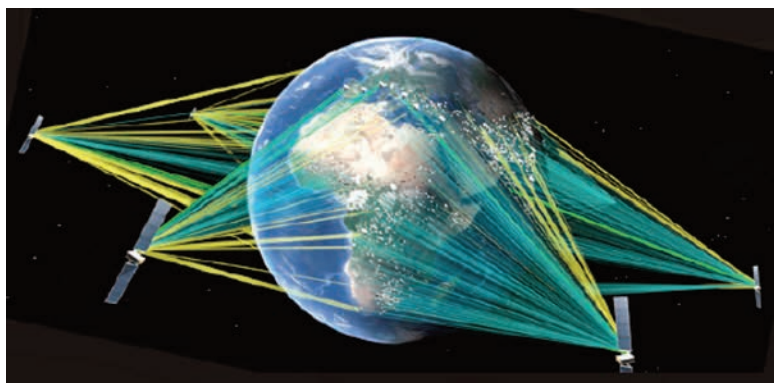
A VISION OF THE FUTURE THROUGH INNOVATION

Throughout the year, our team continued to be heavily involved in several consortia and initiatives that promote the integration of satellite into 5G delivery. To play a significant role, satellite must fit, seamlessly, into a 5G hybrid ecosystem and utilize the technologies that are native to the telco world such as virtualization, orchestration and software defined networking. That will enable us to leverage advances in our industry, such as the move to multi-orbit constellations, and be part of the global communications fabric.

In October, together with **Avanti Communications**, we enabled the successful integration of a commercially available 5G core network into a live satellite network within the **Sat5G** project. This marked a major milestone for the Sat5G initiative and the industry as a whole, as it was the first time a live satellite network has been managed and operated using a standard and unmodified commercially available 5G core network. Several 5G use case demonstrations over live satellite links were performed with satellites carrying out several different tasks. The project undertook research and demonstrated the benefit of satellite technology in delivering content to the network edge.



We have taken our first and very significant steps toward the multi-orbit approach that will define our future as an industry. Our high-performance ground infrastructure has been selected for **O3b mPOWER**, **SES's** next-generation MEO communications system. Pairing our breakthrough ground technology with spacecraft innovations, O3b mPOWER will enable a flexible, low-latency, high-speed, fiber-like



experience. Our ground technology is key to optimizing the end-to-end capabilities of the MEO constellation which promises to transform how satellite services are delivered.

But it's not just MEO connectivity where we have seen significant developments. We have also made groundbreaking advancements in LEO (Low Earth Orbit), as well. We completed the world's first **Over-the-Air (OTA)** testing of our **Multi-Frequency Time Division Multiple Access (MF-TDMA)** return link on the **Telesat Phase-1 LEO satellite**.

This achievement demonstrated dynamic sharing of bandwidth among multiple terminals within a LEO constellation, a capability that extends the capacity and flexibility of Telesat's multi-beam beam hopping architecture, and opens up a wide range of use cases for Telesat's LEO customers in the commercial, government, and defense markets.



Telesat's LEO constellation.

THE ROAD AHEAD


Though 2020 has been filled with challenges for everyone, there are many reasons to be positive and we will see recovery with markets coming back to 2019 levels in 2021 and 2022. NSR already forecasts long-term potential with SATCOM revenues reaching \$26.5 billion by 2029.

Some markets will recover rapidly but others, such as the aviation and IFC (Inflight connectivity) will take longer to bounce back to the levels they were at before. However, when they do, they will emerge as an important differentiator.

Technologically, there is much to look forward to and some disruptive technologies are emerging that will shape the future of our industry. Take virtualization and the cloud. As a ground infrastructure provider, we will create the scalability and throughput so that many different services may be used. This will transform the way in which satellites are viewed by the telecommunications industry and how satellites link up to the global fabric of terrestrial communication.

In 2021, we look forward to further enabling our customers and partners in our established, core markets and also to taking our first steps into new ones, opening up a new future of connectivity that can be enjoyed by everyone, everywhere.

www.idirect.net

 **ST Engineering** Author Thomas Van den Driessche is the President and Chief Executive Officer of ST Engineering iDirect.





Celebrating its 20th birthday in 2020, Wavestream has shipped more than 40,000 systems to airborne, ground/mobile, and gateway customers in support of both commercial and military applications. Wavestream has earned a reputation across the SATCOM industry for innovative design, high quality, reliability, and performance of its Solid-State Power Amplifiers (SSPAs), Block Upconverters (BUCs), Block Downconverters (BDCs) and Transceivers.

2020 IN RETROSPECT

2020 was a challenging year for the entire satellite communications industry. In a year full of disruption and uncertainty, Wavestream's employees, customers, vendors, and partners helped see Wavestream through one of the toughest challenges in its 20-year history. Like everyone else, Wavestream's employees had to learn how to adapt to business in a pandemic.

The best news is that Wavestream is going into 2021 with a head full of steam and a strong appetite for innovative and disruptive product development.

