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Front cover photo courtesy of Netwatch

Big tech is transforming the security sector

Powering homeland security

Q&A Intelsat General

Tactical communications

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Serving the subsea market -page 8

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● ● *If you would like to supply information for future issues of GMC please contact Amy Saunders, Editor.*

Photo courtesy Intelsat General

Northrop Grumman delivers first command center for US Army Integrated Air and Missile Defense ●●

Northrop Grumman Corporation has delivered to the US Army the first production-representative engagement operations center (EOC) for the Integrated Air and Missile Defense (IAMD) Battle Command System (IBCS).
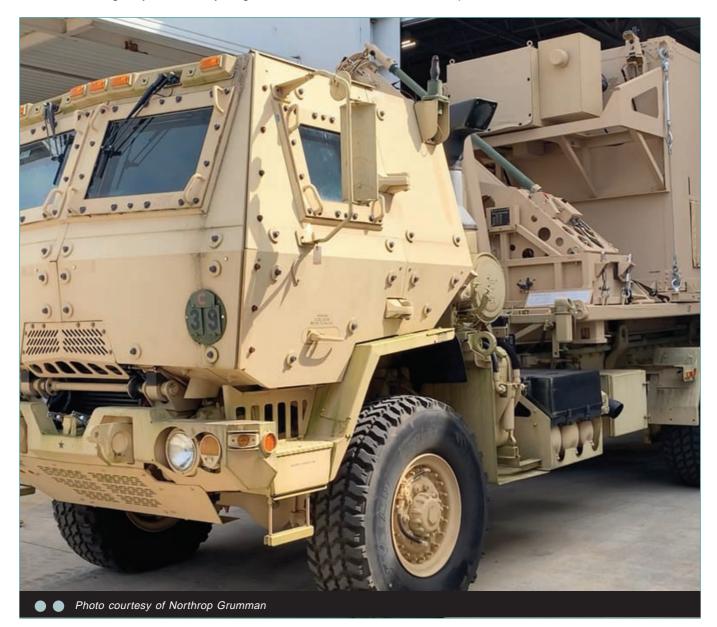
"This milestone is testament to the significant progress toward operational capability that will make pivotal differences to warfighters, commanders and acquisition officials," said Dan Verwiel, Vice President and General Manager, Missile Defense and Protective Systems, Northrop Grumman. "We will be delivering more EOCs as well as IBCS integrated fire control network (IFCN) relays in the near future. These articles will be used for initial operational test and evaluation (IOT&E), which informs future production decisions."

The delivered IBCS EOC has completed all functional configuration audits for major configuration items and system verification review, and is representative of the production configuration for hardware and software that will undergo qualification testing before IOT&E. Northrop Grumman is on pace to deliver 11 EOCs and 18 IFCN relays for the IBCS program by the end of the year.

"Northrop Grumman will continue to closely collaborate with our customer and user communities to realize the groundbreaking vision of IBCS and its transformative impact on the air and missile defense mission," said Verwiel.

IBCS is a paradigm shift for IAMD by replacing legacy stove-piped systems with a next-generation, net-centric approach to better address an evolving array of threats. The system integrates disparate radars and weapons to construct a far more effective IAMD enterprise. IBCS delivers a single integrated air picture with unprecedented accuracy as well as broader surveillance and protection areas. With its truly open systems architecture, IBCS allows incorporation of current and future sensors and effectors and enables interoperability with joint C2 and the ballistic missile defense system.

IBCS is managed by the US Army Program Executive Office for Missiles and Space, Redstone Arsenal, Alabama. **GMC**

●● *Photo courtesy of Northrop Grumman*

Huntington Ingalls Industries delivers eighth National Security Cutter Midgett to US Coast Guard ● ●

Huntington Ingalls Industries' Ingalls Shipbuilding division has delivered the National Security Cutter (NSC) Midgett (WMSL 757) to the US Coast Guard. Midgett is scheduled to sail away in June and will be commissioned later this year.

"We have a mission statement in the NSC program that says during the construction of each NSC we will provide the men and women of the United States Coast Guard with the finest ship in their fleet," said Derek Murphy, NSC Program Manager. "This excellence will be provided by our shipbuilders through working safely, attention to detail and ownership of work. Since the beginning of construction on NSC 8, we've seen an amazing transformation, made possible by the thousands of people who poured their heart and soul into this ship."

Ingalls has now delivered eight Legend-class NSCs and has one more under construction and two more under contract. Stone (WMSL 758) is scheduled for delivery in 2020. In December of 2018, Ingalls received two fixed-price incentive contracts with a combined value of $931 million to build NSCs 10 and 11.

"From a homeland security and defense perspective, this ship provides unmatched command and control," said Cmdr. Brian Smicklas, Midgett's Executive Officer and Acting Commanding Officer. "We've reached a number of accomplishments and milestones up to this point; however, there's more work to do on the water. We have record drug flows in the eastern Pacific, and there are traditional Western Hemisphere missions that our Coast Guard brothers and sisters are conducting on the water every day. We also see a large increase in demand for the geographic combatant commanders for this specific National Security Cutter capability, and we're excited to fill that and be a part of the national fleet."

NSC 8 is named to honour the hundreds of members of the Midgett family who have served in the US Coast Guard and its predecessor services. At least 10 members of the Midgett family earned high honours from the US Coast Guard for their heroic lifesaving deeds. Seven Midgett family members were awarded the Gold Lifesaving Medal, the US Coast Guard's highest award for saving a life, and three were awarded the Silver Lifesaving Medal.

NSCs are capable of meeting all maritime security mission needs required of the high-endurance cutter. They include an aft launch and recovery area for two rigid hull inflatable boats and a flight deck to accommodate a range of manned and unmanned rotary wing aircraft. The Legend class is the largest and most technologically advanced class of cutter in the Coast Guard, with robust capabilities for maritime homeland security, law enforcement, marine safety, environmental protection and national defense missions. NSCs play an important role enhancing the Coast Guard's operational readiness, capacity and effectiveness at a time when the demand for their services has never been greater. **GMC**

● ● ● *With the signing of the ceremonial documents, custody of the National Security Cutter Midgett (WMSL 757) is officially transferred to the US Coast Guard. Pictured (left to right): Cmdr. Brian Smicklas, executive officer, Midgett (WMSL 757); Capt. Travis Carter, commanding officer, Project Resident Office Gulf Coast; and Derek Murphy, Ingalls' NSC program manager. Photo by Derek Fountain/HII*

Photo courtesy of Ultralife

Powering homeland security: Why batteries for homeland security need to adapt to a changing threat ● ●

The nature of terrorism is changing and the threat of domestic attacks in the USA and Europe has bolstered defence spending. Michele Windsor, Global Marketing Manager at global battery manufacturer Ultralife Corporation, explains why the increased focus on homeland security should prompt original equipment manufacturers (OEMs) to rethink the way they're powering their devices.

