SPACENEWS
BUSINESS | POLITICS | PERSPECTIVE
DECEMBER 5, 2016

Constant Contact

An Earth-to-LEO comms revolution in the making

An avalanche of commercial spacecraft are headed for orbit.

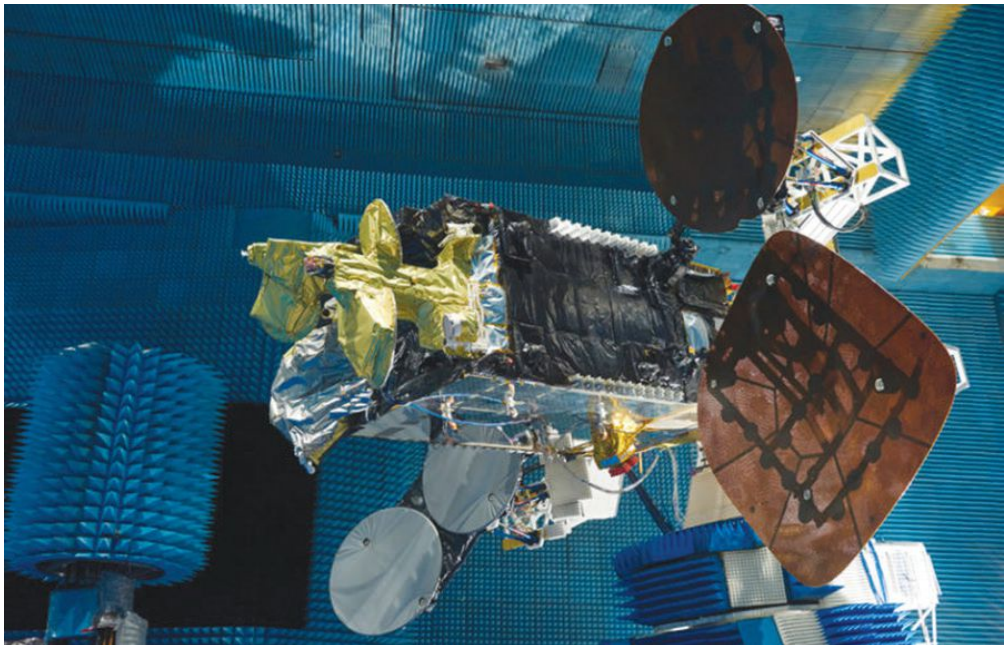
Will they need a commercial data-relay network to keep in touch?

Audacy, Solstar and Spaceflight Networks think so.

INSIDE


READY TO KEEP GPS III
ON TRACK.
For GPS III, Boeing can deliver a seamless and technically proven digital payload solution. Based upon the successful 702 satellite series, Boeing's GPS digital payload is simpler to integrate and test, offering a resilient, modular, flexible product with proven reliability. Add Boeing's 40 years of GPS experience, and you've got a one-of-a-kind commitment to keeping GPS III right on track while further modernizing this vital service.
BOEING

DEPARTMENTS



FEATURES

ABOVE: Spacecom is leasing AsiaSat-8 to help make up for the loss of AMOS-6, shown above undergoing testing at Israel Aerospace Industries. AMOS-6 was destroyed along with its Falcon 9 launcher in SpaceX's Sept. 1 pad explosion. See story, page 9.

ON THE COVER: ADOBE STOCK. THIS PAGE: SPACEOM

HISTORIC

An Ariane 5 ES flawlessly injected four Galileo spacecraft into a Medium Earth Orbit from the Spaceport in French Guiana on November 17. This was the 75th success in a row for the Ariane 5, surpassing the Ariane 4's streak of 74 consecutive missions. With this record-breaking feat, Arianespace brought Europe one step closer to navigational autonomy.

SPACENEWS

VOLUME 27 | ISSUE 25 | $4.95 ($7.50 NON-U.S.)