REFOCUSING ON MILITARY AND GROUND/MOBILE CUSTOMERS

In 2020, Wavestream changed several things about the company's approach to their military and ground/mobile customers. Two new sales executives have joined the Business Development and Sales team — *Tom Cox* and *Greg Johnson* — both of whom have more than 20 years of experience supporting defense and military customers in the satellite communications industry. Their experience as customers of Wavestream means they can deeply empathize with the needs of Wavestream's current and future customers.

Wavestream re-tooled its **Customer Support** department and promoted *Bruce Morris* to Senior Director of Customer Success. Bruce now oversees product repair, sustainment, and lifecycle management as well as handles any problems identified by Wavestream's customers that cannot be solved through the firm's normal channels. Bruce is empowered to be the advocate for Wavestream's customers and has already had a tremendous impact on several of Wavestream's customers.

Wavestream also re-imagined the way the company interacts with their customers, with a focus on Customer Intimacy — the idea that the best relationships with customers are the ones where no one can tell where Wavestream's

customer ends and it begins. Close alignment of Wavestream's priorities and a vigorous measurement of *Key Performance Indicators (KPIs)* has improved many facets of Wavestream's customer-facing capabilities and services.

SHIPPING WAVESTREAM'S 5,000TH 50W KA-BAND BUC TO THE U.S. ARMY + NEW GROUND/MOBILE PRODUCTS

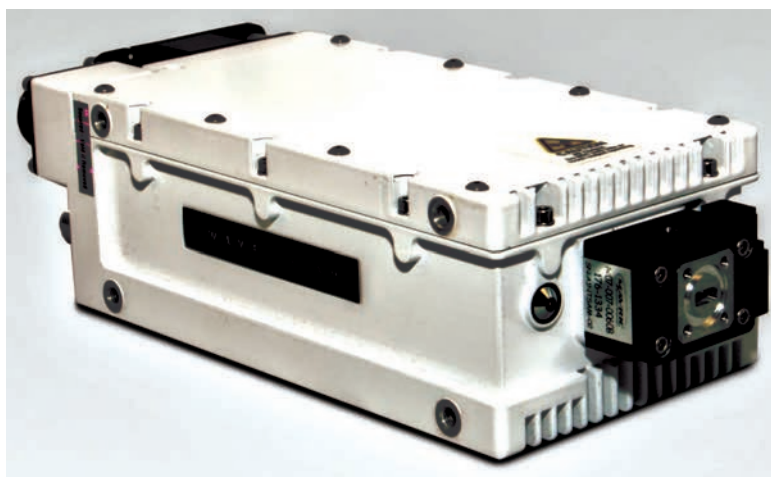
This month, Wavestream is celebrating a huge milestone by shipping its 5,000th *Matchbox 50W Ka* product to the U.S. Army in support of a major military communications program.



Wavestream's Matchbox 50W Ka-band BUC.

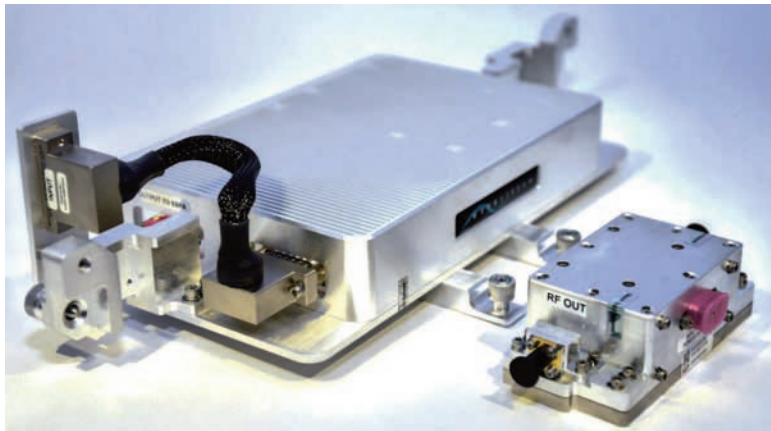
This is a tremendous moment in the history of Wavestream, as this program helped to first define Wavestream as a dominant Solid-State provider in the market more than 13 years ago.

Additionally, Wavestream also introduced a new *Matchbox 12W Ka*, Wavestream's smallest outdoor-rated SSPA product, as well as a new category of products called *MicroStream*, with the launch of *MicroStream 20W ku*.



Wavestream's Matchbox 12W Ka-band BUC.

The MicroStream product line represents Wavestream's tightly integrated BUC/SSPA/BDC solutions that are packaged inside of an integrator's terminal. These are designed for both ground and airborne solutions, specifically where the Power-to-Weight ratio is critically important. These products tend to be custom-built for specific applications. This means if a standard product does not meet a customer's needs, Wavestream's engineering team will work toward a solution that fits those specific, client needs.



Wavestream's MicroStream 20W Ku.