Following a peak in 2014, there has been a global decline in the number of deaths from terrorist attacks. According to the 2017 Global Terrorism Index (GTI) produced by the Institute for Economics and Peace (IEP), there were 25,673 deaths in 2016; a 13 percent decrease on the previous year.

Excluding Iraq, which experienced a 40 percent increase in deaths in 2016, four of the five countries most affected by terrorism — Afghanistan, Nigeria, Syria and Pakistan — also recorded a reduction in the number of deaths.

The less positive news is that, despite military gains in the fight against ISIL in Iraq and Syria, the group's activities have given rise to attacks in Europe and elsewhere in the world. According to the GTI's analysis: "As its battlefield losses have intensified, many foreign and domestic fighters have deserted and sought to return to their countries of origin… more troubling is the potential for many hardened fighters and leaders to leave Iraq and Syria to join new radical permutations of ISIL or existing ISIL affiliates in other countries."

Along with a fresh wave of attacks, the nature of the threat has also changed. It has moved away from sophisticated and premeditated attacks that require a lot of people and use telecommunications networks to make things like bombs, towards simpler lone-wolf attacks, which use low-tech means such as knives and vehicles.
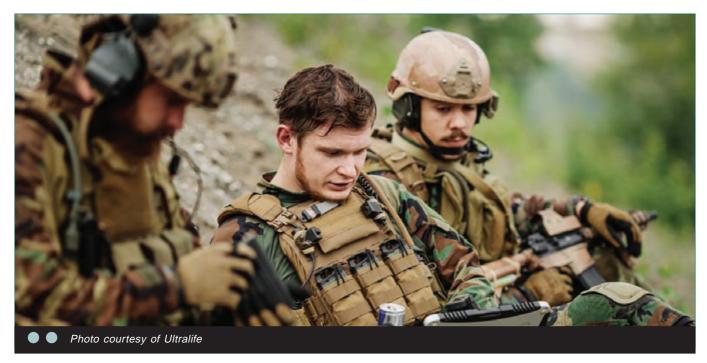
The threat to homeland security means that defence budgets have been bolstered. In February 2018, the US Department of Homeland Security (DHS) issued a statement on the President's Fiscal Year 2019 Budget that explained: "The FY 2019 Budget reflects the administration's priorities, including ensuring the safety and security of the American people. The budget requests $47.5 billion in discretionary budget authority for the DHS, a $3.5 billion or 7.8 percent increase from the FY 2018 President's Budget."

Changing threat to changing tech

As we begin to see this threat shift from the busy streets of Baghdad to the equally packed ones of Boston, it's important that the technology used by security professionals is up to the task. For OEMs supplying the homeland security market, this is a crucial time to review the technology and the batteries used in their devices.

Whether they are used by anti-terrorism staff, border security personnel, immigration and customs officers or cyber security experts, the range of devices used in homeland security applications is broad and varied.

In counter-terrorism operations, undercover officers may need to plant covert listening devices to surveil suspected terrorists. In first-responder situations, police officers may rely on wearable body-cameras to record vital footage from the scene, and in security applications, buildings may need to be protected using motion detectors and wireless alarm systems.

Photo courtesy of Ultralife

However, the problem is that many of the devices traditionally used in these applications are not much more suited for specialist use than the consumer environments they were initially developed for. The batteries used in these devices aren't much better either and lack the crucial ruggedness, longevity and power delivery that's necessary for prolonged use in the security sector.

Batteries inspired by the military
For years, Ultralife's batteries have been specified by the US and international defence departments for use by the armed forces. They've been used in radios and military communications devices as well as vehicle-based charging systems and, crucially, in surveillance and reconnaissance equipment.

It is this specialist knowledge that has helped us to develop two batteries ideal for use in homeland security applications. The first is the M1, a non-rechargeable battery designed to support covert operations. The M1 features an integrated 1m long connector cable so that it can be hidden, along with the device, to avoid detection. It is our most energy-dense battery to date and uses lithium thionyl chloride chemistry to deliver a 238Ah, 12V battery pack in a compact size.

The second is our Thin Cell battery. When we were developing a battery for wearable devices, we were conscious of the fact that it had to be thin and light, yet cater for the most power-hungry wearable tech. What we came up with was the Thin Cell, a battery that uses high-energy lithium manganese dioxide chemistry packaged in a pouch cell that can be manufactured as thin as 0.4mm. It delivers a power rating of 3V at 700mAh and can operate at temperatures between -20 and +60 degrees Celsius.

What this means is that the Thin Cell can be used on the latest connected wearable devices worn by the police and paramilitary personnel. It is also thin enough to fit inside an ID tag or smart card worn under a close-fitting suit jacket worn by intelligence personnel to avoid detection during counter-terror operations.

As the threat from terrorism continues to adapt, so too must the technology that is developed by OEMs, device manufacturers and component suppliers. Only by rethinking the way we power our devices can we thwart terrorism with something as innocuous as the humble battery.

GMC

Riptide Autonomous Solutions is designing the next generation of unmanned underwater vehicles (UUV) and other autonomous marine robots for defense, research, and exploration of our world's waters.

Serving the subsea market ● ●

Riptide Autonomous Solutions develops and produces autonomous undersea vehicles (AUVs). Its flagship product, the Micro-UUV, is a highly-flexible, open source AUV which provides state-of-the-art capabilities for operators and developers. Jeffrey Smith, President at Riptide, discusses the state of the AUV market, and Riptide's place within it.

Question: Can you provide an overview of Riptide's foundation, capabilities and expertise?

Jeffrey Smith: Riptide started in early 2015 with the idea of developing and fielding AUVs at a fraction of the cost of what the undersea market was accustomed to. At the time, the average AUV was about $1 million. With Riptide starting as an unfunded, small team of engineers (three) and a very limited credit card budget, we targeted $10,000 for a vehicle.

The initial team worked from Jeff Smith's kitchen, and we were able to develop our first swimming prototype in about four months. We participated in our first demo for the Office of Naval Research. Coincident with the demo, we received their first larger development award under DARPA, we received our first vehicle orders from a couple US Navy labs, and we received our first round of private investment funding. In the three years since, we have increased our staff to about 20 engineering, manufacturing, and administrative personnel, rolled out new, larger-sized vehicles, moved into a permanent waterfront headquarters, and successfully grown a company.

Question: We understand Riptide's flagship product, the Micro-UUV, is suitable for a whole host of applications. Could you outline its capabilities, and how it compares with rival products?

Jeffrey Smith: Our four primary talking points for our vehicles are "Cheaper, Deeper, Farther, and Faster." We successfully sold our first three dozen vehicles at our initial $10,000 target without payloads. We've made a great number of improvements in vehicle subsystems, materials, and what we now include with them, so our base price has increased some, but its still well below our nearest competitor while providing performance advantages in side-by-side spec comparisons.

I'll come back to Deeper.