SPACENEWS (ISSN 2328-9376) Is published bi-weekly by SpaceNews Inc., 1414 Prince Street, Suite 204, Alexandria, Va. 22314-2853, USA. SpaceNews is not a publication of NASA. **ANNUAL SUBSCRIPTION RATES:** $219 U.S. Domestic mail; $239 Canada; $289 International mail. Periodicals postage paid at Alexandria, Va., and at other mailing offices. Postmaster: Send all UAA to CFS. (See DMM 707.4.12.5); **NON-POSTAL AND MILITARY FACILITIES:** send address corrections to SpaceNews, P.O. Box 16, Congers, NY 10920-0016. SpaceNews is registered with the British Postal System and Canada Post International Publications Mail (Canada Distribution) Sales Agreement No. 546046. To order Space News, to change an address or for subscription information, call our toll free number (in the U.S.) 866-429-2199, or write to SpaceNews, Customer Service, P O Box 16, Congers, NY 10920-0016 or email spacenews@cambeywest.com. For changes of address, attach an address label from a recent issue. **TELEPHONE NUMBERS:** Main: 571-421-2300; Circulation: 866-429-2199, fax 845-267-3478; Advertising: 571-356-0234.

SIGNIFICANT DIGITS

€400M

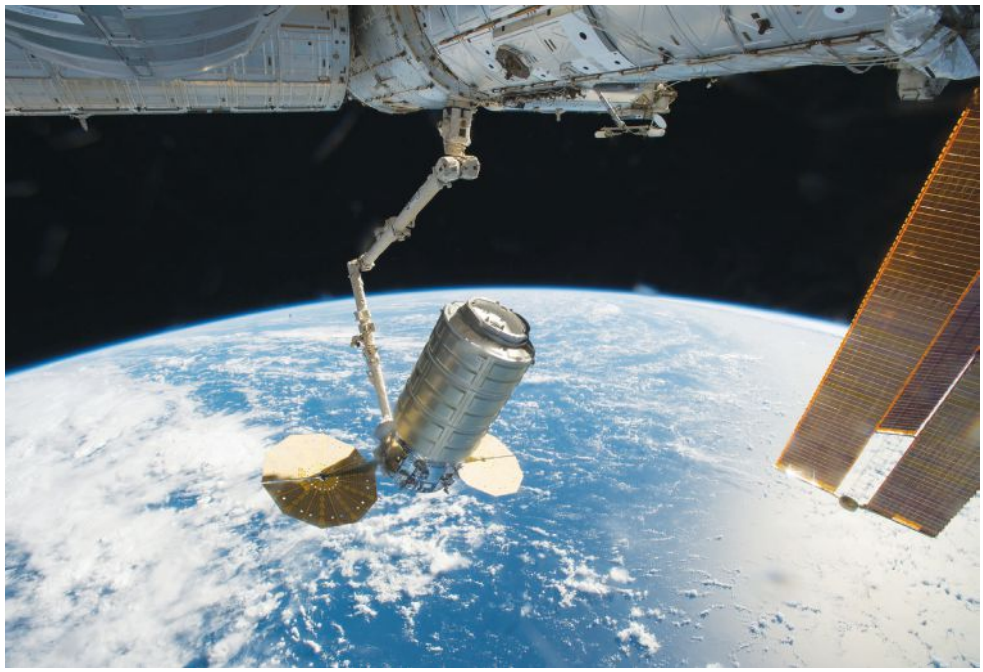
The amount Eutelsat paid Russian Satellite Communications Co. after a French court ruled Nov. 23 that RSCC was not an arm of the Russian government. Former shareholders in the Russian oil company Yukos had filed suit to block that payment after an international arbitrator ruled the Russian government illegally liquidated that company. That ruling does not affect a similar suit blocking payments from Arianespace to Roscosmos for Soyuz vehicles.

$109M

The starting price for an Atlas 5 launch, according to the RocketBuilder online pricing tool United Launch Alliance unveiled Nov. 30. The website emphasizes tens of millions of dollars in "added value" in the form of increased revenue and lower insurance costs that ULA argues significantly reduces the net cost of the launch. The site does not take into account the added costs associated with government missions.

86%

The percent of NBN's Sky Muster satellite broadband customers reporting connection hiccups in a recent survey. NBN said it's aware of the problems and has already resolved many of them. The two-satellite Sky Muster sytem is a key element of Australia's efforts to provide national broadband services, particularly to remote areas of the country.



NASA

Orbital ATK's Cygnus cargo spacecraft is captured Oct. 23 using the Canadarm2 robotic arm on the International Space Station.The vehicle was packed with more than 2,300 kilograms of cargo and research equipment for Orbital ATK's fifth commercial resupply flight to the station since Cygnus' 2013 debut.