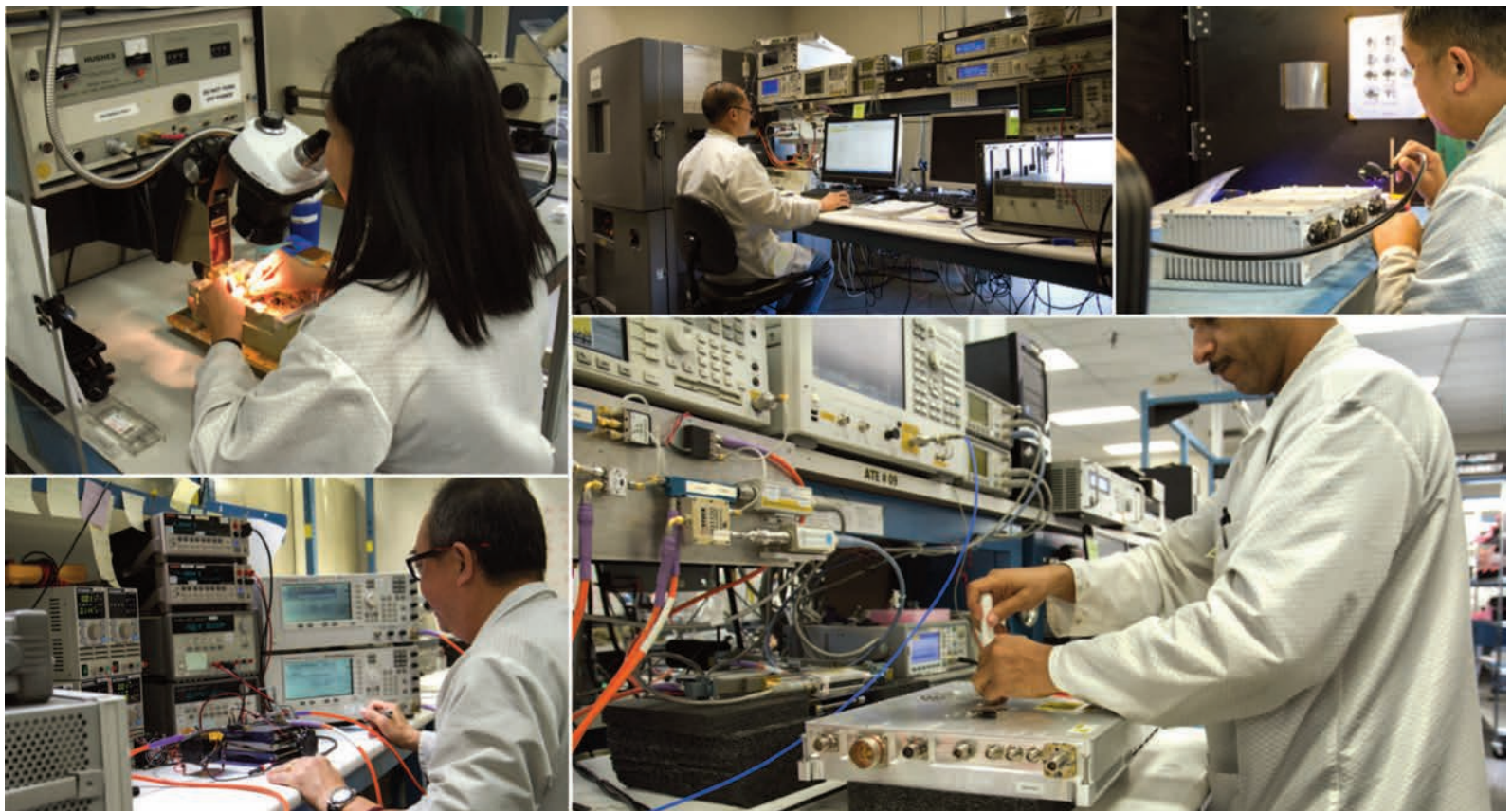
LOOKING AHEAD TO 2021 AND BEYOND

The Research & Development department at Wavestream is burning the candle at both ends these days. By the end of next year, Wavestream will have announced nearly a dozen new products and technologies that will transform much of Wavestream's industry.

The future of SATCOM systems integration will take place at the circuit board level and Wavestream is moving aggressively toward that style of engagement with the company's customers.

In 2021, Wavestream intends to announce several new products in the MicroStream category, allowing *Electronically Steerable Antennas (ESAs)*, *Comms-on-the-Move (COTM)* and *Unmanned Aerial Vehicle (UAV)* system integrators to pack far more power into a much smaller footprint.

Around mid-2021, Wavestream will launch an entirely new product line of highly modular SSPA/BUC/BDC solutions that can fit together to create hundreds of unique solutions for Wavestream's customers. This modular concept allows the firm's engineering staff to quickly build new purpose-built solutions and allows customers to spare modules that fit together like building blocks. These modular solutions will also redefine redundancy in a far more fluid manner, allowing for graceful failures with simple replacement processes as opposed to a hard failure that results in shipping an entire BUC/SSPA assembly back to the factory to fix one, small component.