On day one of starting our vehicle design, we made a very deliberate decision to focus on our efficiencies, both hydrodynamic and electrical. Most commercial AUVs largely ignore both. On the hydrodynamic side, we reduced appendages,

GMC Q&A

we eliminated the typical GPS and communications mast and incorporated the functionality into our dorsal fin. We moved from four typical control fins to three. And we put a great deal of work into a computational fluid dynamic model of our hull to optimize its shape. We did our best not to hang lots of extra things off the vehicle that adds drag and reduces its efficiency through the water. One recent example is working closely with a partner company; they reconfigured their acoustic modem to match our nose shape and take advantage of a forward interface to provide a fully hull conformal acoustic modem. A modem can add 20 percent drag to a small vehicle. This adds no additional drag. Electrically, we were even better. Our rough numbers indicate that we use about 1/10th of the hotel power to run the vehicle as they do. Hotel power typically is vehicle power not counting payload or propulsion power, so just sitting their doing nothing. How much does it consume? Where this provides a significant advantage is in run time. The commercial micro-UUVs out there run for 6-8 hours without a payload on lithium rechargeable batteries. On lower energy dense alkaline batteries, we run for around 40 hours. We have exclusivity for our micro-UUV with a new aluminium seawater power system that will give us a range of about 1,000 miles at 2.8 knots that we should be offering commercially in early 2019. Bringing multi-week endurance to a small affordable platform we see as a large potential game changer in this market.

Our standard micro-UUV we have validated to an operational depth of 300m. With limited run times, it does not make a great deal of sense to go deeper. But with our endurance, we have the energy reserves to go much deeper in smaller more affordable platforms. In 2018, we received our first contract from the US Navy to validate a 6,000m rated micro-UUV.

Speed has a double meaning for us. The micro-UUV is quite fast, having been run over 10 knots. But where we believe we have a larger impact is on our ability to rapidly try new things and bring new capabilities forward. Our architecture supports quickly and affordably being able to change things. We believe this is a great tool that enables the undersea developers.

Question: Unmanned underwater vehicles (UUVs) have a great deal of potential for government and military applications the world over. What's your opinion on the potential of UUV technology for these applications?
Jeffrey Smith: The government and military markets comprise roughly two thirds to three quarters of the global UUV demand currently. There are countless applications for all varieties of unmanned systems for performing the dull, dirty, or dangerous missions for these customer sets. Unmanned undersea we see growing quickly, especially as more and more of these capabilities prove themselves and as the barriers to use such as cost, complexity of operations, and logistics to name a few, come down.

● ● *Photo courtesy of Riptide*

NEWS IN BRIEF

Comtech Xicom Technology, Inc., which is part of Comtech's Commercial Solutions segment, received a contract valued at more than $5.5 million for high-power satellite communication ("SATCOM") amplifiers to relay data for the early detection of missile launches.

"Comtech Xicom Technology, Inc. has been developing higher power millimeter-wave ("mmW") TWTA technology for more than two decades and we are a leader in the market for millimeter-wave TWTAs," said Fred Kornberg, President and Chief Executive Officer of Comtech Telecommunications Corp. "The customer required a higher power solution as part of a system upgrade and expansion and came to Comtech Xicom Technology to get the product they needed."

Comtech Xicom Technology, Inc., a world leader in high-power amplifiers, manufactures a wide variety of tube-based and solid-state power amplifiers for military and commercial satellite uplink applications. The product range encompasses power levels from 8 W to 3 kW, with frequency coverage in sub-bands within the 2 GHz to 52 GHz spectrum. Amplifiers are available for fixed and ground-based, shipboard and airborne mobile applications. Please visit www.xicomtech.com for more information.   **GMC**

RUAG MRO International has successfully completed the first inspection of an NH90 transport helicopter for the German Bundeswehr. In mid April, a crew from Transport Helicopter Regiment 10 took delivery of the NH90 maintained in Oberpfaffenhofen. This milestone gives the Bundeswehr's Federal Office of Equipment, Information Technology and In-Service Support (BAAINBw) an alternative support provider for NH90 maintenance to the original equipment manufacturer (OEM), NHIndustries.

"Our helicopter specialists prove many years of experience in the maintenance of military helicopters. This successful NH90 inspection confirms our ability to apply our experience to include the Bundeswehr's most advanced helicopter type as well," explains Volker Wallrodt, Senior Vice President Business Jets, Dornier 228, Military, RUAG MRO International. "The Bundeswehr is our long-standing customer and RUAG is well positioned to meet their requirements in full. We are able to ensure fleet availability, planning reliability, and dependable turnaround times, and all at maximum quality," Volker Wallrodt continues.

Before RUAG began working on the NH90 in autumn 2018, the related type rating needed to be obtained from the German Military Aviation Authority. This involved meeting all necessary requirements, such as rules on e.g. personnel certifications, process instructions, technical documentation, infrastructure, and also included fully equipped aircraft docking facilities, as well as on-site availability of special tooling. Information technology services also needed to be prepared for the NH90 inspections as all maintenance tasks performed on the helicopter must be documented in the Bundeswehr's IT system.

This required the Oberpfaffenhofen site to implement the requisite SASPF software, covering project management, logistics and operations management, and all dock workstations.

RUAG continues to be a partner to the German Bundeswehr over many years and provides maintenance, overhaul and logistics services for the Bell UH-1D helicopter fleet, still in use for search and rescue missions.   **GMC**

Question: The autonomous undersea vehicle (AUV) market is a difficult one to crack and is facing challenges in uptake due to uncertainties regarding communications capabilities. What's your assessment of the market?

Jeffrey Smith: Communications for AUVs has always been and will continue to be one of the largest technical challenges due to the limitations of physics. Historically, it has driven complexity and redundancy into the systems because the vehicles need to act more autonomously without real-time communications. AUVs cannot be remotely piloted like air and surface vehicles that have almost infinite bandwidth compared to AUVs in the RF spectrum for streaming video and communications links. But, as autonomy and AI advance quickly, Riptide believes smaller, more affordable systems can make a large difference in addressing the applications challenges that are out there.

Question: In April 2018, Riptide introduced a new variant of its UUV product line, a deep rated version to support acoustic telemetry research programmes. What can you tell us about the new variant and its potential applications?

Jeffrey Smith: Riptide received a Small Business Innovation Research (SBIR) contract from DARPA to enable a deep-sea communications application. I cannot say much about the specifics, but I think it is a great example of the technology, flexibility, and affordability of Riptide is trying to accomplish.

We see a large opportunity for undersea swarming, but when traditional platforms cost $1 million or more and run for a day or so, there is a large question about the cost and effectiveness of the swarm. With our price and endurance, we think we enable this capability. We proposed this concept to DARPA, but DARPA has always pushed the envelop well beyond standard, developing capabilities. DARPA wanted longer ranges between the vehicles which drove us much deeper than we could demonstrate with a 300m maximum operational depth rating. I've been in the undersea technology space for 25 years and I am unfamiliar with any vehicles less than 15 inches in diameter and under 1000lbs that have gone to 1,500m. Showing the flexibility of our architecture, we built three 7.5 inch diameter

vehicles under the contract to that depth rating under our $1 million base funding.

