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MilsatMagazine

ORS-5 launches aboard a Minotaur IV rocket from Cape Canaveral Air Force Station, Florida — Photo is courtesy of James Murati.

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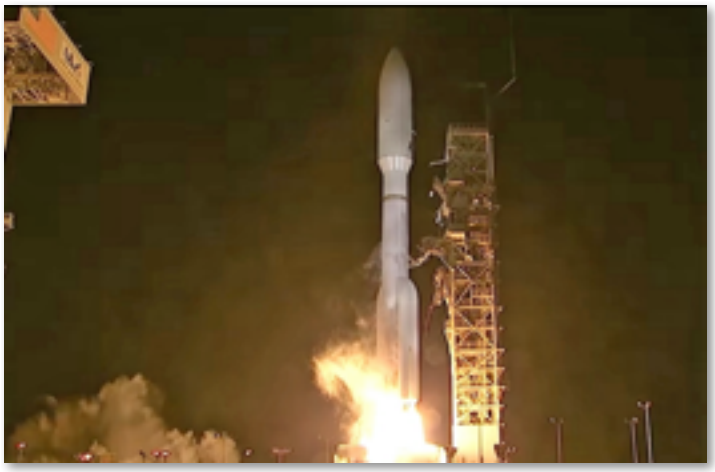
DISPATCHES

ULA LIGHTS UP THE NIGHT WITH NROL-42 LAUNCH



The NROL-42 satellite launch by ULA's Atlas V rocket.

The night lit up as the launch of ULA's Atlas V lift occurred, carrying NROL-42 with a classified national security payload at 10:49:47 PDT on Saturday, September 26, from Space Launch Complex 3, Vandenberg Air Force Base, California.

This launch moved forward after the original launch date on Thursday, September 21 was scrubbed due to a battery that needed to be replaced on the Atlas V.

NROL-42 is believed to be the second spacecraft in the newest generation of Molniya-orbit signals intelligence satellites unofficially called Trumpet Follow-On. The highly-inclined orbit enables the craft to dwell over northern latitudes to collect surveillance.

This launch is ULA's sixth of 2017 and 121st overall. NROL-42 is the 25th mission that ULA has launched for the National Reconnaissance Office (NRO) since the company was founded in 2006. This mission will mark the 73rd Atlas V launch since its inaugural launch on August 21, 2002. The mission is to provide innovative overhead intelligence systems for national security.

Headquartered in Chantilly, Virginia, the National Reconnaissance Office develops and operates overhead reconnaissance systems and conducts intelligence-related activities for U.S. national Security. The NRO is the nation's eyes and ears in space, supporting policy makers, the Armed Services, the Intelligence Community, Departments of State, Justice and Treasury, and civil agencies. All of them depend on the unique capabilities NRO systems provide.

Frequently, NRO systems are the only collectors able to access critical areas of interest, and data from overhead sensors provides unique information and perspectives not available from other sources.

The NRO's key customers and mission partners include: policy makers, the Armed Services, the Intelligence Community, Departments of State, Justice and Treasury, and civil agencies.

All of them depend on the unique capabilities NRO systems provide:

- ***Monitoring the proliferation of weapons of mass destruction***
- ***Tracking international terrorists, drug traffickers, and criminal organizations***
- ***Developing highly accurate military targeting data and bomb damage assessments***
- ***Supporting international peacekeeping and humanitarian relief operations***
- ***Assessing the impact of natural disasters, such as earthquakes, tsunamis, floods, and fires***

Together with other Defense Department satellites, the NRO systems play a crucial role in providing global communications, precision navigation, early warning of missile launches and potential military aggression, signals intelligence, and near real-time imagery to U.S. forces to support the war on terrorism and other continuing operations. NRO satellites also support civil customers in response to disaster relief and environmental research.

Scientists created a global environment database using NRO imagery to help predict climate change, assess crop production, map habitats of endangered species, track oil spills, and study wetlands. NRO data also forms the basis for products that help depict and assess the devastation in areas affected by natural disasters.

The National Reconnaissance Office is taking a different approach. Though the NRO often deploys small experimental systems, the preponderance of its requirements will likely continue to be met with very large, highly capable and expensive satellites, said U.S. Air Force Maj. Gen. Susan Mashiko, deputy NRO director.

The NRO's innovation also inspires technology in everyday life with contributions to medical imaging, global communications, high-definition television, cellular phones, the global positioning system (GPS), and much more.

The NRO, one of 16 Intelligence Community agencies, was officially established in September 1961 as a classified agency in the Department of Defense (DoD). The existence of the NRO and its mission were declassified in September 1992.

www.ulalaunch.com/

www.nro.gov/

DISPATCHES

U.S.A.F. ORS-5 SATELLITE LAUNCHES VIA ORBITAL ATK'S MINOTAUR IV

A statistic that anyone would be proud of ... 26 out of 26 successful launches of the Minotaur rocket including today's launch.

Orbital ATK's Minotaur IV space launch vehicle successfully launched and placed into orbit the U.S. Air Force's Operationally Responsive Space-5 (ORS-5) spacecraft on August 26, 2017.

The Minotaur IV launched from Cape Canaveral Air Force Station's Space Launch Complex 46 (SLC-46), which is operated under license by Space Florida.

This mission marks the 26th consecutive successful launch for the company's Minotaur product line.

The rocket's first stage ignited at 2:04 a.m. (EDT). Approximately 28 minutes later, the Minotaur IV deployed the ORS-5 satellite into its targeted low inclination orbit 372 miles (599 kilometers) above the Earth.

From the designated orbit, ORS-5 will deliver timely, reliable and accurate space situational awareness information to the United States Strategic Command through the Joint Space Operations Center.

"*This was our first Minotaur launch from Cape Canaveral Air Force Station, demonstrating the rocket's capability to launch from all four major U.S. spaceports*," said Rich Straka, Vice President and General Manager of Orbital ATK's Launch Vehicles Division.

Straka added, "*With a perfect track record of 26 successful launches, the Minotaur family has proven to be a valuable and reliable asset for the Department of Defense.*"

The Minotaur family of launch vehicles is based on government-furnished Peacekeeper and Minuteman rocket motors that Orbital ATK has upgraded and integrated with modern avionics and other subsystems to produce an affordable launcher based on flight-proven hardware.

Minotaur rockets have now launched from ranges in California, Virginia, Alaska and Florida. The vehicles are procured under the OSP-3 contract administered by Kirtland Air Force Base.

"*Orbital ATK has launched nearly 100 space launch and strategic rockets for the U.S. Air Force*," said Scott Lehr, President of Orbital ATK's Flight Systems Group. "*We're proud to be a partner they can count on.*"

The ORS-5 launch was the sixth Minotaur IV flight.

The Minotaur IV is capable of launching payloads up to 4,000 lbs. (or 1,800 kg.) to LEO.

This mission's Minotaur IV configuration included three decommissioned Peacekeeper stages, an Orion 38 solid-fuel upper stage and an additional Orion 38 insertion stage for the payload.

The Minotaur rockets are manufactured at Orbital ATK's facilities in Chandler, Arizona; Vandenberg, California; and Clearfield and Magna, Utah.

The ORS-5 team is led by the Space and Missile Systems Center's Operationally Responsive Space Office, located at Kirtland Air Force Base, New Mexico.

The Massachusetts Institute of Technology Lincoln Laboratory in Lexington, Massachusetts, is the ORS-5 prime contractor.

The 50th Space Wing at Schriever AFB, Colorado Springs, Colorado, operates the ORS-5 system.

The Air Force Space Command's Space and Missile Systems Center, located at Los Angeles Air Force Base, California, is the Air Force's center of acquisition excellence for acquiring and developing military space systems such as ORS-5.

SMC's portfolio includes the Global Positioning System, military satellite communications, defense meteorological satellites, space launch and range systems, satellite control networks, space based infrared systems and space situational awareness capabilities.

"*The hard work and dedication of the launch team and its mission partners has absolutely paid off*," stated Col. Shahnaz Punjani, Director of the Operationally Responsive Space Office. "*This launch of ORS-5 culminates a fast-paced and very demanding effort by a broad team of government and industry professionals.*"

The spacecraft separated from the upper stage approximately 28 minutes after launch. Engineers and operators are well into the complete checkout and tests in preparation for operational use.

"*The capabilities ORS-5 brings to the nation are ushering in a new era of faster, cheaper satellite development. ORS-5 will deliver global, persistent, optical tracking of satellites in geosynchronous orbit, enabling the nation to have increased global situational awareness of space objects*," said Lt. Gen. John F. Thompson, commander of the Space and Missile Systems Center and Air Force program executive officer for Space.

At $87.5 million, the ORS-5 satellite will operate from a low inclination orbit 372 miles above the Earth to aid the U.S. military's tracking of other satellites and space debris in geosynchronous orbit, 22,236 miles above the equator, commonly used by defense-related communications satellites, television broadcasting stations, and international space platforms.

ORS-5 will deliver space situational awareness capabilities at a significantly reduced cost compared to larger, more complex satellites, and serves as a gap filler mission for the Space-Based Space Surveillance (SBSS) Block 10 mission, originally launched in 2010. A successor SBSS mission is not expected to launch before 2021.

Additionally, three CubeSats — two from Los Alamos National Laboratory, and one from DARP — were aboard the Minotaur IV launch vehicle via a rideshare agreement, resulting in a lower price to the government for the launch.

The launch was led by SMC's Launch Enterprise Directorate on the first Orbital ATK Minotaur IV launch from Cape Canaveral. SMC's Advanced Systems and Development Directorate integrated the ground system into its Multi-Mission Space Operations Center (MMSOC) version 2.1.

ORS-5 is the first system on the updated ground system, which serves as the foundation for Enterprise Ground Services. Air Force Space Command's 50th Space Wing/1st Space Operations Squadron, will operate the ORS-5 system.

The ORS-5 program is designed to deliver timely, reliable and accurate space situational awareness information to the United States Strategic Command through the Joint Space Operations Center. The system enhances space tracking capability, supports the nation's space programs, and bolsters safety of satellites in geosynchronous orbits.

www.orbitalatk.com

DISPATCHES

U.S.A.F. COORDINATING THE UNCONTROLLABLE

U.S. Air Force Staff Sgt. Bradley Bertram, 7th Operations Support Squadron weather forecaster, briefs other weather flight Airmen at a meteorological conference at Dyess Air Force Base, Texas, August 30, 2017. At the conference, weather conditions for the near future and collaboration to ensure an accurate forecast is discussed. U.S. Air Force photo by Airman Kylee Thomas.

Weather forecasters assigned to the 7th Operations Support Squadron weather flight protects Dyess Airmen by keeping an uninterrupted watch over the forecast and weather conditions to provide information for a safe and effective mission completion.

The weather flight has many duties. They primarily involve integrating current and forecasted atmospheric and space weather conditions into operations and planning, however, their two primary functions are supporting the airfield weather element and the mission weather element.

"*Part of our focus is on the weather element which provides all the weather information supporting B-1B Lancer, C-130J Super Hercules and any transit aircraft flights from Dyess AFB*," said Master Sgt. Rory Kling, 7th OSS weather flight chief. "*Our other primary function includes the airfield services. We provide the weather forecast for everywhere within five miles of the base, but we also focus on resource protection to guarantee the safety of the base populous and our assets.*"

The weather flight works hard to provide accurate forecasts in order to make sure Dyess personnel are able to complete the mission as efficiently and safely as possible. It's the job of weather specialists to keep a constant watch over the forecast and conditions that can affect the safety of pilots and aircrew.

"*The mission of the weather flight is to provide timely, relevant and accurate weather data to the war fighter*," said Staff Sgt. Bradley Bertram, 7th OSS weather forecaster. "*Whether that be delivering the forecast on base or making sure our pilots flying the planes have the information they need to safely complete the task they need to do.*"

Along with collecting accurate data, the weather flight also pushes out watches, warnings and advisories when hazardous weather is detected in order to properly warn the base so the necessary precautions can be taken.

According to Bertram, "*We warn the base of hazards such as lightning, freezing rain, thunderstorms or any*

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U.S. Air Force Staff Sgt. George Trosper, 7th Operations Support Squadron weather forecaster, reviews weather radars for the local area at Dyess Air Force Base, Texas. U.S. Air Force photo by Airman Kylee Thomas.

severe weather. We help contribute to the success of the mission by forecasting weather for the base to make sure the Airmen can complete their task as efficiently and safely as possible."

These Airmen are experts when it comes to utilizing the latest technology to predict weather patterns, prepare forecasts and communicate weather information to the commanders and pilots so that every mission goes as planned. Although technology helps with a large portion of determining daily weather conditions, a human input is always needed to ensure accuracy.

"*Weather is very complex*," said Bertram. "*The technology we use makes the forecasting process easier on us, however it still requires a human input with experience just because there's no way for any sort of computer to fully take over. Because our mission is very precise, we cannot fully depend on technology to forecast our weather."*

While the flight is very skilled in determining an accurate forecast, data from the technology they use is almost always up for interpretation.

Kling added, "*There's always going to be flaws and the models we look at may not always be correct which affects the products we produce*."

Just like how the weather changes every day, so do the tasks in which the flight is tasked with. Each weather condition calls for different procedures making the job of a weather forecaster change every day.

"*My favorite thing about my job is that it's always changing*," said Kling. *"You're never going to see the same two things when we come in every day. The weather is always evolving and changing. It's kind of challenging but it's also interesting and exciting because you never know what you're going to get when you come into work that day."*

Constantly changing weather patterns can be forecasters' greatest ally or strongest adversary, which is why accurate weather forecasting plays such an integral part in the success and safety of the mission.

"*We have very specific processes and procedures to predict the most precise forecast, but sometimes we get it wrong*," said Kling. "*We will never be 100 percent right 100 percent of the time and that makes it challenging and difficult for us, however we're always working our absolute hardest to get the most accurate information possible."*

Story by Airman Kylee Thomas
7th Bomb Wing/Public Affairs

DISPATCHES

U.S.A.F. X-37B LAUNCH SUCCESS BY SPACEX

In spite of the Category 5 Hurricane Irma raging in the Atlantic Ocean, SpaceX successfully launched U.S. Air Force's X-37B, the Orbital Test Vehicle 5 (OTV-5) payload from Launch Complex 39A (LC-39A) at NASA's Kennedy Space Center in Florida on Thursday, September 7 at 10:00 am EDT.

Following stage separation, Falcon 9's first stage successfully landed at SpaceX's Landing Zone 1 (LZ-1) at Cape Canaveral Air Force Station, Florida. This Air Force mission is the fifth Boeing X-37B Orbital Test Vehicle launch.

The X-37B is the Air Force's unmanned and reusable space plane that resembles a small space shuttle, which will conduct orbital experiments. Currently, the X-37B is the only rocket that is fully designed and developed in the 21st century.

Falcon 9 delivers payloads to space aboard the Dragon spacecraft or inside a composite fairing. Safety and mission success were critical in the design of the Falcon 9 rocket. With a minimal number of separation events and nine first-stage Merlin engines, the SpaceX Falcon 9 rocket is designed so that even if two of the engines shut down, the rocket can still operate. In 2012, SpaceX became the first commercial company to rendezvous with the International Space Station.

Although these flights have not transported crew, SpaceX continues to work toward their goal of one day carrying astronauts to space in Crew Dragon's pressurized capsule using the Falcon 9.

The 3rd Space Experimentation Squadron, based at Schriever Air Force Base in Colorado, managed the ground operations for the launch. The X-37B will glide back to Earth and will land on a conventional runway when the current mission has been completed.

www.spacex.com

DISPATCHES

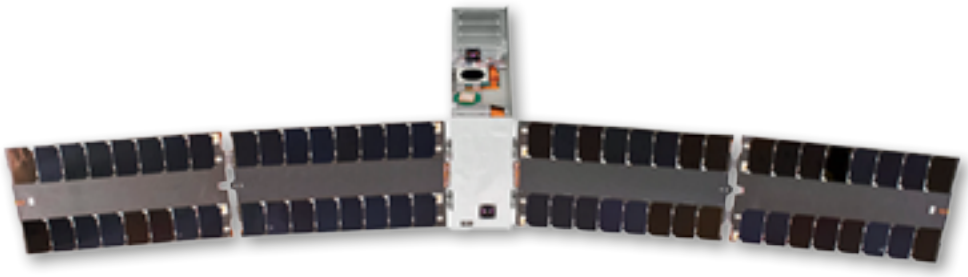
TWO AFRL MISSION CONTRACTS RECEIVED BY BLUE CANYON TECHNOLOGIES

Blue Canyon Technologies (BCT) has been awarded two contracts by the Air Force Research Laboratory (AFRL) for missions that will reach geostationary orbit (GEO).