A look inside Wavestream's manufacturing facility in San Dimas, California.

Team Wavestream celebrating 20 years of excellence.



BRINGING 5G TO THE BATTLEFIELD

Starting in 2021, Wavestream will begin rolling out products and technologies to enable 5G on the battlefield for Gateway, Ground/Mobile, Airborne, and even Space-based platforms.

To enable higher bandwidth 5G services in support of streaming video and real-time collaboration tools, satellite networks need to push more data through a limited amount of bandwidth.

A trend that we are witnessing in the commercial world is the use of higher order modulation waveforms across satellite networks. These high modulation waveforms require extremely clean RF paths with very little phase noise and high flatness and linearity. By optimizing the RF equipment for higher Error Vector Magnitude (EVM) and Noise Power Ratio (NPR) at the Gateway,

on the Satellite and at the End User Terminal, a satellite network can carry as much as eight times the data in the same bandwidth as current MILSATCOM links today can deliver.

A BRIGHT FUTURE

With the first 20 years under Wavestream's belt, the firm is moving forward at full speed to engage the next 20 years. As the defense market starts to adopt some of the technologies being rolled out in the commercial sector, such as LEO/MEO satellite constellations, higher order modulation schemes for more Bits per Hertz as well as ESA technologies, Wavestream will continue to design, develop, and deliver world-class products, technologies, and support for Wavestream's customers and partners for generations to come.



Increasing Data Throughput in Limited Bandwidth

By Tom Cox, Vice President Sales & Business Development, Wavestream



At Wavestream, we are watching a change in attitude toward network optimization in the commercial world, specifically among the Non-Geostationary Orbit (NGSO) constellation providers.

Traditionally, satellite networks were created by integrators or service providers who lease bandwidth from an operator, buy terminals from an integrator and re-sell services to an end user. All these systems being manufactured by various parties meant that there had to be some minimum standards; however, no one organization was responsible for all the specifications — optimization of the network was not high on anyone's priority list.

For these large NGSO constellations to close their respective business models, they need to provide as much capacity as possible — and fill it with customers — to avoid being underwater in revenue vs. cost. As these new constellations are developing not only the satellites but also the Gateways and the End User Terminals, they can optimize the entire network for extremely high orders of modulation, allowing for as much as eight times the amount of data in the same bandwidth as traditional satellite networks.

I believe this is an important trend that will eventually take hold among GEO operators in the commercial and military worlds as well. With the ubiquity of high-quality video and real-time collaboration apps throughout commercial and military applications, the need for more throughput will continue to outstrip bandwidth capacity.

To support these high-order modulation networks, Wavestream has developed extremely high EVM and NPR solutions that can be applied at the Gateway, on the Satellite, and at the End User Terminal, be it on the ground, at sea, or in the air. To use an analogy, when switching from 3G to LTE, carriers upgraded the base stations, and smartphone manufacturers upgraded the radios in the smartphones. They used essentially the same bandwidth for both 3G and LTE signals, but LTE provided far more throughput for the same bandwidth.

At the end of the day, cramming more bits per Hertz just makes sense.

www.wavestream.com/



Tom Cox has been in and around the Satellite Communications industry for nearly 25 years, starting as a satellite controller in the US Army. He has held roles in Engineering, Product Management, Innovation, and Business Development at multiple systems integrators and he founded two startup companies. Tom has an MBA from Georgia State University and lives in Atlanta. Contact Tom at tom.cox@wavestream.com