Question: In September 2018, Riptide announced its first expansion with the creation of Riptide Autonomous Solutions Canada. What can you tell us about this move? Why now, and why Canada?
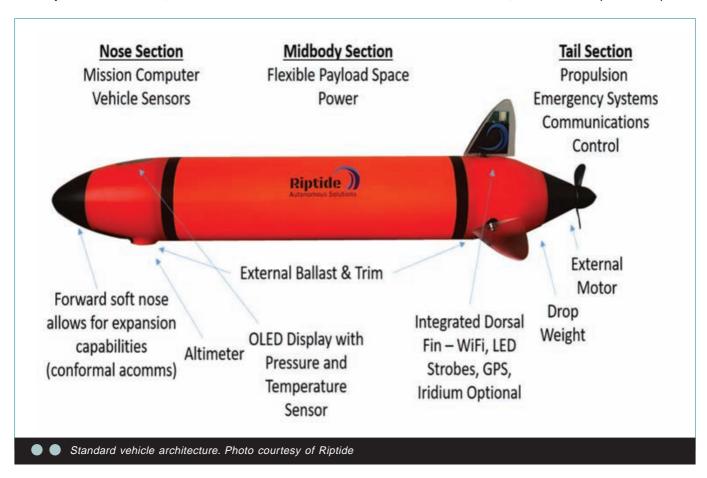
Jeffrey Smith: Since Riptide started, we've been interacting heavily with the undersea research and development community in Nova Scotia. We've built several key partnerships with companies there and we have sold multiple vehicles into Canada. The Canadian Navy has several new UUV programs coming up for acquisition and the Federal and Local governments in Nova Scotia have a large quantity of assistance programs available for developing maritime companies.

For Riptide, multiple parallel activities aligned, and it became the right time for us to do this to have an expanding local representation. To get this started, Riptide moved Lenny Baker to the area to lead this effort. Lenny is our principal hardware architect and has been primarily responsible for driving Riptide's power efficiencies as high as they are. Plus, Lenny has ties to the area and is looking forward to the challenge of standing up this new subsidiary for us.

Question: What's on the horizon for Riptide in the rest of 2019 and beyond?

Jeffrey Smith: Riptide's largest focus currently is to deliver the growing backlog of vehicles coming due to our customers. We have consolidated our operations to a new headquarters in Plymouth, MA, and are currently in the process of more than doubling our floor space, with the new leased area being allocated entirely to manufacturing space. In doing so, we are expanding our physical footprint and capabilities, plus adding several new manufacturing resources as we grow and mature as a company. This activity is critical for our growth and having the capabilities and the capacity to meet our increasing customer demand.

As we look into 2019, we have multiple development

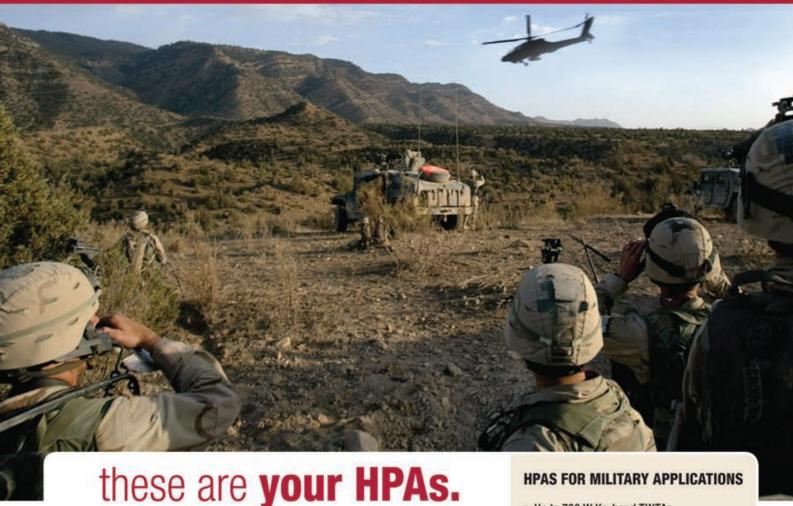*Standard vehicle architecture. Photo courtesy of Riptide*

programs we need to continue to execute on and work to transition into vehicle production efforts. For a fairly small team, we have been extremely busy balancing our development efforts with our deliveries. With the increasing demand and contract awards, we will continue to grow our team. In my 15 years in the UUV market, I have never witnessed such an exciting time. I am very pleased we have come as far as we have in such a reasonably short period but with the steep market demand, we need to keep accelerating our efforts to grow and expand our presence and market position.

As we look out past 2019, we expect to see a continually expanding line of flexible, persistent products, but most importantly, we see larger and larger vehicle volumes needed by our customers.

GMC

Photo courtesy of Riptide

Big tech is transforming the security sector ● ●

Border security is a vital segment of homeland security for every country in the world. Knowing who and what is coming and going is vital for the well-being of the nation. Niall Kelly, CTO at Netwatch, outlines the latest in border security developments, and reports on how Big Tech is transforming the sector.

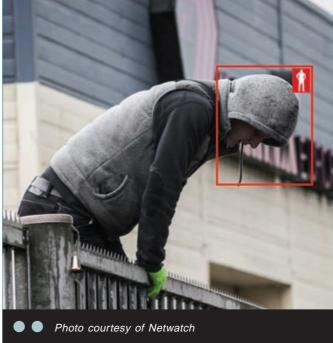**Unconstrained by business case or profit imperative,** defence budgets have been driven by political rather than commercial aspiration. Trillion-dollar spending and a sophisticated military industrial base have traditionally created technologies whose civilian applications were often of coincidental benefit.

But while everything from duct tape to the jet engine, sat nav to sonar, spy satellites to civilian drones, have their roots in military research, the tables are turning. Today's most cutting-edge tech - deep learning, Artificial Intelligence (AI) and the advent of the Cloud - all started life with civilian user cases, driven not by governments, but by large corporates for competitive gain. Less of an arms race, more of a race to trillion-dollar valuations. While some of their origins stretch as far back as the 1950s, these technologies have all come into their own within the last decade.

This shifting dynamic is especially apparent in security technology, where radar, long range detection systems and thermal cameras were all rooted in military applications. Today, across the expanse of emerging CCTV technologies, quantum strides over the last few years have come not from military oriented research, but from the expansion of processing power. Just as Moore's Law governs the endless duplication of transistor power, so are startling advances in AI evolving to deliver a new generation of smart cameras with incredible image recognition and object detection capabilities.