SPIRE DEPLOYS 4 IN A CYGNUS FIRST

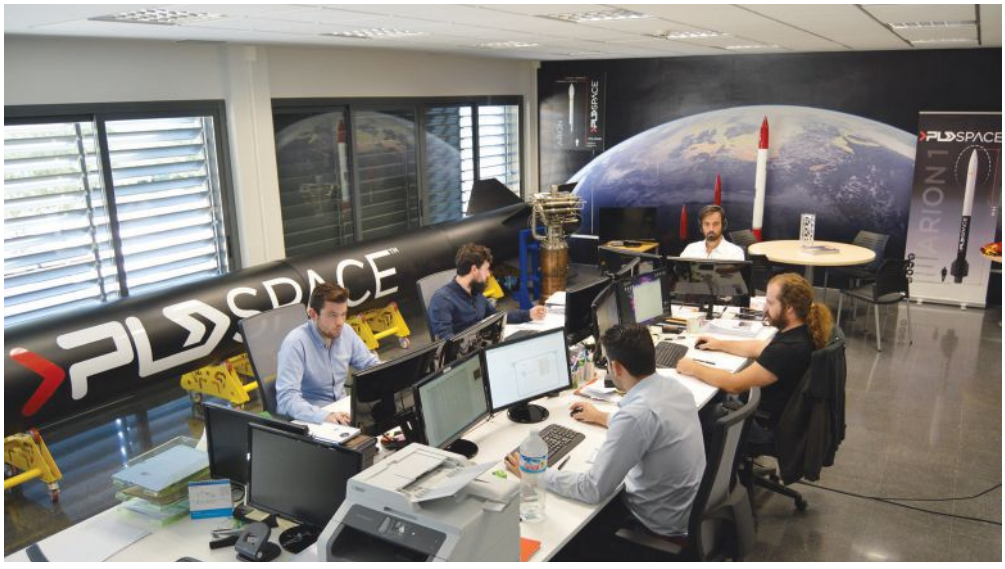
A CYGNUS CARGO SPACECRAFT ended its mission Nov. 27 with a destructive reentry over the South Pacific. The Orbital ATK cargo spacecraft launched Oct. 17 on the return-to-flight mission for the Antares rocket and arrived at the International Space Station Oct. 23, delivering supplies and equipment for the station. It departed from the ISS Nov. 21.

Prior to its reentry, the Cygnus deployed four cubesats for Spire. The deployment marked the first time Cygnus deployed cubesats from an orbit higher than the ISS, as the spacecraft moved to an altitude of 500 kilometers before releasing the cubesats. The higher orbit will give the satellites a longer lifetime before reentry.

The deployment brings Spire's constellation of satellites, used for ship tracking and weather-data collection, to 16. The company says delays in other launches have slowed the deployment of its constellation, particularly for spacecraft it plans to put into polar orbits.

"President Obama just reaffirmed his commitment to placing people on Mars in the near future. There's Virgin Galactic, SpaceX—various companies that are looking to begin civilian suborbital space travel. It's a topic that has fascinated people for many years. I thought it would be great to try and put forward as a ballet."

ETHAN STIEFEL, discussing his plans with *Washingtonian* magazine for creating a ballet about spaceflight for the Washington Ballet to celebrate the centennial of the birth of John F. Kennedy next year.



PLD Space is a Elche, Spain-based startup developing space technologies to provide suborbital and orbital commercial launch services dedicated to small payloads and nanosatellites.

SMALL ROCKETS AROUND THE WORLD

PLD SPACE wants to build Europe's first reusable launch vehicle. The Spanish startup won a contract in November from ESA's Future Launchers Preparatory Program to develop technology for a recoverable first stage.

The company's approach involves the use of parachutes to slow down the first stage, followed by a propulsive landing.

PLD Space is planning to develop a suborbital rocket, Arion 1, by 2018, followed by a small orbital launcher, Arion 2, in 2020.

EXPACE TECHNOLOGY CO., a spinoff of the China Aerospace Science and Industry Corp, is trying to get into the small launch business by offering low prices and high flight rates.

The Chinese firm is selling launches of its Kuaizhou 1 small launch vehicle at a price of $10,000 per kilogram of payload.

Expace says it expects to launch 10 Kuaizhou 1 rockets per year, and has letters of intent from customers for nearly 20 launches.

ROCKET LAB has slipped the first launch of its Electron rocket until early next year.

The company, which had been saying in recent months it would begin tests of its small launch vehicle from its New Zealand site by the end of this year, now plans to give its employees a break over Christmas.

The delays will also avoid road closures in the area during the busy holiday season, a company spokeswoman said. Rocket Lab has not announced a new date for the first Electron launch.