The first contract has BCT designing and manufacturing a state-of-the-art 60 kg microsat bus (*artistic rendition below*) for the Space Situational Awareness (S5) mission, led by the Air Force. Applied Defense Systems (ADS) will provide the payload.

BCT will spearhead integration of the S5 payload with the microsat bus, conduct launch vehicle integration and perform bus-level functionality testing of the spacecraft prior to delivery.

The objective of the S5 mission is to measure the feasibility and affordability of developing low cost constellations for routine and frequent updates to the GEO space catalog.



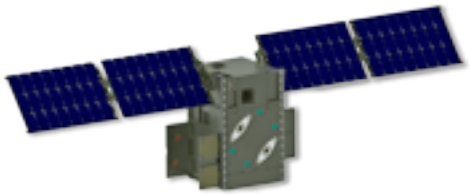
AFRL awarded a second contract for BCT to build, test and deliver a 12U-class CubeSat bus for the ASCENT mission.

AFRL will provide and integrate the ASCENT payload with BCT's 12U spacecraft bus. Blue Canyon Technologies will perform bus-level testing of the complete spacecraft prior to delivery.

The ASCENT mission will demonstrate various CubeSat operations in geostationary orbit (GEO).

BCT's 12U-class CubeSat and 60 kg microsat spacecraft are both high-performance satellites which include ultra-precise attitude control systems that allow for accurate knowledge and fine-pointing of the satellite payloads.

The highly integrated design also maximizes payload volume. Both spacecraft will be developed at BCT's Spacecraft Manufacturing Center located in Boulder, Colorado. The office and laboratories are designed specifically for high-volume production of spacecraft systems and components, with the manufacturing capability to handle large constellations of small spacecraft.



George Stafford, BCT president, commented that by leveraging the firm's flight-proven, smallsat avionics, spacecraft costs are lowered and lead times reduced to enable new types of missions such as S5 and ASCENT.

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DISPATCHES

HARRIS DEVELOPS BATTLESPACE

Harris Corporation (NYSE:HRS) has received a $260 million order to develop an integrated tactical communications network as part of an Asia-Pacific country's modernization program — the order was received in the first quarter of fiscal 2018.

The integrated network solution will include tactical radios, network planning, monitoring and routing software, and other systems and technology from Harris and partnering companies. The solution will feature Harris' Falcon III® AN/PRC-158 multi-channel manpack radios and vehicular amplifiers and provide voice and data services to tactical forces for line-of-sight and beyond-line-of-sight applications.

"*Harris is the incumbent tactical radio provider to the country, and this order is an important step in integrating Harris' advanced products into their tactical communications network*," said Brendan O'Connell, president, Tactical Communications, Harris Communication Systems. "*Our integrated solution will play a pivotal role in the customer's continued modernization efforts.*"

www.harris.com

U.S.A.F.'S FALCONSAT-3 OPENS FOR AMATEUR RADIO ENTHUSIASTS

AMSAT has reported that the U.S. Air Force Academy satellite FalconSAT-3 is now open for amateur radio use as a digital store-and-forward system.

FalconSAT-3 was built in 2005 and 2006 by cadets and faculty in the Space Systems Research Center at the U.S. Air Force Academy in Colorado Springs, Colorado, and launched in 2007 on an Atlas V. After serving in scientific and training roles, the Academy has now made the satellite available for amateur radio use.

The satellite is in a 35.4 degree inclination orbit, with an approximate altitude of 465 to 476 km. The Packet Bulletin Board System is operating at 9600 baud with a 145.840 uplink and 435.103 downlink. Output power is 1 watt and the downlink is continuously on. Digipeating is enabled for live QSOs, but unattended digipeating operations are not authorized at this time. Current Keplerian elements can be found in the AMSAT distributed Keplerian elements.

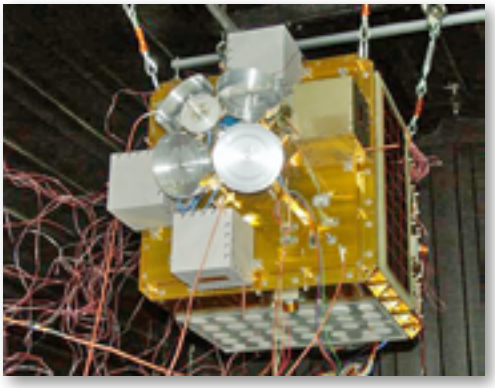

Photo of the U.S. Air Force FalconSAT-3 satellite.

More information can be found at ***https://www.amsat.org/falconsat-3/***

The Radio Amateur Satellite Corporation (as AMSAT is officially known) was first formed in the District of Columbia in 1969 as an educational organization with the goal to foster Amateur Radio's participation in space research and communication.

AMSAT was founded to continue the efforts, begun in 1961, by Project OSCAR, a west coast USA-based group which built and launched the first Amateur Radio satellite, OSCAR, on December 12, 1961, barely four years after the launch of Russia's first Sputnik.

Today, the "home-brew" flavor of these early Amateur Radio satellites lives on, as most of the hardware and software now flying on even the most advanced AMSAT satellites is still largely the product of volunteer effort and donated resources.

For more than 48 years, AMSAT groups in North America and elsewhere have played a key role in significantly advancing the state of the art in space science, space education, and space technology.

Undoubtedly, the work now being done by AMSAT volunteers throughout the world will continue to have far-reaching, positive effects on the very future of both Amateur Radio, as well as other governmental, scientific and commercial activities in the final frontier.

Rarely have a group of "amateur" volunteers managed to do so much… for so many… with so little.

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DISPATCHES

SMI'S MOBILE DEPLOYABLE COMMS CONFERENCE STRESSES SECURITY VS. CYBER WARFARE

At this year's 11th Mobile Deployable Communications Conference, qualified specialists will be providing their knowledge of how to avert cyber warfare with the goal of ensuring flexible and continuous connectivity.

Flexible and continuous connectivity, anywhere, at any time remains a key priority for major defense forces around the world.

With the critical threat of cyber warfare intensifying, there is now a pressing need to ensure secure communications can be effectively operated in contested environments.

Taking place in Warsaw, Poland on February 1-2, 2018, SMi's 11th Annual Mobile Deployable Communications Conference returns to look at the key drivers causing the growing demand for flexible, protected, and interoperable CIS capabilities.

Through expert led presentations, from some of the world's leading authorities, will discuss the challenges for both solution providers and end-users of deployable communications.

Host nation speakers include:

- ***Conference Chairman— Colonel Grzegorz Szmit, Head of IT Branch, J6, General Command of the Polish Armed Forces***
- ***Day one, keynote presenter— Colonel Robert Drozd, Chief of the Command and Control, J6 Directorate of the Polish Armed Forces***
- ***Opening address, 'Bringing CIS to The Polish Armed Forces', includes the following topics:***
  - » *Fulfilling critical CIS requirements for the Polish Armed Forces*
  - » *Using a Polish Mission Network (PMN) to incorporate with allies during mission and as a national FMN implementation*
  - » *Implementing Polish Armed Forces CIS Enterprise Architecture as part of PMN (FMN) implementation*
  - » *Cyber: Combating threats and challenges*

Joining the host nation will be neighboring and international speakers who will provide a diverse but focused two-day agenda.

Attendees will include:

- ***Heads of CIS***
- ***Tactical Communications Program Managers***
- ***Heads of J6***
- ***Heads of Signals***
- ***Heads of Communications***
- ***and more***

This conference is sponsored by: General Dynamics Mission Systems, GMRE Inc, NSSLGlobal and Tampa Microwave.

For information on exhibiting and or sponsoring at Mobile Deployable Communications 2018, email ***smalick@smi-online.co.uk***

There is a £400 early bird booking discount available until October 31st.

To register or for more information, visit: ***www.mobiledeployable.com/satnewspr***

DISPATCHES

SUBSTITUTE NAVIGATION SATELLITE BEING WORKED ON BY ISRO

Work has started in Bengaluru, India, to assemble a substitute navigation spacecraft, according to The Hindu infosite, which became essential after the main backup was lost in a failed launch on August 31, 2017.

IRNSS-1I was earlier approved as a ground spare, to be sent to space in an emergency. The Indian Space Research Organisation has been training a team from an industry consortium to assemble this spacecraft and its lost fellow satellite, IRNSS-1H.

M. Annadurai, director of ISRO Satellite Center (ISAC), Bengaluru, said the current approval is for seven navigation spacecraft (all of which are in orbit) and two spares — IRNSS-1H and IRNSS-1I. Should a new backup be sought and approved, it may be part of another model of outsourcing of its satellites to the Indian industry. ISRO has just begun the process of identifying a set of external partners who would assemble its future satellites, he noted. Until now all Indian spacecraft have been assembled at ISAC by its engineers.

Back in December, the consortium of six industries was given six months to work on each spacecraft. The deadline for IRNSS-1I was around May of 2018. Dr. Annadurai said that as of now, the timeline remained the same. The launch of 1I, when it was ready, would also have to align with ISRO's other missions, he said.

ISRO awaits the report of the failure analysis committee, which is looking into reasons why the launch failed, before it returns to launch its next missions. The seven IRNSS spacecraft, from 1A to 1G, are part of the 1,400-crore GPS-like fleet for India, called NavIC (Navigation in Indian Constellation). They were put in orbit between July 2013 and April 2016 and have a life of 10 years each.

Soon after all of these satellites were in place, all three atomic clocks in IRNSS-1A failed, warranting that spacecraft's replacement. IRNSS-1H was sent up on a PSLV rocket but was not released from the upper heat shield of the rocket and has been falling slowly to Earth in the same state, embedded in the heat shield — this is where 1I enters — as a backup to both IRNSS-1A and IRNSS-1H.

The atomic clocks on the other satellites are being used sparingly to extend the clocks' life in space. ISRO chairman A.S. Kiran Kumar recently said there was no urgency as the remaining six are working as planned.

DISPATCHES

COMMUNICATIONS IN THE VIRGIN ISLANDS RESTORED BY U.S.A.F.

Chief Master Sgt. Don Johnnson and Staff Sgt. Tony Baca, Joint Incident Site Communication Capability team members with the 151st Air Refueling Wing Communications Flight in Salt Lake City, Utah, set up a SWE-DISH CCT120 satellite dish outside the Leonard B. Francis Armory in St. Thomas, U.S. Virgin Islands, September 20, 2017. The September 7 deployment of the Utah JISCC helped re-establish critical military and emergency civil service communications within areas of the U.S. Virgin Islands severely impacted by Hurricanes Irma and Maria. U.S. Air National Guard photo by Master Sgt. Paul Gorman.

Six Airmen assigned to the Joint Incident Site Communications Capability team of the 151st Air Refueling Wing in Salt Lake City, Utah, deployed to the U.S. Virgin Islands September 7, to provide critical communications in the wake of Hurricane Irma.

The Utah Airmen established a base of operations at the Leonard B. Francis Armory in St. Thomas, rapidly setting up the antenna systems required to provide the islands Tactical Operations Center with a wide array of communications capabilities.

"*When we first arrived in St. Thomas, all cell services, local phone lines and internet services were down*," said 2nd Lt. Tyler Olsen, JISCC officer in charge. "*We were able to establish voice and data for the first time on the island since Hurricane Irma had wiped them out. It was their first opportunity to communicate with the outside world.*"

JISCC capabilities are designed to augment civilian first responders, and bridge the communications gap between military and civilian agencies.

Each team is equipped to establish remote internet, telephone and radio capabilities at locations with a damaged or nonexistent communications infrastructure.

The 151st ARW JISCC is one of 42 block three teams distributed throughout the Air National Guard, 15 of which are currently mobilized to support hurricane damaged regions of Texas, Florida, and the U.S. Virgin Islands.

According to Chief Master Sgt. Don Johnson, vice chairman of the ANG JISCC working group, recent events represent a historic activation of the domestic operations asset.

"*While JISCC teams are routinely called upon to support regional incidents and events benefiting from their unique capabilities, the recent chain of hurricanes impacting the southeastern U.S. has resulted in the largest mobilization of JISCC assets since first fielded to the ANG*," Johnson said.

A C-17 Globemaster from the 164th Airlift Wing sits on the flight line at Roland R. Wright Air National Guard Base in Salt Lake City on Sept. 7, 2017. The aircraft will take Airmen from the151st Communications Flight to the U.S. Virgin Islands in support of Hurricane Irma relief efforts. U.S. Air National Guard photo by Tech. Sgt. Chris Cook.

On September 19th, the Virgin Islands were further impacted by the passing of Hurricane Maria.

The Utah JISCC members were forced to disassemble their equipment in advance of the storm, and re-establish communications in its wake.

Airman 1st Class David Zham, newest member of the Utah JISCC team considered the event little more than an interruption.

"*We had to protect our equipment in order to resume service as soon as it was over*," Zham said. "*We were able to bounce right back, so our mission never stopped, it was merely put on pause.*"

With the extensive damage further levied by the passing of Hurricane Maria, additional ANG JISCC teams are being mobilized to meet the continued requirements for emergency communications support to the region.

"*Hurricane Irma gave us vital insight into how important communications can be in a large scale disaster*," Olsen said. "*I believe the JISCC will be an integral component of domestic operations from here on into the foreseeable future.*"

DISPATCHES

STEM DAY WITH THE IOWA NATIONAL GUARD

High school students visited Camp Dodge, in Johnston, Iowa for the Iowa National Guard's inaugural STEM (Science, Technology, Engineering and Math) Day.

Approximately 40 students spent Wednesday with Soldiers and Airmen, learning about science, technology, engineering and mathematics applications in the military.

Harlan Community High School and Davis County Community High School — the first two schools to participate in what the Guard hopes to be a quarterly program — each invited high school students in their STEM or career technical programs to attend the field trip.

Dan Maeder, superintendent of Davis County Community School District in Bloomfield, and the battalion commander of the Iowa Army National Guard's 224th Brigade Engineer Battalion in Cedar Rapids, said STEM Day was a chance for him to make a connection between his civilian life and his military service.

"*I'd be happy to bring my perspective as a school superintendent and a Guard soldier to help make this a successful program for the Guard and our schools as well*," Maeder said.

Justin Wagner, superintendent of Harlan Community Schools and the Iowa National Guard's Vice Chief of the Joint Staff, was similarly positioned to help get the first event off the ground.

While at STEM Day, students toured the Iowa National Guard's Sustainment Training Center, a state-of-the-art facility where they learned about plasma cutting, metallurgy and calculating amperage.

They also visited the Black Hawk Aircrew Trainer, a flight simulator using real UH-60M "Black Hawk" controls and technology to recreate challenges faced by helicopter pilots, and the Medical Simulation Training Center, where combat medics are assessed on their ability to treat casualties by treating technologically-sophisticated mannequins that breathe, bleed and react to touch.

"*One of the most important things we can do is find applications for what kids learn every day in school*," Wagner said. "*This STEM Day here is just one example of what we try to engage our kids in: partnerships that*

High School Students from Harlan Community High School, in Harlan, Iowa, and Davis County Community High School, in Bloomfield, Iowa, watch UH-60 "Black Hawk" helicopters practice sling load maneuvers during the Iowa National Guard's inaugural STEM (Science, Technology, Engineering and Math) Day event at Camp Dodge, in Johnston, Iowa. The Guard hosted its first STEM Day in an effort to showcase the applications of science, technology, engineering and mathematics in day-to-day military operations.

U.S. Army National Guard photo by Cpl. Tawny Schmit.

really try to take what the kids are learning in the classroom and apply it to real world scenarios."

Students were also able to watch actual Black Hawk helicopters practice sling load maneuvers, see an Unmanned Aerial Vehicle (UAV) demonstration, and test their skills with one of the Iowa Air National Guard's intelligence analysts.

Staff Sgt. Beth Rodas, a geospatial intelligence analyst with the Intelligence, Surveillance and Reconnaissance Group (ISRG) at the 132nd Wing, Iowa Air National Guard in Des Moines, gave students a presentation on how to identify aircraft, submarines and tanks in satellite imagery.

After her class, she tested students' ability to decipher actual photographs in a timed game that resulted in prizes for the high schoolers.

"*I want them to understand that the state of Iowa wants you to stay here*," Rodas said. "*We want you to be invested in your school, and we want you to stay in those STEM career fields."*

As a member of the STEM Outreach Program at the ISRG, Rodas spends a lot of time visiting high schools and colleges to talk about how she utilizes STEM for the military.