In the field, the benefits such advances have delivered for border and site security applications are extraordinary. The need for manpower has been mitigated, just as the risks of intrusion have grown, thanks to fast, cost-effective deployments with little need for the supportive power or communications infrastructure that were once necessary. These advances also coincide with parallel developments in autonomous satellite and cellular communications, where higher data rates and global coverage, coupled with Solar and VLP (Very Low Power) device

● ● *Photo courtesy of Netwatch*

capabilities, are proving vital wherever intelligent surveillance over large, often unmanned terrains is required.
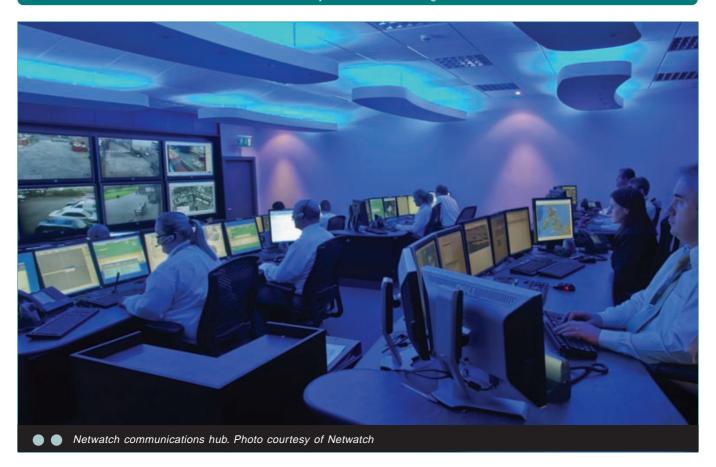
Seeing is believing

Video analytic detection technology is another dynamic innovation whose advances continue to evolve at lightning speed. Today, the ability of analytic software to recognise the difference between an intruder or an animal crossing an area, or other paraphernalia such as vegetation in high wind, and all at very long ranges, is being 'boosted' by off-site image processing in vast cloud-based image processing servers.

CCTV images can be sent from the field for off-site processing and returned with classification to appropriate field personnel, in seconds, with accuracy levels of 99.9 percent. Our own image recognition system, CRATOS, has pioneered the application of proprietary software to a degree that achieves differentiation between human and animal shape intrusion of 99 percent. Armed with satellite, cellular or WAN communications capability, and able to stream live to a remote command centre or PDA/tablet style device, allowing situational awareness for Command and Control situations, CRATOS is a component of our proven technology suite that features extended long-range detection with thermal CCTV coupled with microwave and laser scanning, similar to radar, with ranges up to 5km and longer.
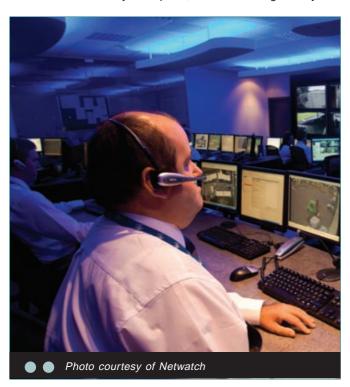
Such extended range human and vehicle detection technologies have had successful parallel applications in civilian deployments such as airports, high value mines, data centres and the financial sector, where intruder and trespasser prevention and identification are crucial. Where such valuable assets are widely spread over large areas, rapid deployment units can now be cited quickly, and inexpensive tower systems with autonomous fuel cells with three-month power capabilities can be towed or dropped into place for tactical or longer durations.

However, permanent the deployment, wherever there is temporary power such as solar, the analytics powered by long-range thermal cameras with point-to-point connectivity enable rapidly-deployable centres of surveillance excellence to be established and linked in minutes to monitoring stations anywhere on earth, with no need of human intervention.

● ● *Niall Kelly, CTO at Netwatch*

Netwatch communications hub. Photo courtesy of Netwatch

Looking ahead, one important area where the fusion of video analytic and AI technology will make a massive contribution in military applications, will be that of digital imaging and body-worn imaging devices. Unprecedented research is being conducted into the possibilities afforded by the real time analysis of live images from body worn devices, whether visible, infrared or thermal.

Live streaming of such images to cloud-based processing algorithms enables decisions to be made relating to threat analysis or long-range object recognition with processing that is way beyond the ability of any combination of human eye and brain. In their accuracy and speed, these technologies may well

Photo courtesy of Netwatch

afford the upper hand in situations where immediate, critical decision making is of the essence.

High pressure? Cloud to the rescue

The common thread to much of all this innovation is the cloud, which in military and security applications has been delayed by the fear of disruption, concerns over data security and attacks; classified material and networks of interconnected, shared computers do not mix easily. But when measured against the sophistication on offer from the likes of ultra-competitive upstarts such as Amazon and Google and judging by the interest we have seen from military users across the world, fears of loss of control are gradually giving way to new thinking in military circles. From emerging abilities to create mini clouds in specific assets or scenarios, to the enormous economies of scale and reduced costs, cloud technology is of relevance to more and more mission critical military applications.

A little hazier may be the requirements for GDPR compliance which came into force across the EU in May 2018. The demand for protection of personal information in the public space is obvious; but perhaps less so where issues of national security, terrorism, or border security come in to play. Members of the general public can rightly expect any images captured of them, for example, when crossing a state border, to be properly stored, encrypted and eventually destroyed to proper standards, but probably accept that issues of national security can supersede any privacy rights if serious enough; but it certainly is a fine balancing line. Looking ahead, border security, as we see on both sides of the Atlantic, presents ever more pressing challenges, as witnessed by flows of mass immigration and the threats of sophisticated terrorism. New thinking and new technology are combining to meet these threats, not merely by upgrading the old, but with entirely new transformations. Data driven, AI and machine learning enabled innovations are giving birth to unmanned, autonomous robots and intelligent drones, powered by nanosecond networking and revolutionary methods of energy production and storage.

This astounding pace of change makes it difficult to keep up with, let alone predict, the astounding advances yet to come. **GMC**

High-performance network ●●

Intelsat General (IGC) is a wholly owned subsidiary of Intelsat, operator of the world's first Globalized Network. IGC provides secure satellite communications services to the world's militaries and the US Government. Skot Butler, President at Intelsat General, discusses the company's latest advances, as well as recent developments in the field of government and military services.

● ● *Skot Butler, President at Intelsat General*

Based in McLean, VA, Intelsat General (IGC) is a US-incorporated, wholly owned subsidiary of Intelsat, operator of the world's first Globalized Network. IGC provides its government and commercial customers with high-quality, cost-effective, communications solutions via Intelsat's leading satellite backbone and terrestrial infrastructure.

Its customers rely on IGC to provide secure and seamless broadband connectivity, video communications and mobility services for mission-critical operations anywhere on the globe through an open, inter-operable architecture.

GMC Q&A

Question: What has the response been to Intelsat Epic^NG? How has that changed what you can provide to government customers, particularly now that your fleet is now fully global?

Skot Butler: We've had a positive response to Intelsat Epic^NG. In September 2018, we successfully launched the sixth and last of our first-generation Intelsat Epic^NG satellites, Horizons 3e. Horizons 3e entered service in January 2019, and with its coverage of Asia-Pacific and the Pacific Ocean region, our global high-throughput fleet is complete. Our government customers are already realizing the benefits of the higher data rates, availability, resiliency and redundancy of the Intelsat Epic^NG fleet.