" It's very rare where I sit down with folks from an industry who say we want to plus-up the regulatory bodies who regulate us."

U.S. REP. DEREK KILMER (D-WASH.), speaking at the Washington Space Business Roundtable's November luncheon in D.C.

"A BIZARRELY LOW BAR"

NASA touts report vouching for asteroid mission's scientific bona fides; House Science chairman calls boloney

Two members of the U.S. Congress are raising questions about a report that NASA claims offers scientific validation for its Asteroid Redirect Mission.

In a Nov. 29 letter, Reps. Lamar Smith and Brian Babin, both Texas Republicans, asked NASA for more info about a report released earlier in the month that said ARM could help close a number of "strategic knowledge gaps" for exploration and answer some scientific questions identified in the most recent planetary science decadal survey.

Smith and Babin argue that NASA set a "bizarrely low bar" for the report's success by not considering other options to address those issues, and argued that the incoming Trump administration deserved more information and should be "unencumbered" by any decisions made in the final months of the Obama administration.

PLD SPACE

Workers encapsulate the Progress MS-04 vehicle Nov. 25 at Baikonur Cosmodrome.

ROSCOSMOS

EUROPE APPROVES EXOMARS FUNDING AND ISS EXTENSION

THE 22 MEMBER NATIONS of the European Space Agency approved an extension of the International Space Station and additional funding for an ExoMars mission, but at the cost of another science mission.

ESA announced Dec. 2 at the end of a two-day ministerial meeting in Lucerne, Switzerland, that the ExoMars 2020 mission, including a lander and rover, will go forward after nations agreed to provide an extra 440 million euros to keep it on track.

Other science programs, however, will absorb some of the cost. ESA set aside the Asteroid Impact Mission, a planned joint mission with NASA, after it failed to win support in Lucerne. One or more medium-class science missions yet to be selected may also be delayed.

ESA members formally agreed to extend ISS operations through 2024, the last station partner to do so. The extension also means ESA will provide a second Orion service module for NASA under a barter agreement between the agencies.

RUSSIA SUFFERS ANOTHER PROGRESS FAILURE

A PROGRESS CARGO SPACECRAFT bound for the International Space Station failed to reach orbit after launch Dec. 1, a failure that should not have an immediate impact on operations of the station and its crew.

Telemetry from the Soyuz-U rocket ended 6 minutes and 22 seconds after liftoff from Kazakhstan's Baikonur Cosmodrome, partway through the engine burn of the Soyuz's third stage. Roscosmos said the spacecraft crashed in a "remote and unpopulated mountainous area" in southern Siberia.

The spacecraft was carrying 2.5 tons of cargo for the station, including equipment, food, water and propellant. Had the spacecraft launched successfully, it would have docked with the station Dec. 3 and remained there for several months.

The supplies, intended primarily for the three Russian cosmonauts on the station, were not critical. NASA said after the failure that there were large stockpiles of key supplies on the station.

Additional supply missions are planned for the station in the next several months. A Japanese H-2 Transfer Vehicle (HTV) cargo spacecraft was scheduled to launch Dec. 9 on an H-2 rocket prior to the Progress accident. That HTV launch, according those familiar with station planning, could be delayed a few days to add any critical cargo items lost in the Progress failure.

Orbital ATK plans to launch its next Cygnus cargo mission on a United Launch Alliance Atlas 5 in early 2017, most likely in March. SpaceX may also resume Dragon cargo missions to the ISS in early 2017, depending on its launch schedule and its success in resuming Falcon 9 launches after a Sept. 1 pad explosion. The Falcon 9 return-to-flight mission, carrying 10 Iridium Next satellites, is scheduled for Dec. 16 from Vandenberg Air Force Base in California.

The station's six-person crew was notified of the failure later in the day, and appeared to take the loss in stride. "We are fine up here and will function fine until the next supply spacecraft arrives," Thomas Pesquet, a European Space Agency astronaut on the station, tweeted several hours after the failed launch.

The launch failure is the second loss of a Progress cargo spacecraft in just over a year and a half. The Progress M-27M spacecraft spun out of control after separation from its upper stage on an April 2015 launch and reentered in early May. A Russian investigation blamed a "design peculiarity" between the spacecraft and the upper stage of the new Soyuz-2 rocket for the mission failure.

NASA taps SpaceX to take a swing at SWOT

SpaceX won a NASA contract Nov. 22 to launch an Earth science satellite aboard a Falcon 9 rocket in 2021.