"*I'm an educator*," Rodas said. "*I'm not trying to get you to join [the Guard]. Ultimately, I'd love to have more people in the Guard; I love it, that's why I'm doing it. But I'm not a recruiter.*"

Staff Sgt. Beth Rodas, a geospatial intelligence analyst with the Intelligence, Surveillance and Reconnaissance Group (ISRG) at the 132nd Wing, Iowa Air National Guard in Des Moines, Iowa, gives a presentation to high school students about identifying aircraft, submarines and other military vehicles in satellite imagery during the Iowa National Guard's inaugural STEM Day event at Camp Dodge, in Johnston, Iowa. Rodas is a member of the ISRG's STEM Outreach Program and works regularly with the Governor's STEM council to spread the word about science, technology, engineering and mathematics in the Iowa National Guard. U.S. Army National Guard photo by Staff Sgt. Christie Smith.

Rodas partnered with several other Soldiers and Airmen to help plan Camp Dodge's STEM Day.

In the past year, the Iowa National Guard has put an emphasis on STEM outreach as Maj. Gen. Timothy Orr, the Adjutant General, has joined the governor's STEM council.

"*From the Guard's perspective, I'm excited about it because there's a misconception out there in many communities that the National Guard is full of door-kickers and infantry shooters and killers*," Maeder said.

"*The reality is that's only a small part of our force. We are full of other opportunities for people who may need some assistance to where they want to go in their life.*"

As for the students, STEM Day was a hit. Maggie Koke, a senior at Harlan Community High School, said she was surprised to learn how much STEM plays a role in the military's day-to-day operations.

Although seeing the helicopters was cool, Koke said her favorite parts were experiencing the Humvee Egress Assistance Trainer — a simulator used to recreate the experience of a vehicle rollover — and the Engagement Skills Trainer — a simulator, similar to a video game, used for weapons training.

With the first STEM Day in the books, the Iowa National Guard hopes to continue the program several times throughout the school year to host schools and students from around the state.

"*This is just the beginning*," Rodas said.

Story by Staff Sgt. Christie Smith
Joint Forces Headquarters,
Iowa National Guard

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DISPATCHES

SPECTRA GROUP HAS PARTNERSHIP EXTENSION WITH AIRBUS

Spectra Group (UK) Ltd. has announced an extension of the SlingShot® sales partnership with Airbus — SlingShot is a cost-effective solution that enables secure BLOS COTM (Beyond Line Of Sight Communications On The Move) using in-service tactical radios connected to a global commercial satellite network provider.

Using SlingShot, existing tactical radios can be connected to commercial L-band SATCOM in order to extend secure Command and Control COTM for UHF and VHF radios BLOS.

Small, lightweight and flexible, SlingShot can be used dismounted or on any transport platform, including fixed wing aircraft and helicopters, extending tactical communications to where it is needed.

With reduced cost compared to other SATCOM BLOS options, increased channel availability and minimal training burden, SlingShot is redefining tactical communications.

Daz Ware, the Head of Sales for UK Land at Airbus, explained that the ability to communicate from anywhere to anywhere is especially critical in the military environment.

Daz explained that as a leading military communications service provider, it is important for Airbus to have a wide range of solutions in the company's portfolio to meet all their customers' needs and requirements and this partnership with Spectra offers this unique radio extension capability to complement an already strong company portfolio.

Steff Taylor, the Head of Business Development at Spectra noted that before the development of SlingShot, military forces and government agencies were limited to line of sight tactical communications on the move. Slingshot offers dedicated bandwidth for secure communications while creating a BLOS communications network that can extend over thousands of kilometers.

Taylor also commented that this is a capability that Airbus will be able to offer their customers on a wider basis. Working with its worldwide sales team to supply SlingShot, this partnership builds on two years of successful delivery to the UK. This relationship shows the strength and importance of SlingShot in defence and national security market places.

spectra-group.co.uk/

DISPATCHES

NEW O.C.H. MICRO CIRCULAR CONNECTORS RELEASED

TE Connectivity (TE) has released their O.C.H. micro circular connectors in accordance with standards specified by the U.S. Army's Nett Warrior program.

TE designed its circular connectors to meet these rigorous performance requirements, and they are now the second authorized source of Nett Warrior connectors for use in Nett Warrior soldier systems and peripheral devices.

The Nett Warrior program was developed to directly connect ground soldiers to the Army's tactical network through instant communication tools.Engineers strive to make these communication devices smaller and lighter to take extra weight off the backs of soldiers. The U.S. Army also requires certain mechanical and performance standards, including MIL-STD-810G.

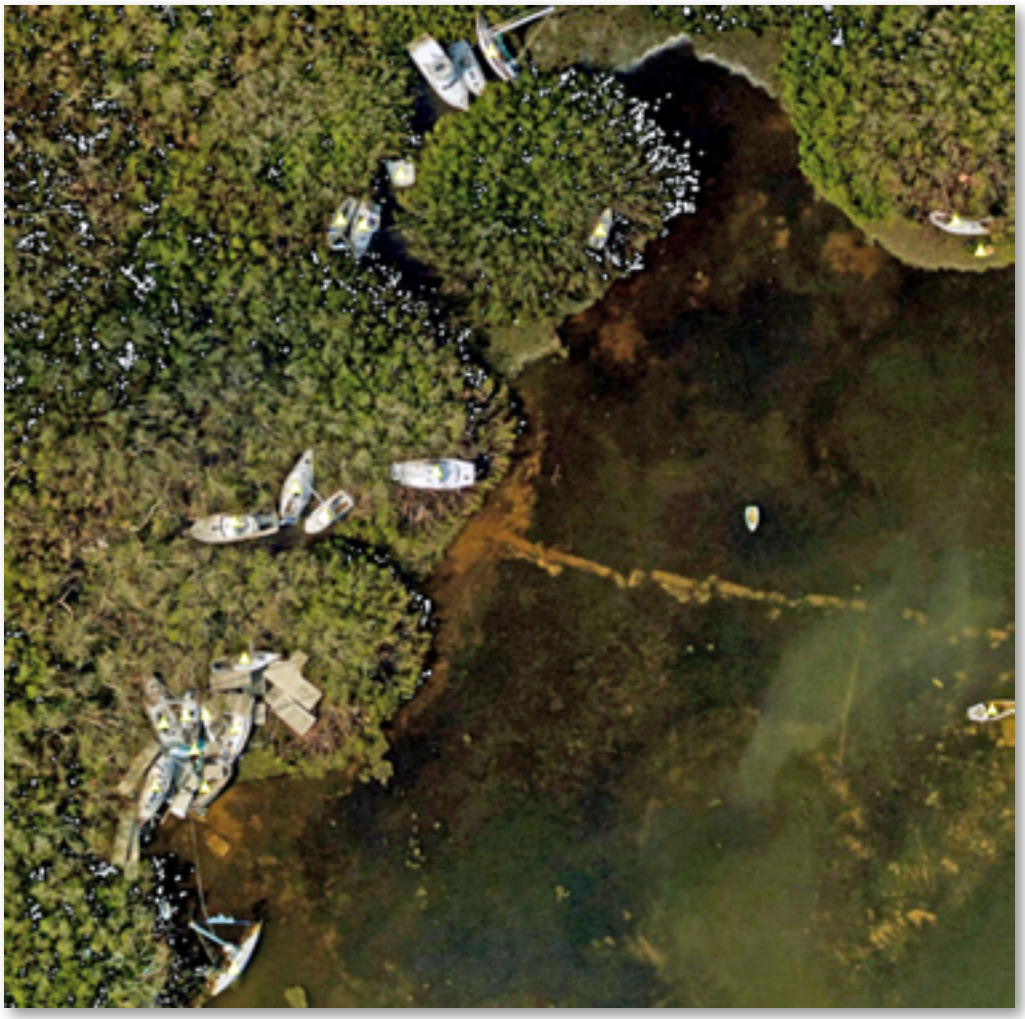
In addition to the above specifications, TE's O.C.H. micro circular connectors feature breakaway coupling, enabling quick connection and single-action disconnection that battlefield conditions require.

The lightweight aluminum shell and thermoplastic inserts provide a small, rugged package well-suited for soldier-worn applications.

te.com

DISPATCHES

U.S. COAST GUARD INTO ACTION POST HURRICANE IRMA



Members of a Coast Guard Hazardous Materials Assessment Team look for potential threats to the environment presented by damaged boats in Key West, Florida, in the wake of Hurricane Irma.

Hundreds of vessels have been reported damaged or have sunk as a result of Hurricane Irma's force.

Teams consisting of federal and state response members are assessing the potential risk of pollution from these vessels.

A satellite image (above) from the National Oceanic and Atmospheric Administration displays vessels damaged and sunken in the aftermath of Hurricane Irma in Marathon Key, Florida, September 16, 2017.

A boat is discovered mostly submerged in Marathon, Florida in the aftermath of Hurricane Irma.

A debris-filled waterway in Key West, Florida demonstrates the destructive power of Hurricane Irma, September 17, 2017.

Photos 2, 3 and 4 are by Petty Officer 1st Class Stephen Lehmann, U.S. Coast Guard PIAT.

DISPATCHES

U.S.A.F. COMMUNICATES WITH ORS-5 USING DISA MANAGED NETWORK

The Orbital ATK Minotaur IV launch of the ORS-5 satellite for the U.S. Air Force. Photo credit: Orbital ATK/Ben Cooper.

The ORS-5 satellite was launched in August and all is working according to plan for the U.S. Air Force Space Command and DISA-managed network.

Air Force Space Command (AFSC) and the Diego Garcia tracking station (DGS) are using the Defense Information Systems Network (DISN) Converged Access (DCA) Lite Network to communicate with the Operationally Responsive Space-5 (ORS-5), a space surveillance satellite that launched on August 26.

ORS-5 is a single-satellite constellation with a primary mission to provide surveillance of activity in the geosynchronous orbit belt, where communications satellites are typically found, for the 45th Space Wing.

While in orbit, the satellite is using the DCA Lite Network to transmit collected data to AFSC and its mission partners.

The network relies on a telemetry downlink upgraded with greater bandwidth to communicate between the tracking station and the satellite.

The upgraded downlink, currently running at the highest rate of all satellites supported by the Air Force Satellite Control Network (AFSCN), allows data to be transmitted faster.

Lester Vanbuskirk Jr., an AFSCN technical advisor said that without the circuit rate increase, AFSCN could not have supported ORS-5 at the Diego Garcia tracking station.

DISA first deployed network equipment at Diego Garcia in the Indian Ocean; Okinawa, Japan; and Singapore to begin the process of sunsetting its DISN Asynchronous Transfer Mode System — a legacy transport network designed to exchange information between facilities, bases, and land masses.

The DCA Lite Network was officially commissioned by the DISA Pacific Field Command on April 18.

DISPATCHES

ND SATCOM DEVELOPS NETWORK FOR BOLIVIAN AIR DEFENCE

ND SatCom has won the opportunity to develop a telecom network for Sistema Integrado de Defensa Aérea y Control de Tráfico Aéreo (SIDACTA) to securely and reliably connect locations across Bolivia.

In the presence of Bolivian President Evo Morales and former French President Francois Hollande, Thales Air Systems signed the SIDACTA contract with the Bolivian Ministry of Defence to modernize civil and military airspace across Bolivia.

This telecommunications network for integrated air defence and civil air traffic management (ATM) will rely on the SKYWAN 5G VSAT network as the primary network, with a secondary one from ENTEL providing terrestrial backup where feasible.

The VSAT network uses C-band transponders as recommended by ICAO (International Civil Aviation Organization).

Applications in this complex network design require several traffic classes (from radar to other IP tunnel-based services with guaranteed metrics) when transmitting over the primary SKYWAN VSAT network or when a fraction of the user traffic is sent on the satellite link and the terrestrial lines at the same time.

Radio data may contain VHF/UHF voice while telephone data originates from legacy analogue voice devices that are handled as real-time critical data and benefit from SKYWAN 5G's rooftop-to-rooftop direct link capability.

The SKYWAN 5G network will be used in a star topology. This VSAT network will interconnect 11 fixed radar sites and two GM 400 mobile radars to form the robust primary telecom network for civil and military air traffic controls in Bolivia.

Redundant master sites will ensure network availability and guarantee data security. The VSAT network will make use of fly-away terminals for mobile deployments.

Since the network will cover high-altitude locations in Bolivia, operational capability at 5000 meters above sea level is required.

The kickoff for SIDACTA's VSAT project occurred in May, and factory acceptance is scheduled for December.

The next phase of shipment and site installation will follow, which will be conducted jointly with Thales Air Systems and the end customer COSDEA (Comando Seguridad y Defensa del Espacio Aéreo) at each location.

According to Michael Weixler, ND SatCom's Head of Product Management, SKYWAN 5G again demonstrated its outstanding VSAT network capabilities for managing demand through either exceptional reliability or complex topologies when flexibility is essential. SKYWAN's telecom feature set allows the company to integrate with any terrestrial infrastructure.

Plus, he added, SKYWAN's support of numerous traffic classes, from legacy voice applications to mission critical real-time radar services, is a key advantage. A single disruptive feature was not required; rather, the collective effect of well-designed features in one cost-effective unit made the difference.

www.ndsatcom.com/en/

DISPATCHES

HARRIS ADDS SUITE B SECURITY TO MANPACK RADIO

Harris Corporation (NYSE: HRS) has launched a new Suite B security capability for its Falcon III® AN/PRC-117G multiband manpack radio — an industry first that combines secure interoperability and key independence to enable U.S. and NATO forces to communicate in joint or individual missions.

The Suite B encryption allows users to switch between U.S./NATO and independent networks on a single radio, removing the need to maintain two separate radio systems.

This enables the elimination of duplicate maintenance, training, user support and logistics activities, freeing up capital for other military expenditures.

Suite B security can also be integrated with additional waveforms to address new battlefield challenges as they arise.

Chris Young, president, Harris Communication Systems, noted that this secure capability allows the company's NATO partners to use the 117G to its fullest extent in battlefield scenarios that require multi-mission capabilities, while still maintaining independent communications capability for their own training and operations.

www.harris.com

MILITARY SPACE 2.0: COUNTERING MOUNTING CHALLENGES TO A PEACEFUL SPACE ENVIRONMENT

A Kratos Perspective by John Monahan, President, Kratos-RT Logic

Space is the ultimate high ground for the U.S. military and its allies, providing operational advantages that are essential to winning wars.

But no longer are satellites safe deep in space. Adversaries have notably stepped up their resolve and activity to disrupt space capabilities in their efforts to challenge this strategic advantage.

Countering these threats and subsequent vulnerabilities will require more awareness, automation, resilience, agility, and speed in order to predict, pre-empt, and prevent them. Some efforts extend beyond space, for example, requiring the military's shift to multi-domain operations to better integrate air, space, ground, sea and cyber operations.

The Department of Defense (DoD) and National Reconnaissance Office (NRO) have jointly authored the Space Enterprise Vision and related Space Warfighting Concept of Operations (CONOPS) to help address the increasingly contested space environment.

The SEV outlines key principles to guide the design and build out of space architectures suitable for operation in contested environments. Its goal is a more sustainable, resilient space architecture that can respond to threats and protect space-based assets. It provides the vision to link and integrate the various DoD, Civil, International, Commercial, and Intelligence Community capabilities into an overarching architectural vision.

The SEV includes three components: a new, more resilient space architecture, one in which space enterprise forces can respond to the full range of known threats and quickly adapt to counter future threats, while continuing to deliver space effects to coalition partners. The two other components include a more responsive satellite launch capability and a more resilient, cost-effective ground architecture, Enterprise Ground Services (EGS).

EGS will result in a multi-mission ground architecture that is more cost effective and robust, provides for enhanced space situational awareness (SSA) and will integrate with the Enterprise Space Battle Management Command and Control system (BMC2) now being developed.

Kratos is making key investments toward the success of EGS, including participation and leadership roles in various EGS working groups and in standards development.

Additionally, the company is investing in research and development (R&D) and developing an internal system integration lab (SIL) to further EGS' technical development and deployment.

The Space Warfighting CONOPS documents (SSA and Indications and Warning [I&W], Strategic Command and Control [C2] and Integrating CONOPS) articulate how the joint force will conduct multi-domain training and operations to ensure they are prepared to dominate in full spectrum conflict.