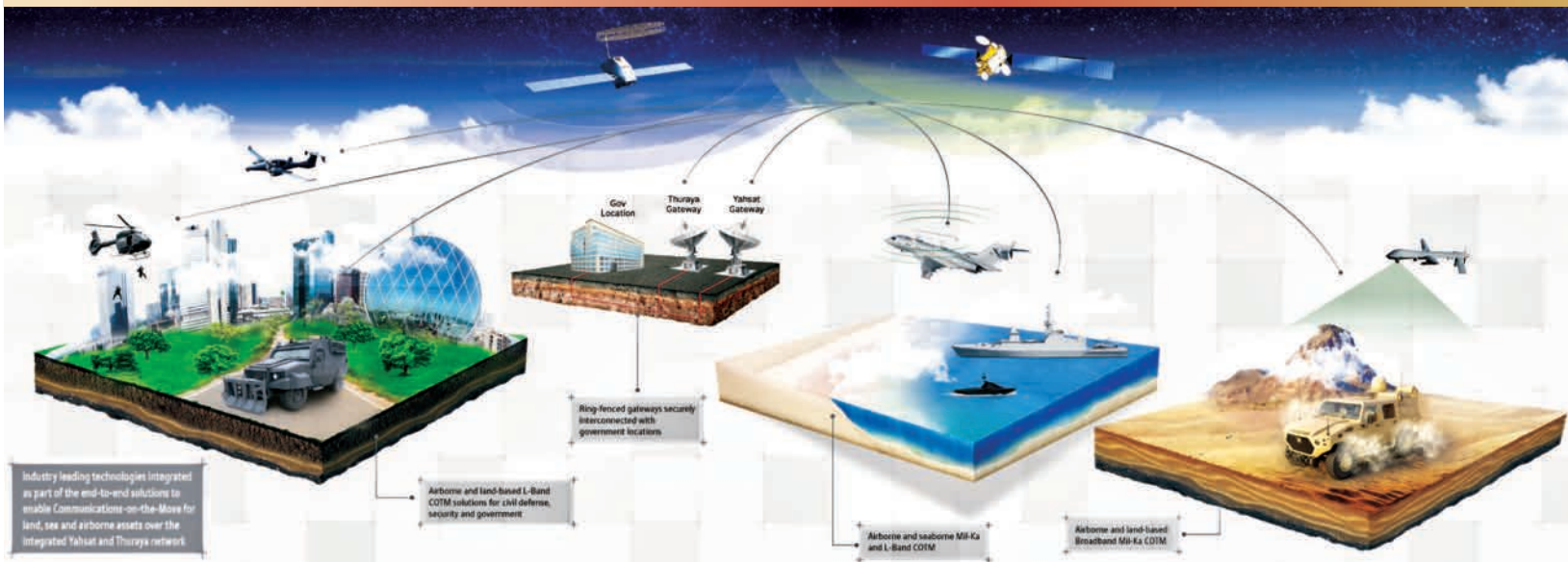


Figure 1. Yahsat provides end-to-end solutions to enable Communications-on-the-Move

on land, seaborne and airborne platforms over the company's integrated FSS - MSS network. [To better view this infographic, please access this direct link...](#)

PLATFORM INTEGRATED, SATELLITE-ENABLED COTM SOLUTIONS ENSURE MISSION SUCCESS

By Eisa Al Shamsi, Deputy General Manager, Yahsat Government Solutions

Critical communications between Command Centers and troops in the field call for systems that are reliable, available and secure. With militaries transitioning to connected, unmanned and collaborative combat, satellite communications are the only way to guarantee Beyond-Line-of-Sight (BLoS) extended connectivity, considerably reducing the decision-making process to a few seconds, and giving a vital tactical advantage.

Initially reserved for Special Forces operating in depth within enemy lines and commanders, satellite-enabled Comms-on-the-Move (COTM) solutions are increasingly preferred by military, government, and commercial users to maintain communications in any situation on vehicular, seaborne and airborne platforms.

TAILORED FOR GOVERNMENT OPERATIONS, APPLICATIONS + OTHER CRITICAL NEEDS

The lessons learned from large scale deployments have created requirements for satellite-based COTM solutions supporting different concepts of operations, ranging from ensuring a wider area of coverage and stable connectivity during sand storms and tropical rains to higher data rate connectivity in more geographically focused operational areas (see Figure 1 above). Furthermore, newer defense and government use cases demand flexible, secure platforms with beyond-line-of-sight capabilities to enable a host of bandwidth hungry applications supporting the *Connected Soldier*, *Artificial Intelligence (AI)*, *Common Operational Picture*, *Situational Awareness* and *Remote Command and Control*.

Providing ubiquitous coverage, satellite architecture is expected to leverage network orchestration, software-defined technologies, virtualization and slicing functions to offer defense entities a seamless communication service anywhere in the world. Besides combat scenario

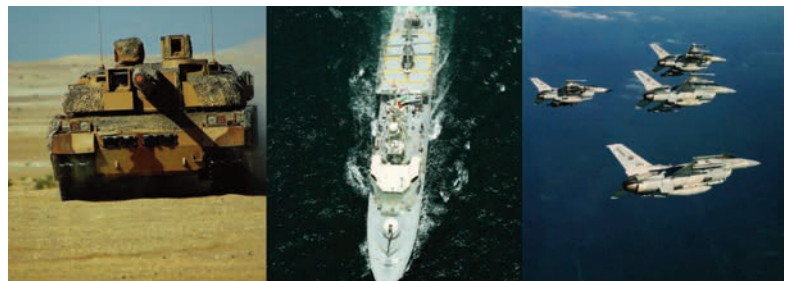
applications, armed forces and governments require these communication systems to deliver humanitarian assistance, disaster relief, telemedicine and training. Governments' bid to improve their communication infrastructure is spurring service providers, such as Yahsat Government Solutions, to expand the scope of COTM services to include flexible options, addressing their different operational needs:

Designed for rough conditions

COTM solutions are developed to be deployed in situations that are very constrained. They are rugged and robust, and usually mounted on platforms that bounce around in dirt or tossed by rough seas while providing consistent operational performance.