From a performance perspective, the Intelsat Epic^NG high throughput satellite (HTS) constellation far surpasses the bandwidth speed and throughput possible with previous, wide-beam satellites. Tests conducted in 2018 on a Gilat 6" flat panel antenna on an Intelsat Epic^NG satellite demonstrated throughput rates of 3.9Mbps with an efficiency of 0.26bits/Hz. This compares to an uplink rate of 1.8Mbps and an efficiency of 0.09bits/Hz achieved with a conventional wide-beam satellite. The HTS link was effectively twice the data rate and almost three times more efficient than traditional wide-beam satellites.

So, what does this mean from a customer perspective? It powers new applications and services for government users. For example, the Marine Corps demonstrated the power of Intelsat Epic^NG to support their Networking-on-the-Move (NOTM) requirements. And a variety of users can now support high-definition full-motion video (HD-FMV) over small, Class III unmanned aircraft systems (UAS), something never before possible.

It is also important to note that as our Intelsat Epic^NG fleet evolved, so has our technology. For example, Intelsat 37e has steerable Ku and Ka-band beams, which can be positioned as needed to increase network access and support high-demand areas for government applications. Horizons 3e is the first Intelsat Epic^NG satellite to feature a multiport amplifier that enables power portability across all Ku-band spot beams. With the multiport amplifier, power can be adjusted to

● ● *A Government C-17 FlexAir Fuselage Mount 45cm Antenna. The C17 is in operations today using enroute comms and sometimes, VIP comms mode.*

each beam to meet customer throughput demands. By matching satellite power usage to traffic demands, government customers can leverage the additional efficiency improvements to expand their network and applications across the Asia-Pacific region.

Question: Where do you see the government heading in terms of commercial satcom this year?

Skot Butler: In the 2019 financial year, defense appropriators provided explicit guidance to develop an integrated, interoperative wideband and narrowband architecture and acquisition strategy that should include "government and commercial space systems" and "be based on flexible operations, open standards, and commonality that has communications path diversity."

Congress' years-long concern with the pace, progress and innovation of space mission recapitalization efforts, COMSATCOM investments and development of a flexible, fully-integrated, resilient satellite communications architecture manifested in the creation of a dedicated program element in the FY19 DoD budget for COMSATCOM integration into the future DOD satellite communications architecture.

We are encouraged by Air Force Space Command (AFSPC), tasked in the FY18 NDAA with sole acquisition authority for all COMSATCOM (by integrating DISA's COMSATCOM team), is demonstrating to industry its plans to move forward with a "core-network" acquisition strategy.

Question: What are their most pressing and urgent communications needs?

Skot Butler: Government customers across the board need higher data rates to ever smaller user terminals, availability whenever or wherever it is needed, security and flexibility.

Question: How has that changed your approach? Are you moving toward providing more end-to-end services?

Skot Butler: Our announcement of FlexAir in December 2018 is a great example of how we are responding to the changing needs of our government customers. It is a managed terminal service based on our seamless, multi-layered Ku-band network. It delivers high data rate transmissions; redundancy and security needed for government aviation missions. What is unique about FlexAir is that it allows government users to select from a number of service plans that meet their data and geographic needs; without an upfront commitment.

The service was designed with our government customers in mind. They need services that provide them with on-demand availability whenever and wherever they need it; consistency of service; high performance and the utmost resiliency. It also provides them with a flexible and efficient service package. They are not always on the move and the flexibility enables them to obtain the broadband connectivity that they need on demand;

in a much more efficient and cost-effective manner.

Question: What does the commercial satellite industry need to bring to the table to meet the explosive demands of comms on the move?

Skot Butler: For comms on the move-whether it be on land, sea and air, government customers need high data rate transmissions; on-demand availability wherever and whenever they need it; highest level of security; resiliency and redundancy of the communications network to ensure the consistency and reliability of service. Given the current budgetary constraints, it also needs to be efficient, affordable and have a more predictable cost structure.

Our Intelsat Epic^{NG} and global network delivers higher performance and a total lower cost of ownership today. We expect that only to improve as we bring more software-defined satellites to market which will enable faster time to market, more flexibility and continued improvements in performance.

Question: Do you think there is potential for more public/private partnership to meet those demands? What have been the barriers to date?

Skot Butler: Absolutely. However, one of the barriers playing out right now in Europe is the hardened "European autonomy" stance being taken in the EU Space Programme negotiations. We do not believe that this position will enable the attainment of the objectives of this programme i.e. make available to customers the best technologies at the best price and as such, urge the European Institutions to adopt a policy framework which will enable the achievement of the stated objectives.

A Government Gulfstream FlexAir Tail Mount 45cm 18" Antenna. Gulstream aircraft are in use today for enroute comms, ISR and VIP applications.

Intelsat, as a global communications company headquartered in Luxembourg, is ready to help and participate in the EU Space Programme notably in the GOVSATCOM program.

Question: As cybersecurity concerns have been a barrier, what has Intelsat done to mitigate your government customers concerns?
Skot Butler: Cybersecurity, or information assurance, is rightly a concern for our government customers, we have found it to be a discriminator for us rather than a barrier. We have a mature and robust security program that was started over a decade ago; which we continue to invest in and improve. We put uplink command and downlink telemetry encryption on all of our satellites and our ground network is tested regularly by expert third-party auditors to ensure we meet the strictest government and commercial information assurance standards

Furthermore, the security enhancements of Intelsat Epic^{NG}'s advanced digital payload enables us to quickly identify when someone is trying to jam a signal and then quickly switch the user to a different beam, mitigating any impact from the interference attempt. **GMC**

A Government C-130 FlexAir Hatch Mount 45cm 18" Antenna. C130 aircraft are used for ISR and more often for enroute communications.

● ● *Emlyn Taylor, Managing Director of Lockheed Martin UK System Solutions*

Partnering with national security and military, civil government and commercial customers, the company develops space-based solutions to help protect lives and advance the cause of civilization.

From satellite production advancements to business model innovations, it is driving towards the nexus of satellite affordability, capability and resiliency for all of its customers.

With a full range of remote sensing, navigation, meteorological and communications missions, Lockheed Martin-built satellites serve to connect, protect, and explore the world in which we live.

GMC
Q&A

Machine learning in the military ● ●

Lockheed Martin is a global security and aerospace company primarily concerned with research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services. With technologies becoming increasingly advanced, it's critical that companies like Lockheed Martin stay one step ahead of the game. Emlyn Taylor, Managing Director of Lockheed Martin UK System Solutions, comments on the roll-out of machine learning software throughout the government and military sectors.

Question: Machine learning is playing an increasingly important role among a variety of sectors today. What can you tell us about its potential for battlefield applications?