Another supporting initiative is the Wideband Communications Architecture Study (WCAS), part of the Wideband Analysis of Alternatives (AoA), to help define the next generation resilient ground architecture for the DoD. Kratos is on contract and supported by a world-class team of satellite operators including Intelsat General, SES, INMARSAT, Hughes and OneWeb to execute the study.

The aim is to expand SATCOM capacity and resiliency by enabling DoD terminals to work effectively across multiple satellite networks. To achieve this capability, the next-generation systems must be able to flexibly access commercial and government resources and traverse among a diverse pool of satellites, teleports, and managed systems.

Kratos is actively engaged in developing ground architecture enhancements in support of a variety of DoD initiatives. These and other initiatives coincide with a wave of innovation occurring throughout the commercial satellite industry.

The DoD, fortunately, is showing greater willingness to leverage these commercial capabilities to improve resiliency and situational awareness, and leverage commercial best practices, in the defense of its space assets.

MORE SATELLITES, MORE VIABILITY

Contending with the reality of future attacks, the strategy of investing in more agile and resilient satellite capabilities is being bolstered by new space.

Newly planned LEO and MEO constellations are radically changing the economics, lowering the cost of satellites such that the concept of resilience through numbers and basic protection capabilities is now viable. Supplementing a few critical, expensive satellites with larger numbers of agile, cheaper ones creates a more defensible space. As a result, adversaries will need to reconsider their ability to disrupt this more diversified space architecture.

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IMPROVED SPACE SITUATIONAL AWARENESS AND BATTLE MANAGEMENT

Even so, the best defense, no matter whether the target is a ship or a satellite, is the awareness to pre-empt or avoid the threat.

Programs such as the AWACS (Airborne Warning and Control System) and JSTARS (Joint Surveillance Target Attack Radar System) provide situational awareness and C2 for the air and ground domains. However, the ability to see and understand threats in space and direct space forces is in its early stages. Today's contested and congested environment differs vastly from days past of a few geostationary satellites in a sanctuary space domain.

A major step in this direction is the National Space Defense Center, which is bringing together the DoD, the intelligence community and the commercial sector (and in the future, our international partners). This fusion hub at Schriever Air Force Base is focused on integrating new approaches for SSA, I&W and unifying plans and efforts for directing space forces.

This collaboration demonstrates the Pentagon's growing interest in leveraging commercial sector data and services to gain an integrated view of an environment with thousands of space assets and objects in various orbits. Kratos is one of several companies bringing its unique, commercially sourced, Radio Frequency (RF) SSA data into the National Space Defense Center to aid in the SSA battle.

However, just as computer defenses require updated signatures for effective scanning, attaining near real-time awareness of the space domain depends on machine speed data collection and analysis: sensors and platforms talking machine-to-machine, with advanced algorithms and Artificial Intelligence quickly uncovering attack patterns. These provide the basis for early warning detection, improving the likelihood to react and respond accordingly. Predictive and preventive efforts could then avert collisions and/or operate through intentional jamming, for example.

CLOUDS IN SPACE

This shift would also lay the groundwork for leveraging the benefits of secure cloud services, which is generating huge interest as of late. Not only could modems be hosted in the cloud, but it would also facilitate the 'Internet of Things' of space. Data from sensors, applications and equipment could be collected, stored, and analyzed across the space enterprise at machine speed, providing insights on threats unavailable through standalone systems.

Combined with technologies like digital IF, which digitally routes RF signals over unlimited distances just like IP traffic, these evolved architectures would offer further flexibility in concepts of operations. For example, the ability to decouple antennas from signal processing would enable site diversity of ground operations and the placement of assets out of harm's way.

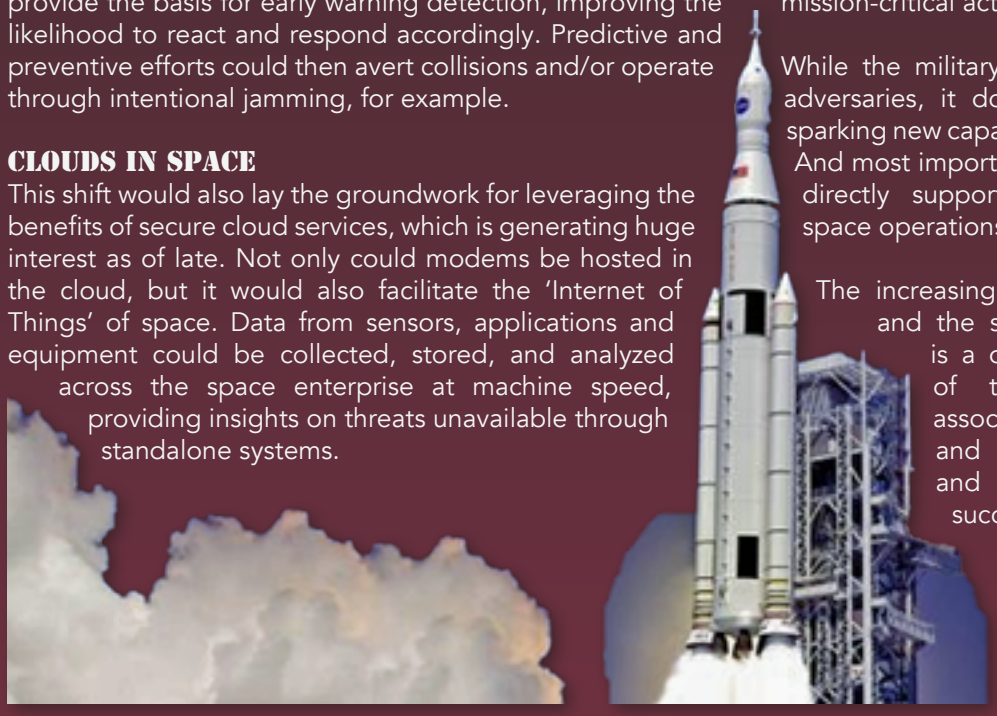
Just as the apps and communications of today's smartphones are useless without the underlying systems, this presumes significant change from today's current infrastructure.

THE ASSURED, RESPONSIVE NETWORK

Satellites are indispensable for nearly all military missions. Ensuring the faultless, uninterrupted delivery of services across complex grids of satellite, IP and terrestrial networks is a far greater challenge today. There are huge advantages to managing data and communications services end-to-end, with the satellite treated as just another node on the network, rather than a stand-alone platform. Defense organizations require network management that ties together strings of networks, from service management and service assurance all the way through to signal protection.

MANAGED SERVICES

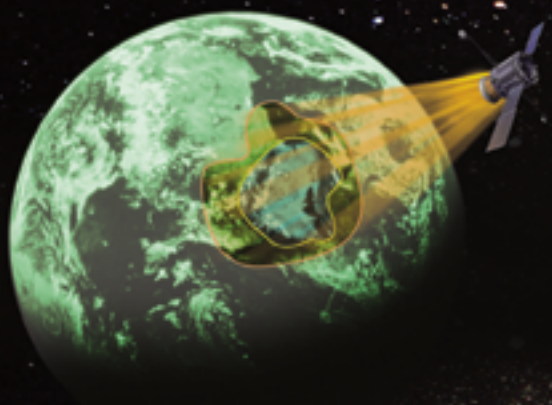
Another approach to gaining accelerated access to advanced satellite capabilities is through managed services, as opposed to the lengthier and more costly process of owning, and operating infrastructure. As an example, the U.S. Joint Functional Component Command for Space contracted with a commercial partner, Kratos, to monitor and protect the commercial satellite bandwidth for its worldwide combatant commands. Relying on Kratos' global infrastructure of 60+ RF sensor and antenna sites, the military gains advanced satellite monitoring and SSA at reduced costs, avoiding systems obsolescence and freeing its personnel for other mission-critical activities.



While the military is facing an era of new threats and adversaries, it does so at a time when innovation is sparking new capabilities, cost structures, and efficiencies. And most important, these technologies and techniques directly support more resilient, agile, and secure space operations.

The increasingly ominous space threat environment and the speed with which those threats occur is a driving force behind the development of the Space Enterprise Vision and associated CONOPS. There is a path ahead, and the partnership between the military and commercial sector will ensure we succeed together.

www.kratosdefense.com



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Dr Graham Turnock, Chief Executive, **UK Space Agency**

Air Commodore Nick Hay, Head of Capability C4ISR & SRO for Future Beyond Line of Sight Programme, HQ Joint Forces Command, **UK Ministry of Defence**

KEYNOTE ADDRESSES:

Deanna Ryals, Chief of International MilSatCom, **U.S. Air Force**

Colonel Cameron Stoltz, Director Space Requirements, Director-General Space, **Canadian Forces**

Brigadier General Nag Jung Choi, Commander of Defence Communication Command, **Republic of Korea Military***

Colonel Shinichiro Tsui, Counsellor National Space Secretariat, **Japanese Cabinet Office**

MILITARY AND GOVERNMENT SPEAKERS ALSO INCLUDE:

Colonel Laurent Jannin, Head of Syracuse III and IV Programs and MilSatCom Operations, **DGA France**

Colonel Jan der Kinderen, Programme Manager MilSatCom, Defence Material Organisations (DMO), **Netherlands MoD**

Lieutenant Colonel Frank Ruckes, Staff Officer, Cyber-/IT- Division, CIT I 3, **German Federal MoD**

Lieutenant Colonel James Dryburgh, DDC4OPS CIS Branch, **New Zealand Defence Force**

Lieutenant Colonel Luigi Mauro, Chief SATCOM Section, Department 1, Computer Science, Telematics and Advanced Technologies, **Italian MoD**

Major Geoffroy Beaudot, SatCom and CIS Programme Manager, **Luxembourg Directorate of Defence**

Dean Olson, Senior SATCOM Policy Analyst, Chief Information Office, **Department of Defense**

Brigadier General Carlos de Salas, Head of C4ISR & Space Programmes, **Spanish Armed Forces**

Commodore Victor Anuge, Director of ICT, **Nigerian Defence Space Agency**

Colonel Jorge Vital, Executive Vice President of Space Systems Coordination and Implementation Commission (CCISE), Department of Air & Space Technology - DCTA, **Brazilian Air Force**

Lieutenant Colonel Martin Vlach, Senior Staff Officer, Communication and Information Systems Agency, **Army of the Czech Republic**

Eron Miller, Chief, SATCOM Division, Infrastructure Directorate, **Defense Information Systems Agency (DISA)**

Bernd Kremer, Service Line Chief, Directorate Infrastructure Services, **NATO Communication and Information Agency**

Mike Rupar, Branch Head, Transmission Technology Branch, Code 5550, **US Naval Research Laboratory**

*Subject to Final Confirmation

PRE-CONFERENCE WORKSHOPS | Monday 6th November 2017

A: Global Government Payload Exploration
Hosted by: **The Hosted Payload Alliance**
8.30 - 12.00

B: Interference in SatCom Systems
Hosted by: **Jamie Dronen,** Director, MILSATCOM Future International Programmes, **The Aerospace Corporation**
12.30 - 16.00

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CPD CERTIFIED

MEETING SATCOM MOBILITY AND CONNECTIVITY DEMANDS

by Ulf Sandberg, Managing Director, Paradigm

NGOs (Non-Governmental Organizations) and First Response teams require fast and reliable communications to support their efforts when saving lives and providing relief for families and survivors.

Satellite communication is revolutionizing the delivery of content worldwide — new satellites are continuously being designed to meet this growing need for fast, cost-effective and global content delivery. Now, high throughput satellites (HTS) provide greater capacity than their counterparts by using multiple spot beams and competing with fiber in bandwidth, speed, efficiency and coverage.

The satellite communication industry is constantly developing and improving the mobility, speed and ease-of-use of satellite terminals. The first two scenarios are similar in that they both require a communication system that is mobile, able to handle high data rates and quick to assemble and point.

SCENARIO #1

The requirements of an NGO or first responder team in an emergency environment, such as a man-made or natural disaster, are crucial to a mission's success.

Their work could be in an area where existing communication networks are inoperable, or where the location is so remote or lacking in infra-structure that no communication network exists.

Rapid, reliable and ultra portable communication systems are vital for aiding the survivors. These systems need to be simple enough to be setup quickly and then used by untrained operators who have other key tasks to focus on.

Time taken to transport, assemble and point a system is critical and must be kept to a minimum. The sooner pictures and up-to-the-minute information on the situation can be transmitted from the disaster area, the sooner the rescue and aid organizations can respond properly.

Paradigm's Swarm45 with backpack.

For survivors, the ability to access a WiFi network in order to locate missing family members and reassure relatives around the world cannot be underestimated.

SCENARIO #2

The second scenario focuses on the requirements of the broadcast sector in a similar environment.

The world's broadcast networks want to be on the scene as fast as possible to communicate live pictures and video to an awaiting world. While this is important for global awareness as well as for friends and families of those affected around the world, a rapid response is also a commercial necessity for broadcast companies.

The first television or press organization to break the story gets the audience and the syndication opportunities. The correspondent who travels lightest, who is first off the plane and first on the scene, gets the jump on the rest of the press. If they are then able to assemble a SATCOM system in seconds and point it just as quickly, then their report is the one that hits the airwaves first.

Additionally, both sectors often also need a satellite communication solution that is discreet. A large satellite antenna has no place in politically sensitive and volatile environments — such demands a SATCOM solution that is unobtrusive and quickly stowed.

A terminal or antenna which is visible in this sort of unpredictable environment becomes a target. If the site is located in a busy city environment with large volumes of vehicular traffic and high-density, tall commercial buildings, then the satellite communication solution needs a small footprint and the ability to be located in an extremely protected area.

In addition, the satellite terminal must provide high enough data rates to handle the transfer of large video and photographic files. Likewise, if an NGO is providing vital communications for survivors in a war-torn hostile environment, then a discreet, ultra-portable SATCOM solution is much less vulnerable and much quicker to stow and secure when necessary.

Over time, these scenarios and many others like them, have presented themselves to Paradigm for a solution. The company's many years of integration and development experience in satellite communications place the firm in an ideal position to respond.

It was clear that the emergence of HTS would provide VSATs with the bandwidth and cost reduction to become an option for these kinds of situations. However, the VSAT pointing process was still too complicated for it to be an ideal solution.

Paradigm's design engineers studied the simplicity and portability of equipment already in use in these situations, such as BGAN (provided by Inmarsat, where a laptop-sized terminal can be used to connect via a low data rate link from remote locations) and compared it with VSAT setup and SWaP (Size, Weight and Power).

Of particular interest was the set-up, point and re-deploy process. From this assessment, Paradigm has developed the Outdoor PIM (Paradigm Interface Module), a common terminal interface controller that operates many different types of VSATs. It minimizes the need for training by offering simple operation; using audio and visual cues to point a VSAT terminal and control transmission — all achieved with three buttons and a cross-hair target of LEDs. No screen to smash or freeze. No heavy, bulky motors or controllers to weigh it down and no additional engineering tools to carry around.

The PIM is extremely rugged, weatherproof and very portable—all critical for global use in remote and demanding environments such as the ones outlined above.

Next, Paradigm took on the challenge of designing a VSAT terminal around the PIM that was ultra-portable, highly discreet and quick to deploy and stow; factors demanded by the scenarios outlined earlier. The aim was to design a VSAT terminal that could be carried as airline hand luggage, be setup and operational by an unskilled user in less than five minutes and still deliver high data rates for video and image transmission. Better still, with Inmarsat's Global Xpress, provide a terminal which can be re-deployed anywhere in the world without the requirement to contact the service provider.

Swarm45 checked into airline overhead compartment.

The ground-breaking Swarm45, released into the market in 2016, meets all of these requirements and more. The unit is a low-profile, 45cm flat panel VSAT with performance comparable to a 65cm parabolic antenna. Swarm45 is designed around the PIM for easy pointing and packs down into a lightweight backpack or hard case. Crucially, both packaging options are compliant as airline carry-on baggage — a unique feature for the Swarm45.

Setup is achieved in an astonishing 90 seconds and the user-friendly PIM allows even an unskilled operator to be on the air in 240 seconds. The flat panel design is reliable and greatly increases wet weather performance when compared to a unit with a parabolic design.

Paired with an HD video send and receive comms system, the Swarm45 provides a complete portable media station. This combination creates the ideal solution for anyone working in remote areas who needs to rapidly and accurately communicate video and pictures to the world.

The Swarm45 can operate in X-, Ku- or Ka-Band and is already compliant and used on many HTS networks, including Avanti, Inmarsat's Global Xpress, Intelsat EPIC and Telenor's Thor 7.