Multi-network COTM system interoperability

An effective COTM solution works on secure, reliable, flexible and dedicated networks that are interoperable between themselves and with existing communications infrastructure to ensure persistent and resilient connectivity. Such systems operating on multiple networks, enable users to cope with the complexity, uncertainty and dynamic nature of an emergency, allowing them to integrate tactical information from multiple sources (more than one Command) to improve effectiveness and achieve a common operational picture.



Operating on multiple satellite frequency networks

Comprehensive satellite services, operating cohesively on different frequency bands ensure real-time information sharing for situational awareness. Users now look to switch between frequency bands based on their operational requirements, as the military community considers such operational flexibility critical for mission success.

Manned-Unmanned Teaming (MUM-T) operations

As militaries continue to invest in new capabilities such as teaming of manned and unmanned platforms, integrated satellite COTM solutions have become a core component. They meet user requirements for HDR video processing, tracking, surveillance and monitoring on remote operated vehicles and airborne systems, working hand in hand with manned command post communication vehicles, seaborne, and airborne platforms. As a result, users gain capabilities for additional situational awareness and are able to accommodate C4I/C2SA systems.

Integration with other combat sub-systems

Users require COTM solutions on various land, sea and airborne platforms to be designed to integrate easily with other combat and operational systems as a single offering.

Communication redundancy and resilience

Satellite-based COTM solutions often provide redundancy to the traditional, line-of-sight land-based variants. Moreover, a COTM service operating on multiple frequencies enables users to counter possible jamming measures by opponents or link degradation due to adverse weather conditions. When links are provided through multiple satellites — a case in point being Yahsat and Thuraya systems — on the same platform, the risk of both of them getting compromised by weather or offensive frequency jamming measures is mitigated.

COMPREHENSIVE PORTFOLIO OF NEXT GENERATION COTM SOLUTIONS

Yahsat offers cost-effective, turnkey solutions with advanced capabilities to enable comms-on-the-move on vehicular, sea and airborne platforms over its integrated FSS - MSS network. After acquiring Thuraya, Yahsat has grown to be one of the few satellite operators in the world, operating networks that provide both government-focused Ka- and L-band services as part of an integrated network solution. Drawing on the synergies of both Ka- and L-bands, Yahsat's COTM services enable communications with high throughput rates in good weather, in addition to providing resilient links, which are operational even in inclement conditions.

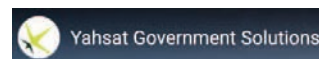
In addition to ensuring uniform coverage across vast geographies, L-band allows Yahsat to design terminals with smaller form factor and antennas, making them lightweight and portable to enable tracking and monitoring, command and control and situational awareness. While Ka-band devices support significant uplink data rates for programs such as government Intelligence, Surveillance, and Reconnaissance (ISR) and other data-intensive applications.

Yahsat's COTM solutions provide operational units secure connections with high availability to exchange HDR videos, voice and data flows in fast evolving circumstances, and can be integrated with tactical radio as well as C4I systems. They enable capabilities that are not available through legacy non-satellite based communication systems for applications such as beyond-line-of-sight ISR, and remote command and control on both manned and unmanned platforms. Users can add equipment sensors, video cameras and radios to mobile platforms on land, at sea or in air. Recent developments and growing government interest While Yahsat provides an extensive range of airborne COTM solutions, it is generating interest in its land vehicular and seaborne COTM solutions for both manned and unmanned applications. After its successful COTM capability demonstrations on airborne platforms in 2019, vehicular and shipborne platforms in 2020, Yahsat is currently working with some government end users to hold a series of demonstrations in 2021.

Recently, owing to customer interest, Yahsat has been working on an integrated mobile platform for a telemedicine solution, comprising a wide range of medical sensors and devices linked remotely by satellite connectivity. It facilitates full motion video, audio and ultrasound streaming to support medical tele-monitoring and expert tele-consultation. The hardware can be deployed on ambulances and medevac vehicles as well as ships functioning as remote clinics in flashpoints, disaster-stricken areas or regions lacking GSM telecom infrastructure.

Innovation is all about continuous development and improvement, and satellite technology is no exception. Melding Ka- and L-band COTM technologies, Yahsat is constantly developing superior, more resilient and flexible systems to meet the growing needs of its government customers on land, sea and air platforms.

www.yahsat.com/en/government-solutions/



Eisa Al Shamsi is the Deputy General

Manager for Yahsat's Government Solutions (YGS). He is responsible for the Government Business including systems infrastructure, projects delivery, operations and maintenance services. With his extensive technical and commercial expertise,



Eisa leads the department's strategy and operations to grow in line with Yahsat's mission and objectives. Prior to his role as YGS Deputy GM, Mr. Al Shamsi was the Executive Vice President of Engineering and Program Management at YGS where he was responsible to deliver YGS projects and ensure the design of the Yahsat Military network. Eisa holds an Executive MBA from INSEAD and a Bachelor of Science in Electrical and Electronics Engineering.