Emlyn Taylor: Advancements in technology products and Internet of Things (IoT) applications are rapidly changing the battlefield. It is transforming the military's ability to perform reconnaissance missions and quickly analyse mission critical data to gain a competitive edge. As military operations become increasingly reliant on technology, these applications will generate a significant amount of data that will need to be evaluated and analysed to help soldiers and support personnel make decisions based on real-time and historical data.

● ● *Photo courtesy of Lockheed Martin*

Lockheed Martin's Minerva technology allows the armed forces to identify the most remote and innocuous enemy positions, using Unmanned Aerial Vehicles (UAV), usually unnoticed by even the most highly-trained human eye. Images are captured by a UAV are then analysed by Minerva's image analytics capability which pinpoints potential threats in the environment. The type of each threat, along with their geographical location, is highlighted to the user in real time, offering enhanced levels of situational awareness and an increase in the tempo of operations.

Question: The British Army is currently trialling Minerva, a machine learning-based software for reconnaissance and battlefield monitoring. What can you tell us about previous applications of this technology?

Emlyn Taylor: The Minerva technology is used globally across several industry sectors. Perhaps most surprisingly is the use of the technology as an important catalyst in the postal industry. Lockheed Martin has over 40 years of experience working together with postal and logistics operators around the world.

The exponential growth in e-commerce activity over the last decade has had a significant impact on the postal and shipping industry. Lockheed Martin's Minerva technology applies integrated artificial intelligence to provide a more effective recognition performance for e-commerce packages. The technology is used by postal operators to identify key information on letters/packages including postal address and customs information to ensure packages are delivered in a timely and accurate fashion. Minerva also improves the process of an increasingly diverse and complex mail stream which has posed problems for mail systems around the world.

Additionally, Minerva has also been utilised for civilian applications to conduct search and rescue activities on behalf of Trials conducted by the Royal National Lifeboat Institution (RNLI). Recent RNLI Trials used the image analytics capability of the Minerva technology to analyse and identify key objects such as boats, buoys and people in seas around the coasts of the United Kingdom. Once the specific locations for these objects are identified, the information is relayed back in real-time to provide critical information, reducing the time it takes for the emergency services to reach people in danger.

Question: How will the Minerva technology be adapted for the British Army?

Emlyn Taylor: Adapted from Minerva, Lockheed Martin's LARES technology will aid the British Army at the front line of battle. Exploiting real time video from UAVs, LARES analyses the battlefield to provide a clear risk assessment, highlighting enemy positions and other potential dangers. Using the images produced by the UAVs, LARES uses a complex mix of artificial intelligence, image analytics and machine learning to carry out a detailed evaluation of the landscape to detect multiple threats to life on the battlefield. LARES allows for a faster and more

Photo courtesy of Lockheed Martin

efficient and effective analysis of the battlefield, whilst the complementary use of UAVs ensures that our troops are able to achieve visibility of the battlefield from safer, stand-off, positions. All LARES missions are archived and can be replayed at a later time - this technology capability provides an additional source of intel for military support personnel which helps to inform strategic decisions. The reconnaissance capability of Minerva is another example of how Lockheed Martin is supporting the UK military and creating a safer environment on the battlefield.

Question: What other applications could technologies like Minerva address in the government and military spheres?
Emlyn Taylor: Minerva goes beyond battlefield applications and can have a profound effect on the military. In any environment where specialist human resources are scarce and relied upon in the most high-pressured conditions, machine learning technology can play a critical support role. Industries which require analysts to review data to identify changes and patterns to make important decisions, Minerva can provide a competitive advantage. For example, in Intelligence Surveillance & Reconnaissance (ISR) operations where highly skilled analysts review sensor data or terrain imagery from satellites or airborne assets for extended periods of time, the Minerva technology can learn to become that all seeing, never tiring, analyst. The technology is frequently used for monitoring CCTV or live streaming.

Question: We understand that machine learning is expected to make a big impact on the future of emergency services across the world. Could you outline how?
Emlyn Taylor: Machine learning has allowed emergency services to improve their humanitarian response times and create a more strategic approach to the issues they face. This is mostly used by emergency services such as the fire brigade. For example, during brush fires in Western Australia, ground firefighters relied heavily on information about their terrain when tackling fires. They can use manned aircraft during daylight hours to provide aerial information however, this becomes more difficult during night hours. This leaves a gap in aerial information. To address this issue, the fire brigade utilised the image analytics capability of the Unmanned Aerial System (UAS) to enable firefighters to maximise the effectiveness of night time operations. Indago streamed live video from its thermal sensor to operators on the ground who used this data to identify fire hot spots, fire location and intensity. This provided valuable intel for fire fighters to use and as result Indago was estimated to save an estimated 100 homes, worth more than $50 million, demonstrating the potential of this technology across multiple applications.

Question: What are the challenges associated with rolling out machine learning software throughout different sectors, and how might they be addressed?
Emlyn Taylor: The major scepticism surrounding the increased use in machine learning software in multiple sectors is the inertia that surrounds it. Not much is known about how this technology works, what its purpose is and its capability across multiple sectors. This is most pertinent for the defence sector. Words such as machine learning, artificial intelligence and image analytics in a military context create more anxiety amongst the public and policy makers. Issues such as security of imagery and automated decision making are ongoing sources of significant discussion by policy makers. We believe that it's our role to continuously demonstrate the multiple applications of machine learning, its safe and moral use, and its potential to drive greater efficiencies in industry sectors. **GMC**

Photo courtesy of Shutterstock

Photo courtesy of Viasat

Tactical satellite-based communications ● ●

Delivering secure, timely and effective tactical communications is one of the big challenges in the satellite sector today, as congestion, contestation and competition make the space environment and increasingly difficult place to navigate. However, these communications capabilities are absolutely paramount for the efficient operation of government and military groups the world over. In recent years, the satellite sector has established innovative solutions to meet demand.

Communications have played a vital role in our world since the dawn of time. Over the centuries, communications capabilities and preferences have evolved, with human and animal messengers, telegrams, hand and smoke signals, and later, letter-writing and faxes, being replaced with faster, more instantaneous, options. Communications in any form are important, but it's become clear in recent decades that the priority for consumers, governments, non-governmental organisations and military forces alike, is on-demand, real-time communications.

Delivering real-time communications was once a tricky feat. However, since the advent of Smartphones and satellite communications systems, the ability to communicate via text, image or voice whenever, wherever, has become commonplace, and taken for granted. We can call relatives on the other side of the world with the click of a button, become registered to vote with our local authorities within a couple of minutes on our Smartphones, and send photos of meals instantly across a variety of platforms with no extra charge, using WiFi or data packages.

For government and military groups, on the other hand, there is a wide array of data that needs to be communicated across the world at any one time, including voice and video, situational awareness, battlefield management, etc.

Satellite plays a key role in delivering that connectivity, whether it's serving rural areas unserved or underserved by fibre, providing back-up connectivity to terrestrial options, or delivering connectivity on the move for manned or unmanned missions on land, in the air, or at sea. The other advantage of satellite over terrestrial options is, of course, security; when it comes to government and military data, secure transmissions are absolutely vital.