This level of global coverage and band flexibility, coupled with the considerable reduction in the average cost per Mbps of HTS bandwidth over FSS (Fixed Satellite Services) means that a SATCOM terminal — such as the Swarm45 — is a straightforward, cost-effective and innovative solution for the NGO, First Responder and broadcast markets.

For more information on Paradigm and the Swarm45 please contact ***sales@paracomm.co.uk***.

www.youtube.com/c/ParacommUK.

Ulf Sandberg is the Founder and Managing Director of Paradigm Communication Systems Ltd. A physics graduate, Sandberg has more than 35 years' experience in the global satellite and telecommunications world, starting his career with Notelsat after serving in the Swedish Armed Forces

After a period in the Swedish Government sector based in the USA, he worked for Swedish Telecom International and then Unisource, where he became the satellite business Managing Director based in the Netherlands.

Following time in Europe, San Diego and Russia, holding senior positions in a number of companies that included Versatel, ComStream and ACT Networks, Sandberg started Paradigm in 1996.

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FLAT PANEL ANTENNAS FOR KA-BAND SATCOM

EVOLVING TOWARD VERSATILE SOLUTIONS

by Dr. Yifan Wang, Advance Queensland Research Fellow with joint appointments at the University of Queensland and EM Solutions Pty Ltd.

In today's Ka-band satellite communications-on-the-move (COTM) industry, one of the most significant evolutions for ground terminal design is to employ compact, low-profile, and reconfigurable flat-panel antennas (FPAs) as a replacement for their conventional counterpart, the dish antenna, dominated by its bulky parabolic reflector.

Such evolution is naturally driven by new market demand and user expectations for high-speed satellite communications from ubiquitous on-the-move platforms, such as vehicles, unmanned aircraft systems, and aeronautical services.

The satellite terminals installed on these on-the-move platforms would ideally be both conformal in geometry and low-profile (*i.e.*, to become invisible) to better fit the aerodynamic surface in a limited footprint; and lower weight, to meet the payload quota the vehicle can support. Obviously, volume-based antenna solutions using parabolic or offset reflector dishes are not ideal fits for such requirements.

New opportunities in the COTM market have triggered numerous initiatives to find versatile and low cost flat-panel solutions in Ka-band that can approach the RF performance of their parabolic counterparts. In general, such FPAs are required to deliver a high antenna gain (typically up to 30 dBi) and to support a beam-steerable function that maintains a reliable communication link with satellite over any terrain.

Over the past three years, the design of Ka-band SATCOM FPAs has become one of the most attractive and best supported R&D topics in the industry and the research community alike. Although the concept of generating a focused-beam through a planar-shaped antenna is not new, it is still extremely challenging to design a feasible FPA solution that meets the RF constraints, matches the market needs, and is commercially profitable.

Over the past several years, a number of revolutionary antenna concepts and prototypes have been showcased by worldwide innovators (such as C-COM, Kymeta, and Phasor), but questions remain unanswered about what compromises have been made to meet all the essential antenna patterns and RF parameters for reasonable performances at Ka-band, while maintaining a reasonable cost. This makes it difficult to anticipate when and how FPA technology will dominate the COTM market as a replacement for traditional dish antennas.

Future solutions for flat panel antennas roughly follow four parallel routes as grouped below, in terms of their design philosophy and working principle.

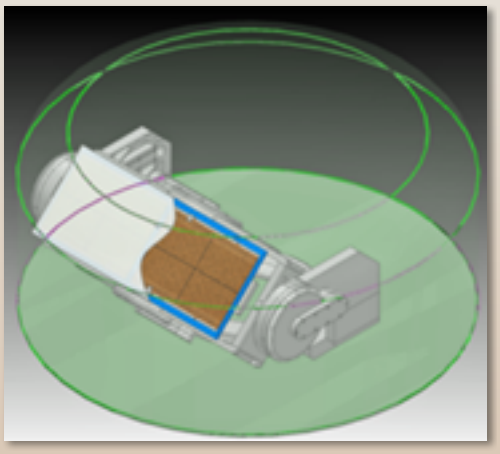

Figure 1. A flat panel array with mechanical pointing in both azimuth and elevation angles. Such an array can maintain constant gain when pointing in any direction, but generates a fan-shaped beam.

1) FPA with fixed radiation pattern, rotated mechanically in azimuth and elevation.

The solutions in this group are simple and straightforward; the FPA itself doesn't provide the beam steering function, but requires an external mechanical subsystem to rotate the antenna body and change the beam direction. A typical product in this group is the one made by DRS or Israeli company Elbit. "Chopped" parabolic dishes are similar to antennas in this category.

As the FPA generates a static radiation pattern, the antenna can easily be designed with a stable and high-gain radiation pattern over a wide frequency range, although it must be noted that low profile antennas that are elongated in shape (to achieve a higher gain) will have a fan-shaped beam that fails many certification requirements. This group of antennas could, in the future, be coupled with a sophisticated monopulse tracking system to enrich their motion performance, as do those already offered by EM Solutions.

In this group of antennas, future solutions can mainly be used to reduce the terminal's body weight on large-footprint platforms, but generally such solutions will not lead to ubiquitous low-profile or conformal terminals because of their requirement for azimuth and elevation movement and the need to maintain good radiation patterns.

Figure 2. A flat panel array with electrical steering in both azimuth and elevation angles. Although low profile, this antenna loses gain and pattern integrity as it points off-axis

2) FPA using a phased antenna array

In this group, FPAs are designed as two-dimensional antenna arrays excited by a feeding network of signals that are

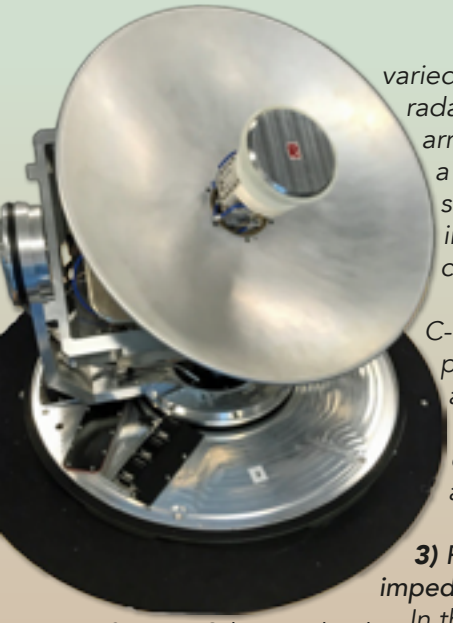

Figure 3. An EM Solutions X-band Taipan terminal. This antenna has optimum performance in all respects if the height profile can be accommodated.

varied in phase. Best known in radar applications, a phased array antenna can generate a focused beam useful for satellite communications, but in low volumes such systems can be very expensive.

Recently, Phasor and C-COM have developed a promising low-cost phased array solution in Ku-band, but it is unclear if the same design methodology is applicable in Ka-band.

***3)** FPA using a digitized impedance surface*

In this group of antenna arrays, the FPA is made from a tunable holographic impedance surface consisting of a large matrix of metamaterial units digitally controlled. The best known product in this group is the one made by Kymeta.

The solutions in this category should reduce the FPA manufacturing cost compared with phased array antennas, but are faced with challenging compromises between antenna radiation performance, resolution and accuracy of steering, and sidelobe levels, as well as limited bandwidth due to the inherent narrowband properties of metamaterials.

***4)** FPA made using sliding mechanical structures for two-dimensional steering*

In this group, the FPA is designed as a surface-wave generator by using the same theoretical framework once widely employed in optical science. The sliding mechanical structure within the FPA is used to steer the beam along the elevation angle, while a separate mechanical subsystem is required to rotate the entire antenna body horizontally to change the beam direction in the azimuthal plane.

A product type using similar concepts is that made by ThinKom. Such a design approach has the potential to reduce the manufacturing cost of the FPA, while maintaining a high-quality radiation pattern. However, the FPA will suffer degradation in its radiation efficiency as it is steered, with fluctuating antenna gain in different beam directions, and limited working bandwidth.

All the solution types listed above are worthwhile for further investigation and development, as they all have the opportunity to evolve towards a versatile and profitable product, depending on the application. In such developments, it is important to keep in mind the performance advantages of the mechanically steered parabolic antenna solution — constant high antenna gain and controllable antenna patterns.

These advantages will inevitably be compromised by reducing the profile and volume in moving to a low profile solution, with the choice of FPA vs parabolic antenna dictated by the relative importance the user will ultimately place on the value of low profile, compared with antenna gain off-axis (which can be critical to be able to communicate with the satellite at all).

With its Cobra and Taipan OTM terminal portfolios that use steered parabolic antennas, EM Solutions has traditionally valued high antenna gain rather than low profile, and sweetened the choice by offering monopulse tracking for very robust performance over rough terrain, as well as coverage of multiple operating bands for assured communications, two advantages not yet achievable with an FPA approach.

How can these two advantages be retained in the FPA approach? At EM Solutions, a long-term research collaboration has been established with the University of Queensland (UQ) to develop a versatile and low cost FPA solution for the COTM market.

Based on the most recent electromagnetics research from UQ, the RF and antenna designers from both organizations have identified a strategic roadmap to develop a low cost Ka-band FPA solution with satellite tracking capabilities.

The proposed product can integrate with the company's current SATCOM systems and offer many of the advantages available in its existing OTM terminal suite. First demonstrations of the prototype antenna will be shown to lead customers in early 2018.

Ultimately, there is no "best" answer for antenna choice. To use a racing analogy, it is "horses for courses"! Parabolic antennas offer the advantages of constant high gain, and certified compliant antenna patterns over broad bandwidths. Flat panel antennas compromise two or all three of these advantages in favor of low profile.

The optimum choice depends on the application, link budget, and the value placed on size, weight, and power. The search for the holy grail continues!

www.emsolutions.com.au

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His research interests are in the areas of complex electromagnetics modeling and system-level development of RF/Microwave equipment for remote sensing and communication applications.

Since 2014, he has been working with the Antenna Technology Development Group at EM Solutions to develop a millimeter-wave reconfigurable flat-panel antenna that complements EM Solutions' existing Cobra and Taipan multi-band terminals.

THE DAWNING OF A NEW SPACE SUPPLY CHAIN

HOW CAN THE U.S. MILITARY CASH IN?

by Doug Campbell, Chief Executive Officer, Roccor

In 2012 General Ellen Pawlikowski, then Commander of the Air Force Space and Missile Systems Center, foretold of the adoption of new military satellite design and acquisition strategies in order to "affordably provide resilient space capabilities . . . as mission needs evolve."[1]

In the five years since that statement, commercial satellites have been redefined by a flood of investment in commercial constellation programs — raising the question whether this "new space" supply chain can meet the vision of affordability and resiliency for future military missions.

General Pawlikowski argued for two key shifts in military acquisition strategy. First, she endorsed a hosted-payload acquisition strategy leveraging emerging commercial bus and rideshare opportunities as opposed to the traditional dedicated military satellite/launch vehicle paradigm.

Secondly, she pleaded for a move away from aggregated, highly centralized and long-life satellite architectures in deference to distributed satellite constellations with shorter lifespans to encourage more frequent technology upgrades. Both strategies are now well within the reach of the U.S. Military because of substantial commercial investments over the past five years.

Coincidentally in 2012, Greg Wyler founded OneWeb to provide internet access to anyone, anywhere on the planet. Since then, his vision has grown into a multi-billion-dollar corporate venture that will launch its first satellites in 2018. If all goes as planned, these inaugural flights will prove the viability of global Internet from space and the profitability of delivering it using 900 satellites with individual design lifespans of only three to four years.

Closing the business case has forced OneWeb to demand unprecedented low unit prices from their supply chain. Meeting those prices while staying in business has forced their supply chain to develop innovative component designs that are simple, can be produced with minimal touch labor, and can be flight qualified using standards more akin to the commercial aviation industry like lot-acceptance testing.

Moreover, OneWeb and their competitors, such as SpaceX, are finding the need to bend management norms for flight hardware development. Creative cost-sharing and infrastructure financing are proving as important to overall program success as the traditional earned-value-management obligations to cost, schedule, and risk.

In order to enforce a different culture, SpaceX initially staffed their satellite division with several dozen ex-software engineers and program managers for whom the build-test-learn-revise methods are the only way to design a system.

Just as Toyota proved to the automotive industry in the 1980's, today's mega-satellite-constellation industry is learning that affordability and resiliency is deeply rooted in a healthy and agile supply chain. Two-way transparency is becoming as important to the B2B relationship as the ubiquitous non-disclosure agreement, and the dialog is revealing a very different business case for component providers.

Gone are the days of maintaining a standing engineering army that feeds on design change orders as the schedule pushes right. Becoming a "bonded" supplier to the likes of OneWeb or SpaceX requires a passion for delivering on time, and a recognition that the business long game will be found in the recurring orders for second, third, and fourth generation constellations launched by these companies . . . assuming their first generation works.

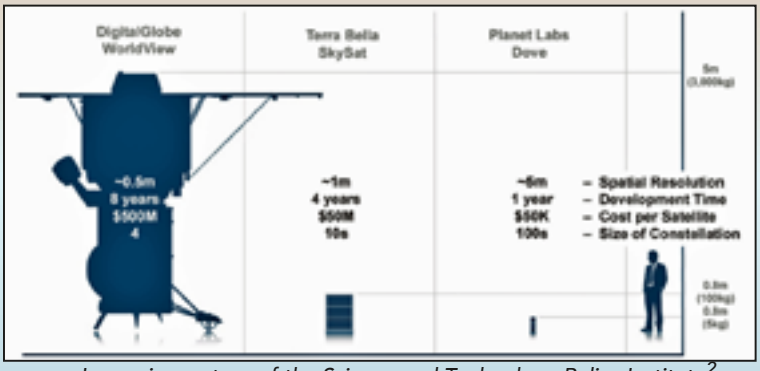

Image is courtesy of the Science and Technology Policy Institute[2].

More importantly than even slashing component prices and development times, this "new space" supply chain is being challenged to produce component designs that can deliver unprecedented performance to vanishingly small satellite platforms — because satellite size is really the key driver of constellation cost.

Ten years ago, DigitalGlobe (now a subsidiary of MacDonald, Dettwiler and Associates, MDA) launched their first WorldView satellite — a 3,000 kg satellite — at a cost of ~$500 million and after an eight year development cycle. Since then, the DigitalGlobe constellation has grown to four satellites — all of similar size and cost — to provide customers with ubiquitous imaging of the Earth's surface to ~0.5 meter spatial resolution.

Meanwhile DigitalGlobe's market share has slowly eroded by more recent entrants into the global imaging market: Terra Bella, which was founded in 2009 and is now a division of Planet Labs, and Planet Labs itself, which was founded in 2010.

Unlike DigitalGlobe's corporate roots in the DoD's Strategic Defense Initiative of the 1990's, these recent start-ups are rooted in Silicon Valley business tactics and have launched dramatically smaller and more affordable satellites for their constellations — deciding to sacrifice modestly on spatial resolution in order to deliver a more sustainable data product at a more affordable price point.

The question then remains: how can this emergent "new space" supply chain be a resource to the U.S. military and its top-tier suppliers and a means to achieve General Pawlikowski's vision of affordability and resiliency?

In 2009, the Australian Defense Force (ADF) announced a novel commercial/military agreement for development and launch of a military UHF payload on an Intelsat commercial satellite.[3] The agreement led to "*significant cost and schedule savings compared to a dedicated [military] satellite," and provided "a good example of the types of reforms required to ensure the most efficient use of Government finances.*" (Press release by the Minister of Defense, Australia, May 2009)

The ADF/Intelsat business partnership was consummated in 2012 with the successful launch of the UHF hosted payload with an advertised savings of $150 million and roughly four years of development time to the Australian Defense Force — an event that may have, at least partially, motivated General Pawlikowski's plea the same year for a new acquisition strategy to be adopted in the U.S. military.

This change in acquisition mindset is now possible. However, for the U.S. Military to meet the vision of affordability and resiliency as foretold by General Pawlikowski, it must cash in on the rapidly expanding commercial ride share opportunities, and embrace the move to smaller satellite platforms and the "new space" management norms that are being established by the mega-satellite-constellation industry and its growing and agile supply chain.

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Doug Campbell is the CEO of Roccor, a world leader in low cost composite deployment systems and thermal management devices for commercial and military satellites. Campbell is a serial entrepreneur with more than 15 years of experience in technology commercialization within the aerospace and clean technology sectors.