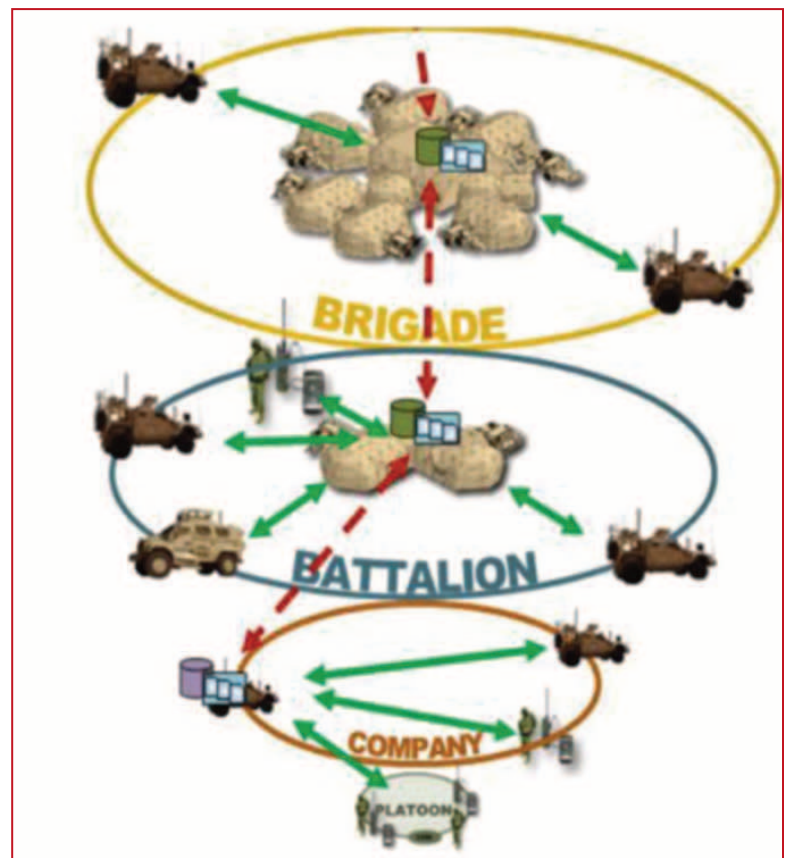
NETWORK CENTRIC WARFARE ARCHITECTURE ON A SATCOM BACKBONE

By Cristi Damian, Vice President, Business Development

In 1990, the US Department of Navy published 'Copernicus,' a battlefield communications modernization abstract that brought the term 'Network Centric Warfare' (NCW) into the light. Intended to unseat the military's traditionally disconnected, hierarchical structure, NCW was a strategic concept that involved the utilization of evolving technologies to connect smart weapons, sensors and surveillance platforms as a means to improve readiness and response times through the rapid collection, analysis and dissemination of data.

Observing the corporate domain's moves toward network-centric operations and processes by incorporating the latest available technologies, military strategists realized that the speed and efficiencies that resulted could be also be applied to the military machine. Despite the challenges of driving new technologies into traditional battlefield architectures, the move from massive divisions to highly connected brigade and battalion-level formations is finally coming into play.

The key benefit of NCW is that it provides the foundation for self-synchronization at the combat-unit level. By incorporating the inherent sophistication of today's information technology, some nations are transforming their Armies into networked organizations as a means to maintain situational awareness on the battlefield — to increase combat power by enabling collaboration among highly dispersed forces.





Self-synchronization drastically reduces response time, denies the enemy's initiative, allows a smaller, distributed force to paralyze a much larger opponent, and can ultimately lead to "success without fighting." Generally speaking, self-synchronization allows 'distributed' forces to organize and synchronize from the bottom up.

The keyword here is 'distributed' forces. In order to gain network centrality through self-synchronization, these distributed elements must be interconnected with links that deliver the highest degrees of security and ubiquity — and this is where **Advantech Wireless Technologies (AWT)** comes to the party. The core of AWT's SATCOM-based **NCW Network Solution** is based on voice, video and data communications subsystems that are networked over a combination of terrestrial and satellite-based platforms.

AWT has been a market leader in the design and deployment of satellite Earth stations and is abundantly aware of the problems militaries face with forces that operate over a centralized platform.

From AWT's purview, a large SATCOM teleport is seen as an imminent point of failure. Large teleports with multiple antennas are subject to enemy attack from something as simple as a weaponized drone — even before the conflict is declared.

Physical damage or even IP-based viral infections will render a teleport inoperative for months. In the traditional battlefield hierarchy, disabling the centralized hub would be catastrophic to field operations. AWT's NCW Network Solutions ensure that all battlefield elements are interconnected with dedicated links that are protected against

interference or disruption from outside forces, ensuring that field personnel are safe, informed and effective.