This has become ever-more important in recent years as the three Cs become increasingly commonplace in the battlefield environment; never before has space been so contested, congested and competitive.

Lockheed Martin launches fourth AEHF satellite
The world's most affluent governments and defence forces have been launching their own satellites for decades now, reasoning that wholly-owned assets are a better solution than the hosted payloads model. The Advanced Extremely High Frequency (AEHF) series of communications satellites is one such group of wholly-owned satellites, operated by the United States Air Force Space Command. AEHF provides survivable, global, secure and jam-resistant communications for the Armed Forces
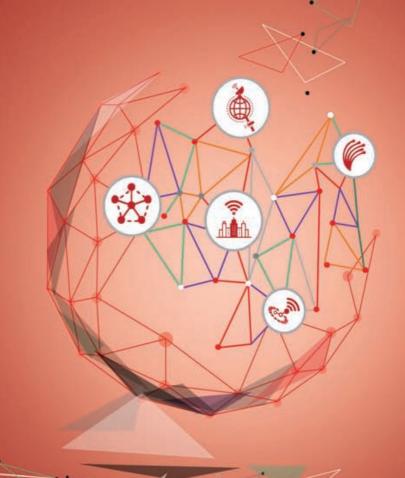
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of the USA, the UK, Canada, and the Netherlands, on land, in air, or at sea.

Once complete, the series will consist of six satellites in GEO, all backwards compatible with the Milstar system, operating at 44GHz up (the extremely high frequency - EHF - band) and 20GHz down (the super high frequency - SHF - band). AEHF will ultimately replace the Milstar constellation, since user data rates are increased five-fold, enabling vastly improved tactical communications, including real-time video, battlefield maps and targeting data.

The AEHF satellites utilise narrow spot beams to communicate with Earth, and crosslinks between the satellites, enabling space-based relay, which is more secure than hopping via ground hubs. With frequency-hopping radio technology and phased array antennas utilising adaptive radiation patterns, many potential sources of jamming are locked out.

Lockheed Martin is under contract to deliver the six AEHF satellites and the mission control segment, with Northrop Grumman Aerospace Systems providing the payload. In October 2018, the fourth AEHF protected communication satellite was successfully launched from Cape Canaveral Air Force Station on board a United Launch Alliance Atlas V 551 vehicle. The fourth satellite reportedly completes the geostationary ring, providing full global coverage.
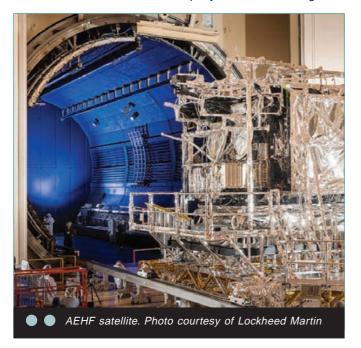
"It's good to return with our mission partners to see the culmination of expertise, skill and partnership that we have worked diligently toward to make this AEHF launch a success," said Mike Cacheiro, Vice President of Protected Communication Systems at Lockheed Martin. "This is a substantial milestone for AEHF, and as we look ahead, we continue to improve and upgrade this mission to deliver these vital communications capabilities to the Air Force."

The fifth and sixth AEHF satellites are well underway, as well as the upgraded mission planning ground system.

Viasat brings artificial intelligence to the stage

Artificial intelligence (AI) or machine learning may also have a role to play in the tactical communications systems of the future. Indeed, back in 2017, the US DoD described AI as 'the most disruptive technology of our time,' in a study in the operational environment and the changing character of future warfare.

In October 2018, Viasat announced the availability of secure cloud-enabled AI and machine learning applications over its global satellite communications architecture and the line of sight (LOS) tactical network technologies for warfighters on the move. According to Viasat, by offering a secure, integrated network of cloud-enabled solutions, the company can reduce warfighters'

AEHF satellite. Photo courtesy of Lockheed Martin

cognitive loads in order to make more accurate, informed, life-saving decisions, faster, across the battlespace.

Viasat has completed a successful connectivity demonstration focused on bringing access to advanced cloud capabilities to the tactical edge. The demonstration showed how Viasat's satellite communications architecture and LOS tactical network can provide a holistic communications solution by integrating Link 16, mobile ad-hoc networking, Wi-Fi and LTE technologies to significantly enhance situational awareness at the tactical edge and fulfil emerging US Government concepts of operation. Throughout the demonstration, Viasat's satellite network and LOS technologies provided a secure, high-speed, resilient backbone connection to link connected devices to media-rich AI and machine learning-based applications offered by a number of today's cloud technology providers.

"Viasat is partnering with global cloud computing leaders to bring advanced AI and machine learning-based operational capabilities to the warfighter—from predictive analytics and media rich intelligence, surveillance and reconnaissance data to prescriptive outputs," said Ken Peterman, President of Government Systems at Viasat. "Through Viasat's modernized end-to-end communications network, we will empower warfighters with advanced data-driven insights and operational capabilities that will allow them to make the most informed decisions possible - even in the fog of war. Today's demonstration shows the power of our SATCOM network and LOS innovations to deliver the next-generation Internet of Battlefield Things (IoBT) to significantly improve military readiness and mission effectiveness."

Viasat will provide ubiquitous and secure satellite communications required to access cloud-enabled military applications via its Hybrid Adaptive Network (HAN) concept. The HAN provides access to Viasat's end-to-end satellite innovations such as active cyber-defence, layered resiliency and elite satellite capacity to support a range of operations requiring IoBT and cloud-based applications. The HAN allows users to seamlessly operate across different networks (both government and private sector), creating an end-to-end layered, resilient network that is unique to Viasat and not offered by any other provider today.

Evolving waveforms

Satellite technologies have come on in leaps and bounds in recent years, with incredible new capabilities being brought to fruition. However, when it comes to the future of tactical communications, the satellites themselves are not the be all and end all. We've been hearing about protected tactical waveforms (PTWs) for some time now, which will protect vital battlefield communications from adversarial jammers that intend to interfere with US satellite communications.

Towards the end of 2018, it was announced that the US Air Force was pressing forwards with the development of a more resilient PTW which enables anti-jamming capabilities within a protected tactical satellite communications system. The Air Force is reportedly expecting responses very soon to its request for information from the satellite sector for protected satellite communications for use in benign and contested environments alike. As satellite plays an increasingly vital role throughout government and military sectors the world over, disruption of those capabilities has been on the rise.

"Tactical satellite communications are vital to worldwide military operations," the US Air Force told C4ISR net. "Our adversaries know this and desire to disrupt US satellite communications. The Air Force is fielding Protected Tactical SATCOM capabilities to … ensure warfighters around the globe have access to secure and reliable communications."

We can expect to hear a lot more in the years to come as industry works in partnership with the US Air Force and other government agencies in order to bring this project, and others like it, to fruition. According to recent reports, early-stage trials for PTW capabilities in-flight have proven extremely promising. **GMC**