He holds an M.S. in Civil/Structural Engineering from the University of New Mexico and began his career as a research assistant at the Air Force Research Laboratory, Space Vehicles Directorate, Kirtland AFB, New Mexico.

THE HPA CORNER

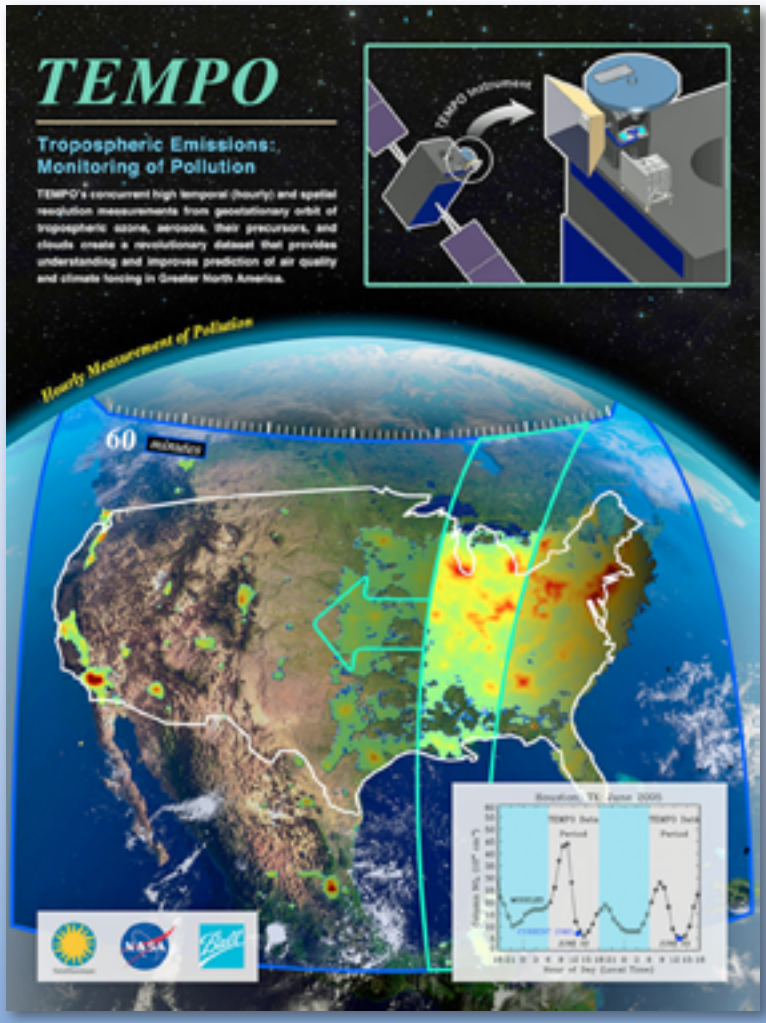
CATCHING THE WAVE

by Hayley McGuire, Deputy Director, Boeing Advanced Government Space Systems

Since the establishment of the Hosted Payload Alliance in 2011, examples of government-owned payloads on commercial spacecraft have been few, as evidenced by the low number of awards on the U.S. Air Force Hosted Payload Solutions (HOPS) contract, which was awarded to 14 companies back in 2014.

However, it is becoming clear that we are now entering an era in which both host owner/operators and payload providers recognize the advantages of commercial hosting, and this is reflected in recent successes.

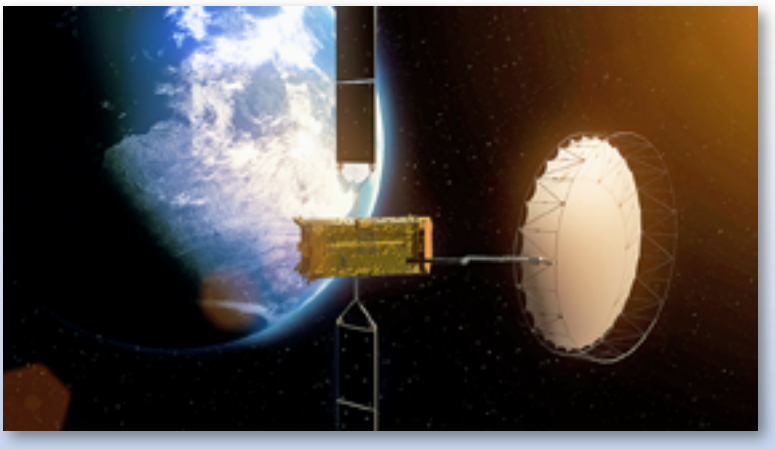
Iridium NEXT satellites have been deployed through two successful launches in 2017. Each of these satellites hosts the Aireon (SM) hosted payloads to provide the foundation of a global air traffic surveillance system. The remaining satellites will be launched over the next two years.



In addition, NASA's Tropospheric Emissions: Monitoring of Pollution (TEMPO) payload has been completed and is being provided a commercial host via the U.S. Air Force Hosted Payload Office's Hosted Payload Solutions (HoPS) program for launch in 2018-2019.

Europe is also continuing its hosted payload programs. In 2013, Inmarsat launched Alphasat, with approximately 20 percent of the satellite devoted to four hosted Technology Demonstration Payloads (TDPs), including a laser communication and Ka-band downlink, a Q/V-band communication and propagation payload, a next-generation star tracker, and the Environment Effects Facility payload. This program has been so successful that European Space Agency (ESA) and Inmarsat, the satellite operator, have agreed to extend operations for another three years (2017-20).

Clearly, the benefits of commercially hosted payloads are driving a new wave of acceptance and applications, enabling more responsive and affordable means of deploying new capabilities into space.



Artistic rendition of Inmarsat's Alphasat.

This column's question for HPA Members and answers on the following page is . . .

How do you see hosted payload opportunities expanding in the next five years?

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"In the coming years, hosted payloads are likely to proliferate as enhancements and alternatives for a wide variety of commercial, government, and science missions, including communications, space situational awareness, intelligence, surveillance and reconnaissance, missile warning, navigational augmentation, and Earth observation. In addition to this, we're seeing equally exciting new missions that would not be feasible without hosting on commercial satellites.

"These are enabled by the lower costs, more regular access to orbit, and increased opportunities for updates and evolution of payloads that the hosted payload model offers. This would support the U.S. government's desire for increased resilience and responsiveness to an evolving threat.

"Supported by the vibrant commercial launch industry, which saw 64 lift-offs in 2016 – a rapid cadence that is driving down costs and providing a wide range of accommodation offerings in multiple orbits – hosted payloads offer the opportunity to benefit from shared resources and a shared ride to space.

"With the capability to offer unique benefits, including fast access to space, lower cost missions, increased resilience through disaggregation, and operational flexibility, hosted payloads are becoming an increasingly attractive option for deploying new capabilities into space.

"SSL has experience in integrating a broad range of hosted payloads for commercial, government, and science customers, including x-ray sensors, imagers, and fully processed communication payloads. We look forward to hosted payloads continuing to gain momentum as a resilient and cost-effective alternative to dedicated missions."—***Al Tadros***, Vice President, Space Infrastructure and Civil Space, **SSL**

"It is hard to predict the future, but we experience a good start with the senior government leadership recognizing COMSATCOM as a primary resource of the future, building a path toward enterprise-level, integrated SATCOM architecture and strategy to ensure reliable, available and resilient seamless, state-of-the-art SATCOM capabilities that are fully interoperable with their owned and operated government systems. Such integrated architecture will enable the DoD to consider MILSATCOM and COMSATCOM as a holistic capability to best support the military missions.

"The ongoing analysis of alternatives for a follow-on wideband communications system to the WGS system, which includes space, air and ground layer communication capabilities, includes industry participation to determine the right way forward, rather than simply buying more DoD-owned, purpose-built satellite assets.

"As part of its analysis, the U.S. Air Force is also exploring alternative business relationships with SATCOM suppliers, such as hosted payloads, as well as managed services rather than merely leasing spectrum inefficiently as has been done historically.

"We in the industry welcome these pilot programs and as a forward-looking means of innovation in acquisition to insert more agility for the end-user. The satellite industry offers a wide range of capable solution sets well-suited for government applications ready for use now and in the future."—***Rebecca M. Cowen-Hirsch***, Senior Vice President, Government Strategy & Policy, U.S. Government Business Unit, **Inmarsat, Inc**.

www.hostedpayloadalliance.org/

The Hosted Payload Alliance (HPA) is a satellite industry alliance whose purpose is to increase awareness of the benefits of hosted government payloads on commercial satellites. The HPA seeks to bring together government and industry in an open dialogue to identify and promote the benefits of hosted payloads.

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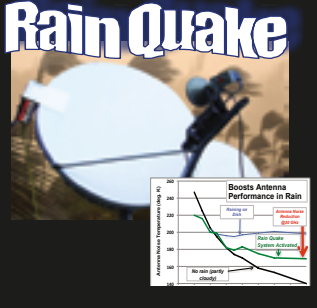

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THE COMING SATELLITE CYBER CRISIS

by Ryan Johnson, Global Cybersecurity Analyst, Access Partnership

A revolution is occurring in the satellite industry that will make 5G connections more robust, power the global Internet of Things (IoT) and bring broadband internet to the world's most remote places.

These diverse new applications are powered by lower launch costs, innovative designs like smallsats, global mesh networks, and terabit speeds. However, as these new applications make satellite connectivity more mainstream, the industry may struggle to adapt to the new cybersecurity issues that come with them, triggering increased regulatory scrutiny.

One key challenge for the satellite industry is a shift in their user base. Traditionally, satellite communications carried highly controlled communications — for example, from an embassy abroad back to the capital, or from a television content distributor to viewers. The users knew their communications were sensitive or proprietary and sought to protect them through a variety of means, chiefly encryption. Services such as Direct to Home (DTH) broadband and connected cars will bring satellite connectivity into the lives of many users who aren't prepared to manage their own cybersecurity.

At the same time, satellites are at the forefront of broadband access for developing countries. This is something the industry is rightly proud of. However, new users in these regions carry additional risks but provide lower revenue per user. More widespread use of off-license software in many developing countries reduces access to basic upgrades and patches that would otherwise reduce the impact of attacks, while growing use of mobile finance and other applications increases the attractiveness of these new users to cybercriminals.

Finally, satellite network operators are in business with the exploding IoT industry, which brings another set of attack vectors onto their networks. In dispersed IoT devices, data is sent via satellite from sensors to data collection centers and vice versa.

Some of this data will inevitably contain some sensitive customer information or authentication data to enable software updates — for internet-connected cars, for example. When IoT device manufacturers don't provide adequate security, this data can be intercepted, leading to data breaches that leave no fingerprints on the network.

Alternatively, people may use the satellite system to hide their malicious traffic and elude authorities. Research published by Kaspersky Lab suggests that hackers have been doing just that — they use tools that can be easily acquired for a few hundred dollars and they can coop satellites as unwitting links in a global malware network called Turla.

In this way, criminal organizations can use satellite links to bypass a major obstacle in the command and control of their malware networks, evading law enforcement activities as well.

It's entirely reasonable to think that in the next few years as billions of IoT devices proliferate, many with questionable security designs, some cunning hacker will find a way to launch a Distributed Denial of Service (DDoS) attack using something as simple, yet ubiquitous, as oil well pressure monitors or weather sensors.

If the Mirai botnet wreaked havoc on global data flows with only around 100,000 devices, an IoT botnet of 1 or 2 million devices could bring the global digital economy to a standstill, affecting satellite and terrestrial networks alike. Such bad actors may very well be even more motivated to target the satellite networks that handle sensitive military and government communications.

The increased amounts of sensitive data — say financial data from satellite-connected banking platforms like ATMs or personal health information from telehealth apps — will serve to increase the attractiveness of satellite data streams to criminal hackers. Breaches of this kind of data increase the likelihood that governments will favor stringent data localization laws, shutting off the benefits of cross-border data flows that satellites are well-suited to provide.

State sponsored cyber actors will also use these vectors to collect data on targets, infiltrate hardened networks, and disrupt or distort data flows to manipulate their adversaries. The geopolitical "wilderness of mirrors" extends out into space with just as much acrimony as it does on land.

As governments continue to research vulnerabilities in satellite networks, it is possible for their discoveries to get out of their hands and into those of criminals, as happened with the WannaCry attacks, where (likely) U.S. Government cyber tools were harnessed for a disruptive global criminal attack.

Of course, it's entirely possible that some of the satellite terminals themselves face security issues which could endanger the increasing numbers of planes, trains, ships, and automobiles relying on them. IOActive ***alleged*** this in 2014, and the industry responded by further hardening its products and ensuring secure design practices.

In short, the satellite industry is headed towards its ILOVEYOU or Mirai moment. Security questions that have been ignored for too long will suddenly come to the fore and the outcome will be a loss of trust in the product. When consumers lose trust in product, regulators tend to come running. As satellites operate on a global scale, the threat from adversarial regulators comes from many different countries.

Satellite operators, for their part, are taking some meaningful actions. For example, the Global VSAT Forum (GVF) and Satellite Industry Association (SIA) jointly released a ***policy statement*** articulating the industry's commitment to common-sense cybersecurity. Some operators have added cybersecurity officials at a high level, ensuring the whole organization is participating in its cybersecurity efforts.

However, as operators increasingly deal with industry sectors that are much less cyber-secure, they remain an easy target for regulators seeking to control the security and privacy of their citizens' data. The regulatory position the United States has staked out — voluntary, risk-based mechanisms that allow for tailored solutions — works well when industry meets the sometimes-unwritten standards of regulators. However, there are more than enough examples of reactionary regulation that comes in the wake of a major breach or failure in the market.

The GVF/SIA joint policy statement is a good start. It embraces the elements that have put the United States among the world's most cyber-secure countries, according to the International Telecommunication Union (ITU)'s ***Global Cyber Index***. Beyond this forward-looking policy stance, operators need to work with their customers to secure data, facilitate encryption of traffic across the entire network, and engage with regulators around the world to promote understanding of their role in the security of networks.

Each company in the satellite space should understand the risks their customers bring to their network, and take appropriate steps to respond. Operators should be prepared to cooperate with governments, industry, and consumers to reduce risks and respond to threats and attacks.

In addition to intra-industry work, they should participate in the global discussions on cybersecurity in the variety of venues that matter: the ***Global Conference on Cyber Space*** (GCCS), the ITU's study groups on technical and development issues related to cybersecurity, and the capacity building work being done by organizations like the ***Global Cyber Security Capacity Centre*** at Oxford University.

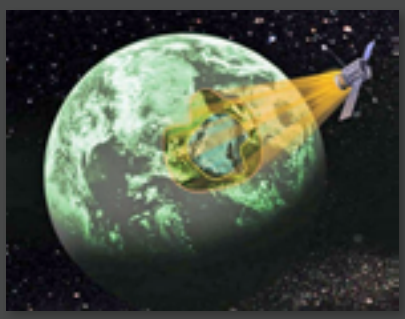
The industry should also work to build links with government cyber regulators and responders to have contacts and procedures in place before an incident occurs. Mitigating risk and minimizing impact before an incident compels regulators to enact stringent rules is the best way to ensure that the satellite can keep driving global connectivity solutions.

www.accesspartnership.com/

Ryan Johnson leads Access Partnership's global cybersecurity public policy practice. He advises clients in industry, government, and international organizations on policy developments in the fields of cybersecurity and internet governance.

GOVERNMENTS MUST PLAN TODAY FOR SPACE FLEXIBILITY AND THE VALUE OF GOVERNMENT AND COMMERCIAL COLLABORATION

The future of satellite communications is all about flexibility. Innovations are already enabling commercial customers to use satellite for new applications and to achieve business agility.



In order to remain preeminent in space, the U.S. government should follow suit and take advantage of the commercial space industry's continual technological development. The time to plan is now.

If the FY 2018 defense budget is any indication, the U.S. government is aware of the need for more flexible, protected, and resilient SATCOM solutions.

Myland Pride, Intelsat General Corporation's director of government and legislative affairs, said, "*The funding is an acknowledgement that space is more important than ever to the military, and that is not going to change—in fact, it is only going to increase. With few exceptions, leaders in both the DoD and both parties in Congress recognize the critical enabling capabilities brought by space assets, recognize the changing space environment, and want to address near-term gaps to improve capabilities and make them more resilient.*"

To be viable for the long-term, the DoD wideband space architecture must have integrated command, control, and operations. It must be agile, resilient, and flexible with the ability to utilize and optimize the frequency band across mission types, geographical locations, and a range of applications.