The preferred approach is to incorporate a **Hub Centric Mesh (HCM)** Architecture. Unlike a central teleport that is easy to target, HCM involves a distributed network of smaller hubs, where each is able to serve as the Main Hub with the ability to operate on a number of different frequency bands simultaneously. For example, a network based on HCM architecture can be designed to communicate over multiband (C-, X-, Ku- and Ka-band) terminals, while maintaining a global view of the battlefield.

With more than 30 years of experience providing innovative solutions to numerous MODs, AWT is keenly aware of the challenges that government organizations face when attempting to incorporate the latest technologies into traditional battlefield architectures. The good news is that these challenges can be overcome by AWT's system engineering team that will design, integrate and deploy battlefield networks comprised of the latest technology innovations, including encryption, anti-GPS jamming, Private LTE and compatibility with the new 5G and LEO satellites.

AWT's rich history in the design and deployment of satellite and terrestrial networks has afforded the AWT team with the necessary tools and experience to produce agile and robust network designs, including link calculations, integration, test and even the manufacture of many of the system elements — a key differentiator from its competitors.



*Advantech Wireless'
2.4 Meter Flyaway Engage™
ClassHigh Performance
SATCOM terminal.*

TACTICAL SATCOM NCW CONCEPT

For brigades and battalions to be compact, mobile and connected, network designs must be based on the latest SATCOM technology with multiple layers of comms and sensing that are jam-proof and highly resilient. One way that ATW has addressed this need is with the firm's Engage™ class of mobile flyaway SATCOM terminals.

The **Engage™ Flyaway** and **Trailer** terminals from AWT are specifically designed to survive stringent battlefield conditions and can operate in the C-, X-, Ku- or Ka-band satellite bands by merely swapping feeds — an exercise that can be accomplished in a matter of minutes. With multiple baseband options, these terminals will operate within a variety of VSAT network architectures as remotes or as hubs, in **STAR** or **MESH** mode, **SCPC** or **TDM/TDMA**. By incorporating a transmitter amplifier from AWT's wide range of products, data throughput requirements can be matched with the suitable GaN-based **SSPA**.

Traffic dimensioning is an important feature of the **Engage Class** terminals. Link size and bandwidth efficiency are scalable by selecting from TDM/TDMA or SCPC modes. Plus, Engage terminals will operate in MESH, STAR or Point-to-Point system architectures.

The ability to operate at multiple data-throughputs is key in NCW, not

only for the purpose of accommodating dynamic capacity requirements, but also for tactical dissimulation. It is well documented that, while the enemy might be unable to decrypt the transmitted data, command center locations can be identified by pinpointing the origination of the highest data rate links.

ADDITIONAL FEATURES

Customers can select from a long list of options that will tailor the Tactical Satcom NCW platform to a specific set of requirements.

Mobile ad hoc Network (MANET): Tactical Radios that are tied to a MANET network are provided to cover the need for edge distribution, frequency changes and integration of voice, video and data. Users can share all information without the need to configure a dedicated IP address. AWT's embedded MANET allows video sharing on encrypted channels from vehicle or shoulder mounted cameras. The networks are self-organized and users can easily be added or removed.



Phantom™ Class ISR UAV: These long-range UAVs serve as airborne mobile radio extension nodes for the MANET network and provide high rates of video surveillance data and voice traffic over distances of up to 70 Km. Phantom UAVs are designed to operate continuously for 20+ hours and are equipped with sophisticated IR cameras that can work during day or night – even in fog conditions. The onboard GPS and laser sighting tools allow target identification and location coordinates. UAV data can easily be made available to the Engage ground terminals.

Beamforming Radio Technology: Will extend the UAV's surveillance data download range of up to 200 km.

Private LTE: A Private LTE network using smartphones with secure SIM cards allows users to communicate within a 1 km radius over frequencies outside of the public LTE networks. This can be a valuable tool if the Army participates in a disaster-recovery exercise when the Public LTE network is down. Private LTE networks can join others when operating as extensions of Engage terminals that are interconnected via satellite backbone.

RADAR: Mobile RADAR systems are available as vehicle mount or man-portable to detect and identify approaching targets, including UAVs, using high-accuracy sensors. Sensor information can be stored locally, remotely and made available to Command Centers.

Network Management System (NMS): All elements of the NCW network are connected to a global network management platform with a proprietary operating system and Graphical User Interface (GUI) that shows the status of each component in the network as well as a top level overview of the entire theater.

Network Centric Warfare is a reality of the 21st Century and a necessary component of any military force that must perform against well-armed adversaries.

Advantech Wireless Technologies has the knowledge, experience and cutting-edge products needed to design, integrate and deploy high-performance battlefield networks – networks engineered for all threat-levels.

"If you find yourself in a fair fight, you didn't plan your mission properly." — David Hackworth

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Wireless in 1995 and has held executive positions including in Operations, Manufacturing, Sales, and Engineering. His expertise is centered on Solid State RF technology for Space Applications, and complex integrated networks design.



Advantech Wireless' Engage™ Class Brigade Comms Trailer.

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