This agility and resiliency will contribute to overall mission assurance. Additionally, this architecture will require flexible acquisition methods more common to the commercial industry, such as those being explored by the Space and Missile Command's Pathfinder programs.

The commercial space sector is well suited to help the military obtain situational awareness and defensive capabilities. However, to maintain optimal agility and flexibility, commercial SATCOM must be designed into the space architecture from the beginning.

Once commercial is part of the long-term fabric in a way that is demonstrated by the Pentagon's planning and spending, commercial will respond and ensure systems meet the needs of the DoD—whether technical innovation or cybersecurity.

In many cases, commercial is already ahead of the government in these things. In other cases, it may just take a strong signal from government to cause commercial providers to pull forward some feature in their technology roadmaps.

Rory Welch, Vice President of Engineering and Service Delivery at Intelsat General, also talked about the future of space. He said, "*Commercial can bring solutions in to meet the needs that the government can't fill quickly with its own projects. The next generation components that will be flying on the next generation of WGS satellites, for example, are already installed on our satellites, and I think that's been very helpful for the government. We're trying to use the government to direct our innovation, rather than innovating for the sake of innovation.*"

Commercial innovation also extends to meeting more demanding performance requirements. IGC has tested many tactical terminals ranging in size from 45cm to 1.3m on the Intelsat IS-29e high-throughput satellite (HTS) and achieved efficiencies up to 2.8 bps per Hz. This is easily an improvement of two to three times over typical wide beam satellites. Next generation ground modems being rolled out this year are expected to achieve efficiencies up to 3.5 bps per Hz on Epic^{NG}-class satellites.

The Predator/Reaper SATCOM package was also tested on IS-29e, using both legacy waveforms and an interim release of the bandwidth-efficient waveforms being implemented by the Air Force. In the same occupied bandwidth, IS-29e enables 2.7 times the data rate to be transmitted. This type of performance improvement is exactly what the U.S. DoD is looking for to accommodate higher throughput requirements and smaller antenna footprints for their expanding mobility requirements.

Commercial SATCOM offers a number of other benefits as well. Commercial services are not only cost effective, but they can also free up limited military personnel to focus on maintaining U.S. dominance in space and increase resiliency and redundancy to operations. The enhanced performance of HTS is very conducive for a move to a more managed services procurement model, as government customers face continually accelerating bandwidth demands.

We're living in a time of technological disruption, and that disruption is impacting space communications. Now more than ever, it's critical for governments to avail themselves of new capabilities already operational in commercial networks. Not only should commercial capacity be part of military planning, it also needs to be designed into future space architecture.

A recent Department of Defense Lab Day featured more than 100 exhibits that demonstrated advances U.S. Air Force scientists and engineers have made in autonomy, unmanned systems, hypersonics, directed energy, and nano-science.

Despite this impressive display of innovation, Dr. Morley Stone, the CTO for the U.S. Air Force Research Laboratory, acknowledged that the DoD is falling behind and commercial innovation offers an opportunity to catch up.

"*DoD's share of [the] research and development ecosystem continues to shrink while the industrial share of that research ecosystem continues to expand, so we have to be thinking about different ways that we can reach out beyond the traditional DoD tech base and find ways to leverage what's happened in the industrial R&D. It is just absolutely exploding*," Dr. Stone told ***Defense & Aerospace Report*** during the Pentagon's recent DoD Lab Day 2017.

A short video of Dr. Stone's interview with Defense & Aerospace Report is available at this URL: ***https://youtu.be/uq-U-pFdwTc***

Dr. Stone started his AFRL career in 1992 as a research engineer in the Materials and Manufacturing Directorate and has held many leadership positions within the organization, including Chief Scientist of the 711th Human Performance Wing. He is now the primary science and technology adviser to the AFRL commander, assisting with the planning and execution of the organization's Science and Technology program. The lab is located at Wright-Patterson Air Force Base near Dayton, Ohio.

The AFRL is no stranger to public/private partnerships. Through the Air Force Technology Transfer (AF T2) program, developments in Air Force science and technology are shared with academia, industry, and state governments to help accelerate the development of products and research. The Vigilant Spirit Control Station (VSCS) software package is a prime example of this type of collaboration and the benefits it offers.

The VSCS software package allows unmanned aircraft system (UAS) operators to pilot multiple airplanes simultaneously. Most UAS manufacturers provide proprietary software that cannot be modified. VSCS, on the other hand, is non-proprietary and can work with multiple groups and brands of UAS. The ability to easily modify the source code to address the operator's needs makes VSCS an important R&D tool for both the Air Force and commercial UAS manufacturers.

As a result, the 711thth Human Performance Wing's Airman Systems Directorate is using Information Transfer Agreements (ITAs) to provide commercial companies with access to VSCS. The ITAs allow researchers from the companies to use the software while protecting the Air Force's intellectual property rights.

An ITA with Bihrle Applied Research Inc. has become essential for continued testing of the integration of VSCS and the Jointly Optimal Conflict Avoidance sense and avoid algorithm. A team from Bihrle Applied Research is working with AFRL Aerospace Systems Directorate on the project.

"*Having access to the software allows our algorithm development team to operate and observe the algorithm's dynamic interaction with the software controls and display functions in real-time and under different encounter scenarios*," said Jacob Kay, the director of sense and avoid technologies at Bihrle Applied Research. "*This first-hand experience with VSCS greatly expedites our development, testing, and refinement process.*"

This is just one example of how government/commercial collaboration can benefit both the Department of Defense and commercial industry. As leaders like Dr. Stone and organizations like the AFRL continue to emphasize the importance of closing the innovation gap by partnering with commercial organizations, we expect to see much more of this activity. And we're excited to see what comes out of it.

www.intelsatgeneral.com/

The preceding articles are courtesy of Intelsat General's SatCom Frontier infosite and editorial team.

SATELLITE, NOT WALLS, SECURE THE BORDER

AN SSPI BETTER SATELLITE WORLD FOCUS

by the Society of Satellite Professionals International

It can literally be a line in the sand or a fence made of concertina wire. A guard outpost on a busy road. A strip of unoccupied beach. A patch of trackless forest. A river snaking its way between two nations.

Invisible yet vital, borders define where one place ends and another begins. Borders are in the mind and heart as well as the laws of a nation, and they represent a barrier or a beginning, safety or threat, opportunity realized or opportunity denied.

In June 2016, the United Nations reported that a record 65 million people around the world had been displaced by conflicts that flared from Latin America and the Middle East to Western Asia and the Pacific Rim. Nearly 41 million were still living within their own countries but 24 million — including 100,000 children — were desperately trying to reach safety and opportunity in a foreign land. Add in the illicit trade in drugs, guns and other contraband and it appears those invisible lines are under assault as never before.

Everywhere, more prosperous nations feel compelled to defend their borders from intrusion even as they struggle with the moral and practical challenges raised by an ever-rising tide of refugees, smugglers and potential attackers seeking entry.

DEFENDING THE INVISIBLE

Australia has a coastline that stretches for 37,000 kilometers. How can such a vast expanse be monitored and managed? The only solution Down Under, as for most countries in the world, is satellite technology.

Satellite plays many roles in securing the border. The first is visibility. Earth observation satellites provide detailed images of hot spots where border crossings peak.

In the U.S., the Department of Homeland Security shares data from military reconnaissance satellites with local, state and Federal agencies responsible for immigration and anti-smuggling programs. Sensors are able to penetrate cloud cover, detect chemical traces and even identify objects inside buildings.

India uses the RISAT and Cartosat spacecraft to capture still images as well as high-resolution video of the nation's disputed borders. South Africa has used satellite imagery to track activity at border control posts between that nation and Zimbabwe.

The imagery picks up new roads and tracks, massed vehicles, temporary settlements and even places where fences have been compromised by migrants seeking access to one of Africa's most stable and prosperous countries.

CONNECTING THE MOVING PIECES

Visibility is not just a matter of sensors in space. Satellites also provide data, video and voice communications with aircraft, helicopters, ground vehicles and maritime vessels on border patrol. That makes it possible for widely scattered forces to share information and images, and to operate as a single unit.

Monitoring Australia's coastline for illegal immigration and resource exploitation is only possible because satellite links a fleet of Coast Guard ships and small boats as well as camera-equipped surveillance aircraft.

Satellite is even being used to link automated surveillance radar units set up at borders to detect moving targets over both land and water. They are particularly effective at spotting the tiny ultralight aircraft that drug smugglers use to bring their goods to market.

Unmanned aerial vehicles (UAVs or drones) have revolutionized warfare. They are also active in border patrols. Flown via satellite by remote operators, they can stay in the air for long periods of time and send video from the field, which effectively extends the reach of border control agencies for thousands of miles.

So successful have drones been on the southern border of the U.S. that drug smugglers have begun hacking into their communications to throw them off course. Ironically, the cyberattack involved another satellite technology: GPS. After gaining access to the drones' control system, the smugglers feed the aircraft fake GPS coordinates that send them hurtling across the sky to the wrong location. A new generation of low-altitude satellites is delivering a solution by transmitting navigation data at 1,000 times the power of GPS.

ADVANCED WARNING

Satellite technology helps stop people and goods at the border — but its greatest value may be keeping them from getting there.

The Automatic Identification System (AIS) is a tracking system that, by maritime law, is used on most ships to identify them and their location. When ships are near the coast, ground stations can pick up its signals — but on the open ocean, AIS connects to satellites overhead to make Coast Guards aware of potential trouble — whether illegal cargo or migration — long before it is in sight.

A combination of satellite radar and imaging technologies is helping immigration authorities in Europe monitor the size and changes at refugee camps on the edge of the Mediterranean and near Europe's land borders. That in turn makes it easier to predict future immigration attempts and, through preparation, save lives.

The European Space Agency (ESA) has recently launched Sentinel satellites to measure sea and surface temperature. These satellites can detect subtle changes in surface temperature that suggest crops are failing, and shrinking harvests can trigger a new wave of migration.

The same system will improve weather forecasting, warning Coast Guards of dangerous conditions at sea for migrants, and better track climate change, a long-term driver of migration.

Border security is ultimately about bringing together many different sources of information and making it available to a widely dispersed team. It runs the gamut from "eyes in the sky" to video from a drone or a text message from the field.

The only technology in the world that can do the whole job is literally out of this world. With unsleeping vigilance, from thousands of kilometers overhead, satellites are standing guard.

An SSPI produced video is available regarding this subject:
www.sspi.org/cpages/how-satellites-secure-the-border
or
www.youtube.com/watch?v=ON7nk4Bcn4o

This article was produced by the
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CUTTING-EDGE TECHNOLOGY FOR BATTLEFIELD COTM

A SPECTRA GROUP PERSPECTIVE

by Simon Davies, CEO of Spectra Group (UK) Ltd. and Senior Contributor

COTM is a term widely used to describe mobile communications capabilities, especially in military applications and when supporting Beyond Line of Sight (BLOS) communications to provide battle winning missions.

When Spectra Group refers to Communications On The Move (COTM), the company is specifically referring to a holistic solution that incorporates low SWaP (Size, Weight and Power) systems that can be used at high speed in any scenario, whether by dismounted personnel, or on land, amphibious or airborne vehicles.

A vital component for military command and control (C2) is the ability to communicate, exchange information and provide support for highly mobile groups of personnel anytime and anywhere. In recent years military engagements have changed greatly with operations becoming more asymmetric and non-linear and greatly increasing in tempo.

As there is a need to focus on maximizing effectiveness, C2 must be able to rely on systems that allow rapid response to changes as and when they happen. Whether the forward units are Special Operations Forces (SOF), conventional, Joint or Coalition Forces, if they are operating BLOS there must be a tactical communications solution capable of strategic reach back to maintain C2. Standard in-service tactical radios, operating in the VHF and UHF frequency ranges, are limited to Line of Sight (LOS) so a solution for BLOS tactical communications is needed.

Often this has been facilitated by ground or airborne repeater stations but these are expensive to deploy and need protection. Satellite technology is well suited to BLOS as it can offer a flexible, reliable and high-capacity service that can cover a vast area and because the 'repeater' is in orbit it is inherently more secure.

However, until recently, BLOS antennae were either too large or needed to be pointed at the satellite. Consequently, tactical communications was on the pause or at the halt.

The key principle of COTM is that equipment is fitted with an antenna that can establish communication without the need to stop or pause. COTM, Satcom-on-the-Move (SOTM) — or satellite communications on the move — are seemingly used interchangeably in the satellite industry. SOTM encompasses all satellite options, including high-bandwidth maritime, land and vehicle options with large, power-hungry antennae.

As demand for improved on-the-ground communication continues to rise, users of the latest modern military mobility equipment have begun focusing their attention on implementing the technology in satellite communications (SATCOM) to deliver data to and from hostile environments. To then implement the latest SATCOM technology — and

to make it militarily and commercially viable — has become the challenge for SOTM equipment manufacturers.

To provide a solution to military, government and commercial organizations who require communications on the move, Spectra developed Slingshot®. The company teamed with commercial satellite operator Inmarsat to use their global satellite network to provide assured access channels, and then developed the system to allow in-service tactical radios to connect to the Inmarsat satellite network and provide BLOS communications.

A major advantage of SlingShot is that this unit can be connected to existing tactical radios without compromising their in-built encryption systems. There is no need for any configuration to tactical radios as it plugs into its antenna socket, converting the VHF or UHF frequencies into the appropriate frequencies and power for the Inmarsat network.

SlingShot has a further market leading feature — an omni-directional antenna — and this is a key differentiator that changes the way people using Tactical Communications Satellites (TacSat) do business. These antennae maintain reliable communications at the operating speed of the platform on which they are installed, whether this is a land vehicle traveling at 80mph (130 kph) or a helicopter flying at 130 mph (113 knots).

Spectra has also successfully brought to market an aviation capability which offers command and control communications to all units on airborne platforms — both fixed-wing aircraft and helicopters— without the need for any land or air-based radio repeaters. Currently the aviation solution is based on a walk-on system where the antenna could be permanently installed and the operator carries on the remainder of the system to connect during the flight. Future testing is about to start on a solution for fast jets to complete the range of aviation platforms.

This year, the capability of SlingShot has been extended with the availability of new power options and the launch of the SlingShot Satellite Emulator (SSE) — an L-band satellite emulator for full offline system testing without a live satellite channel; a Universal Power Supply solution affording flexibility in power needs, as well as an AA battery cassette capable of powering SlingShot in manpack form.

The SSE is comprised of a programmable test tool, permitting operators to train with the system as if it was in real-time operational use by simulating satellite connectivity without expenditure. There is no need for reconfiguration or frequency programming as it behaves as a satellite and only reacts to the incoming RF from SlingShot. All that needs to be done is to ensure the supplied Transmit/Receive antennae are connected, plugged in and the unit is ready for testing.

Spectra Group's expertise is providing voice and data services in areas where either none exist or where high intensity conflicts, natural disasters, terrorist attacks or pandemics have destroyed existing networks. As the company is mainly staffed by ex-serving members of the Armed Forces, the firm knows only too well the crucial importance of the availability of these services and having first-hand experience of the damaging effects when communication services fail.

Spectra prides itself on its detailed understanding of challenges faced by military communicators. The company has experienced first-hand the challenges of maintaining secure voice and data communications in hostile environments. This drives the firm to ensure the solutions provided are always fit for the purpose.

All systems have been designed for ease-of-use, reliability and reducing the burden in the modern battlefield. The end-users consistently feed back highlights of their experiences with the ease of setting-up SlingShot in austere environments and the consistent quality of the service, once connected.

www.spectra-group.co.uk

Simon Davies is the CEO of Spectra Group (UK) Ltd. Spectra is a leading provider of Voice and Data services into remote and hostile areas worldwide for defense, governmental and non-governmental sectors.

Upon leaving the military in 2004, Simon set up Spectra which has achieved steady growth over the past 13 years through these difficult security and economic times and is fast becoming a leading service provider of reliable, robust, deployable communications. Spectra's services are deployed worldwide in some of the harshest environments supporting key NATO Militaries, and the European Union and Stabilization Unit, to name but a few.

THE ARRIVAL OF UPPER MILLIMETER WAVE RF COMMS

THE MOVE ABOVE AND BEYOND KA-BAND IS UNDERWAY

by Mike Sweeney, Director, New Business Development, L3 Technologies EDD

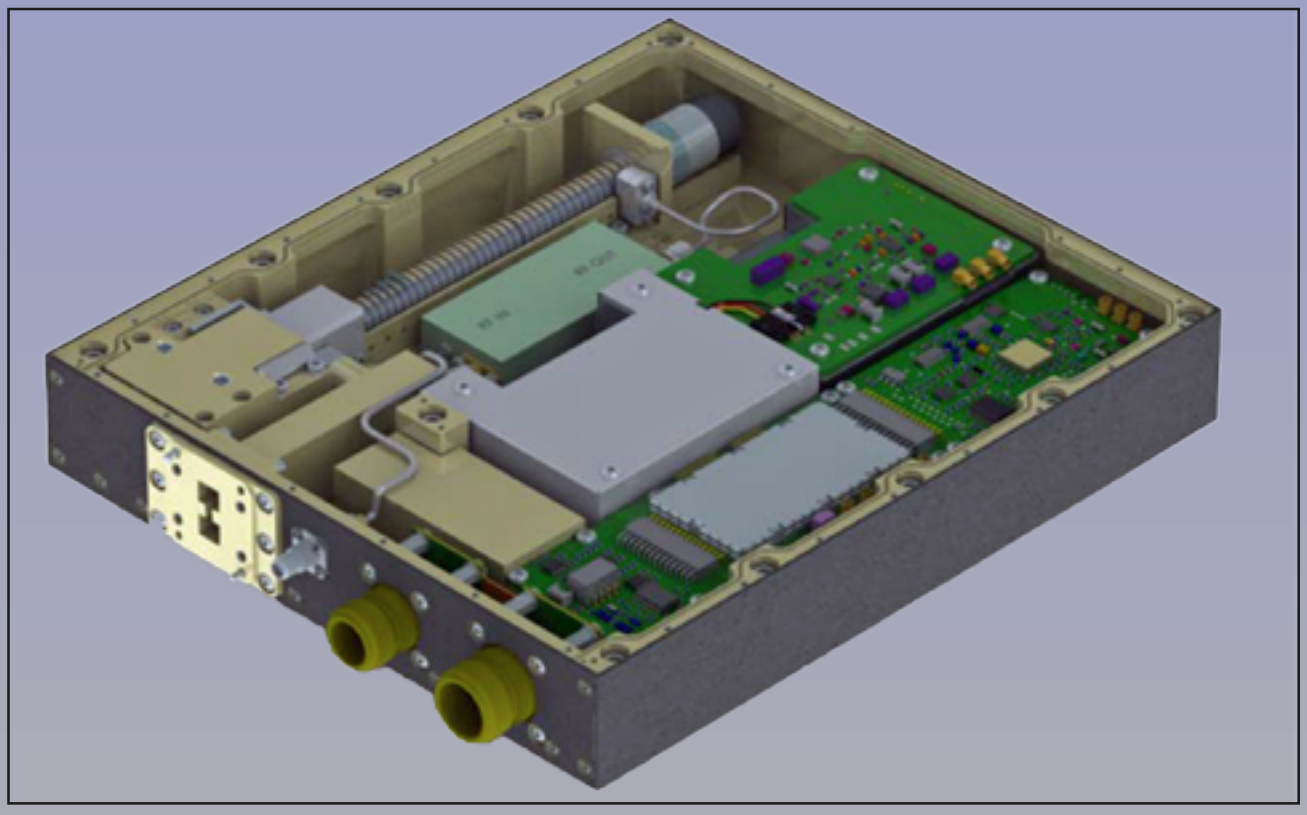
A sea change in microwave power emerged in the early 2000s — while solid-state was making advances with AESA radars and low frequency barrage jammers and predicting the death of vacuum devices such as coupled cavity tubes, klystrons, magnetrons, etc., a stealthy and healthy mass migration of historical High Power Amplifier and TWTA communication systems were being transitioned to microwave power module (MPM) form factor for 40-200 watt class airborne, naval and ground applications.

Since then, L3 EDD has delivered many dozens of different customer inspired variants and shipped thousands of high reliability MPM subsystems. Far more than any near-peer competitor, as the premier vertically integrated design and production team, were controlling every aspect of design and manufacture of these advanced RF products.

During the past half dozen years or so, a significant surge of Millimeter Wave applications (K-, Ka-, Ka-/Q-, Q-band) has driven the development of the MPM form factor as the product portfolio. In that period, a lower power 50W Psat, 22W Linear Ka-Band NanoMPM product was introduced to serve that surge. However, now, even with global regulatory issues to still be resolved, Upper Millimeter Wave is preparing to potentially radically change MILSATCOM and Commercial SATCOM after many quiet years of advance experimentation and hardware development to serve emerging Q/V-Band and W/V-Band applications. L3 is now positioning the company's MPM product line to service = these new frontier segments.

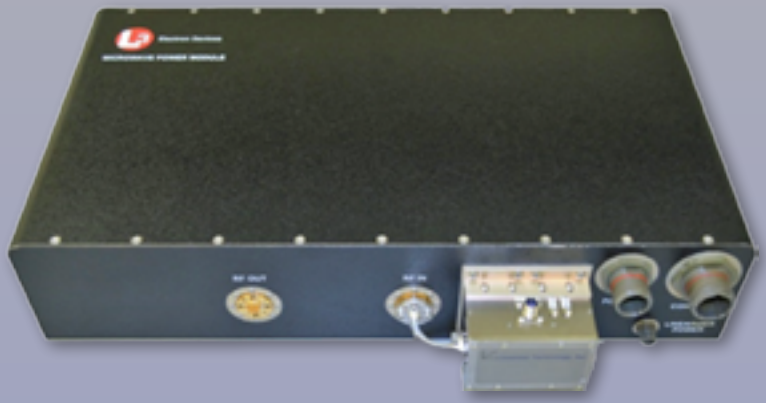
WHY THE ADOPTION OF THE TERM UPPER MILLIMETER WAVE?

The simple answer is reference differentiation. Millimeter is such a generic term nowadays and, within the MILSATCOM and commercial SATCOM worlds, that term has typically meant mostly Ka-band, as well as Military Q-band for AEHF uplink applications. The technology that enabled those segments is mature and now other innovative solutions are needed to drive the next generation of uplink/downlink communications systems at 50 GHz and above — thus, Upper MMW. It's also a convenient way for L3 to categorize the new Q/V and W/V segments and measure strength of demand for investment. The opportunity, or threat, however one might see it, in this new Upper MMW paradigm is significant and the company believes that the L3 MPM products are a legitimate game changing enabler.



NEW UPPER MMW PRODUCTS

L3 is introducing a range of new products in Upper MMW based upon the company's serpentine waveguide technology.

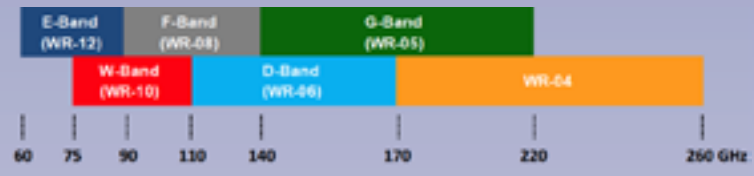


L3 EDD M2841 MPM
81 to 96 GHz 50 Watts Linear.

For instance, at the recent Satellite Innovation Symposium held in Silicon Valley, the company introduced the M2841 (81-86 GHz) E-band MPM, which is now receiving a great deal of attention.

While this demonstrated technology capability now ranges past 230 GHz, one of the primary Upper MMW segments for Comms of interest to L3 is what's being called the "W/V" segment, which is the use of the 71 to 76 GHz range and the 81 to 86 GHz range. Notably, there is some existing nomenclature confusion due to agency designation crossover.

For instance, the IEEE V-band frequency identifier designates 40-75 GHz as the applicable range of coverage and then W-band as the 75-110 GHz range. However, other commonly used Waveguide frequency band designations, such as Q-band (33-50 GHz), which is often associated with MILSTAR/AEHF for example, and E-band (60-90 GHz), are often interchangeably referenced.



L3 EDD Split Package
50 Watt G-Band MPM

Presently, the 71-76 GHz and 81-86 GHz bands are being considered, among a range of alternatives, for ultra-fast, high capacity terrestrial internet and other purposes, including wireless backhaul.

From a MILSATCOM perspective, there is published USAF interest in cooperatively using V-band (71-76 GHz) as a spaceborne downlink with a complementary uplink in W-band (81-86 GHz).

The interest doesn't stop there. Several of the new space and/or "high speed internet for the masses" groups who don't necessarily care to be mentioned by name are considering the advantages of migrating to Upper MMW, given the significant amount of enabling technology already available, in combination with system performance analyses, such as atmospheric attenuation, and so on, that has already been performed.

Recent space borne channel propagation impairment and mitigation experimentation have yielded throughput advancements, wherein now the barrier of cost effective, high power Upper MMW RF amplification has become one of the last system level challenges to resolve. L3 believes the industry has arrived there, in some instances, and this is close to other innovative solutions that are being completed under IRAD.

The core serpentine waveguide technology is frequency agile as well as a great broadband performer with advanced modeling showing stable capability even over a full 70-100 GHz range. Thankfully, the company has been working for a decade on technology maturation and now have functional demonstration hardware available for future system developers of experimental gateway, backhaul and even airborne (near antenna mount) applications to enable rapid exploration and testing for advanced feasibility.

While full system deployments may still be a few years away, L3 has the enabling technology available now for developers to start building and testing tangible Upper MMW communications subsystems.

HOW IS L3 EDD ENABLING THE Q/V SEGMENT?

From a product perspective, the company is already actively working on Space TWTA application insertions.

The overall segment, inclusive of uplink, is also a natural fit for L3's existing MPM line, as specifically derived from the Ka-/Q- and Q-band products, which are inherently broadband. Both the 47.2 - 51.4 GHz uplink and the 37.5 to 42.5 GHz downlink frequency needs are well within the firm's immediate technology products arsenal.

With the recent consolidation of L3's San Carlos facility into the company's Torrance, California, operation, the overall goal is to position L3 EDD as the industry's premier "many choices, one company" solutions provider — especially so in servicing new High Throughput Satellite (HTS) platforms.

M1871 Ka Nano	M1292 Ka-Band	M2836 Q-Band	M2837 Dual Ka/Q	M2842 Multiband
29 – 31 GHz	26 – 36 GHz	43.5 – 45.5 GHz	29.5 – 31 GHz 43.5-45.5 GHz	18 – 40 GHz
50 Watts	100 Watts	80 Watts	80 Watts	100 Watts
16.6 x 10.4 x 2.5 cm	24.1 x 20.3 x 3.8 cm	24.1 x 20.3 x 3.8 cm	24.1 x 20.3 x 3.8 cm	24.1 x 20.3 x 3.8 cm
1.1 kg	3.9 kg	3.9 kg	3.9 kg	3.9 kg

Pulsed W-Band MPM
92-96 GHz
P_{out}: 100W (pk)
Volume: 410 in^3
Weight: 23.5 lbs

M2839

E-Band MPM
81-86 GHz
P_{out}:100W(sat)/50W(lin)
Volume: 364 in^3
Weight: 22 lbs.
V-Band Capable Design

M2841

G-Band MPM
231.5-235 GHz
P_{out}: rated
Volume: 364 in^3
Weight: 20 lbs.

M2840

W-Band MPM
75-110 GHz
P_{out}: 50 W (min)
Volume: 364 in^3
Weight: 20 lbs. (max)

Capability

L3 MPM products can help address existing gaps. All design and manufacturing operations will be fully transitioned to the Torrance site in 2018. This unique confluence will enable the company to better address new performance requirements and cost sensitivities of "ubiquitous" constellations, such as Q/V, where new choices and flexibility are being sought. One shop, one stop.

There are reportedly seven or more major Q/V satellite constellation concepts that have been proposed or are under licensing review. While it's unclear that just one global satellite system builder or operator will be awarded an "all or none" license to control Q/V, the competition for paradigm busting concepts is white hot, including using more "Space COTS" subsystems, such as MPMs (*see Figure 1*).

For some at the leading "launch now" edge, L3 is already fully capable of offering full heritage Space TWTA products to enable new HTS systems per the firm's press announcement in September, which coincidentally was also highlighted at the L3 exhibition at the recent Satellite Innovation Symposium event.

Although the uplink segment is emerging a little more slowly, L3 is planning near term capability to serve system developers with 50 to 150 Watt Q/V devices while also being able to migrate upward to higher power levels for larger Earth station applications once that demand more tangibly presents itself.

The bottom line is that while others are talking a lot about Q/V, we are currently actively positioning high reliability products to the marketplace to serve both ends of the comms link system build out.

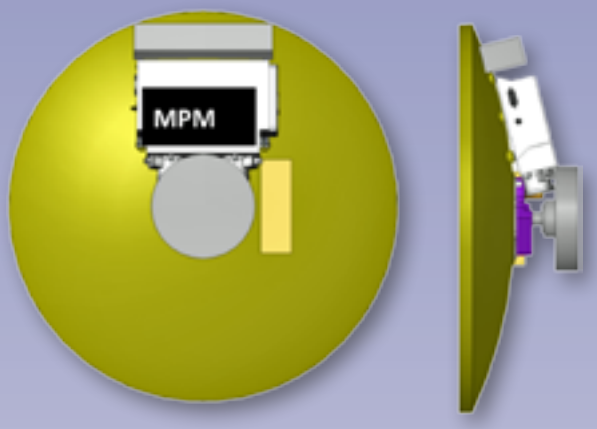
HOW ABOUT THE SMALLSAT SEGMENT?

Admittedly, L3 is not seeing strong demand for Upper MMW (above 50 GHz) in the smallsat segment — that may change.

No longer some sort of university lab sideshow, the smallsat segment is exciting and dynamic, yet is also quite fragmented.

This exploding market segment is also likely to stay that way, meaning that legacy space players who adapt first to that, rather than waiting and hoping it comes back to them, will reap the great rewards. Just look at how SSL, for instance, has adapted to the segment.

Similarly, L3 is also adapting, specifically with the company's ultra-compact NanoMPM (40 to 60 Watts) product line which can serve Microwave and Millimeter Wave frequency needs for Communications or Remote Sensing applications.



With an L3 EDD Millimeter Wave NanoMPM, this is about a self-contained RF amplifier that fits into the palm of your hand, weighs 2.5 lbs. and puts out 50 Watts CW. It really doesn't get much more nimble and flexible than that.

As in airborne applications, L3 is now enabling smallsat system architects to place a compact, self-contained, high efficiency RF power transmitter directly at, or conformal with, the antenna structure itself to preserve volume and mass, also importantly to maximize overall efficiency by reducing typical system plumbing losses that represent a significant penalty in Millimeter Wave (MMW) frequencies.

Outside of single purpose smallsats, it's relatively easy to envision how the Department of Defense's (DoD) transitional use of UAVs (where L3 EDD MPMs dominated datalink architectures) might parallel the future use and functionality of smallsats. That means quickly deployable, lower cost, swarm-like assets that are mission specific, yet also capable of functioning together or teaming as conceptually exemplified by the Army's Manned-Unmanned (MUMT) program.

WHEN WILL MPMS DOMINATE TWTAS IN FUTURE APPLICATIONS?

Highly unlikely, not even close actually — L3's space TWTA technology is so reliable and well developed, all the while being capable of producing functional RF power efficiencies in excess of 70 percent, with flawless performance over extremely long-life service cycles. If anything, by combining MPM and TWTA groups, this will synergistically make both stronger and even more competitively capable with one another, as each compliments one to another.

No other company in the world owns the same comparable depth of technology and capability — L3 believes that by offering this unmatched strength of choice, that customers will seek to invest themselves with the company. The goal again is — one company, many solutions — the potential for crossover does exist, but conflict is reduced as the products provide varying solutions.

HOW LONG WILL IT TAKE FOR UPPER MMW TO MAKE AN IMPACT?

An impact is already being made, but that's probably a better question for those at the satellite builder level. There is already a great number of competitive "first mover" jockeying underway and, with the advent of hosted payloads, the timeline for rapid deployments can be accelerated as never before witnessed.

L3 is building Upper MMW RF MPMs currently in low volumes and has, hopefully, invested correctly in terms of being able to power new system designs. The near term demand is likely to be fairly modest, given the amount of conventional Microwave and Millimeter Wave capacity that exists.

However, large swaths of high capacity Upper MMW bandwidth, as much as 4 or 5 GHz on each side of the link, is extremely attractive to disruptive forward visionaries. L3's new MPM technology, inherently broadband capable, is matured to the point where the product can be a great enabler/accelerator for the new Upper MMW paradigm, whatever that eventually might end up becoming.

Any questions, clarifications or responses can be directed to:
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