The award, with a total cost to NASA of $112 million, is for the launch of the Surface Water and Ocean Topography (SWOT) spacecraft, scheduled for April 2021 from Vandenberg Air Force Base in California. The contract, NASA said in a statement, includes the launch service itself as well as spacecraft processing, payload integration, and tracking, data and telemetry support.

SWOT is a joint mission with CNES to study how bodies of water change over time, providing global coverage twice every three weeks from near-polar orbit.

The contract is the third SpaceX has won for NASA launches, excluding its contracts under NASA's commercial cargo and crew programs. A Falcon 9 launched the Jason-3 satellite in January under a contract awarded in 2012. SpaceX won a NASA contract in December 2014 for the launch of the Transiting Exoplanet Survey Satellite (TESS) mission, currently scheduled for no earlier than late 2017.

The cost of the SWOT contract is significantly higher than previous NASA contracts won by SpaceX. The Jason-3 contract was valued at $82 million and the TESS award at $87 million, according to the contract announcements. All are higher than the price SpaceX quotes on its website for launch services alone, $62 million, which does not include the additional services or other mission assurance work in the NASA contracts. The total cost of the contract also includes payments to organizations other than SpaceX that support the launch and related services.

NASA spokeswoman Cheryl Warner said that the award values can differ from contract to contract depending on the specific requirements for each mission. "The specific launch service price is considered competition and procurement sensitive information," she said.

"We're excited to carry this critical science payload into orbit for NASA, the nation, and the international community," Gwynne Shotwell, president and chief operating officer of SpaceX, said in a statement to *SpaceNews*. "We appreciate NASA's partnership and confidence in SpaceX as a launch provider."

SWOT is a joint mission with the French space agency CNES to study how bodies of water change over time, providing global coverage twice every three weeks from near-polar orbit. CNES, which is responsible for the spacecraft itself, awarded a contract to Thales Alenia Space in January 2015 to develop the spacecraft. SWOT will have an estimated mass of 2,000 kilograms at launch. SN

JEFF FOUST

THALES ALENIA SPACE

A SpaceX Falcon 9 rocket carrying the Thaicom-8 satellite lifts off from Florida's Cape Canaveral Air Force Station in May.

Investor with SpaceX ties joins Trump team

A principal in a venture capital fund whose investments include SpaceX has joined U.S. President-elect Donald Trump's transition team for the Department of Defense.

The office of the president-elect announced Nov. 23 that it was adding Trae Stephens to the existing transition team for the Defense Department. He joins an original group of nine people assigned to the "landing team" covering the Pentagon on Nov. 18, with a tenth person added Nov. 21.

Trae Stephens

Stephens is a principal at Founders Fund, a San Francisco-based venture capital fund co-founded in 2005 by billionaire investor Peter Thiel and several others. Thiel supported Trump's campaign, giving a speech backing him at the Republican National Convention in July, and was named Nov. 11 to the executive committee overseeing Trump's transition.

JEFF FOUST

Founders Fund was the first venture firm to invest in SpaceX, putting $20 million into the company in July 2008. The fund subsequently participated in a $50 million round in November 2010 and the $1 billion round in January 2015 led by Google and Fidelity. Founders Fund has not disclosed the size of its stake in SpaceX, but Luke Nosek, a partner and co-founder of the fund, is on SpaceX's board of directors.

Stephens came to Founders Fund from Palantir Technologies, a data analytics company that is also part of the fund's portfolio. Stephens "focuses on startups operating in the government space" at the fund, according to his biography on its website. Palantir's initial customers were primarily in the U.S. intelligence community.

SpaceX has, in recent years, made it a priority to win business from the Defense Department in addition to customers from NASA and the private sector. After a protracted dispute with the U.S. Air Force that included a lawsuit, the company won certification in May 2015 for Falcon 9 missions under the Air Force's Evolved Expendable Launch Vehicle program. It won its first EELV launch contract, for a GPS satellite, in April after United Launch Alliance declined to bid.

While Stephens came to Founders Fund from Palantir, he does follow the progress of SpaceX to some degree. "BOOM. Two in a row," he tweeted May 6 after SpaceX successfully landed a Falcon 9 first stage on a ship in the Atlantic Ocean during the launch of the JCSAT-14 satellite.

That landing came four weeks after another Falcon 9 first stage landing during the launch of a Dragon cargo spacecraft. Stephens retweeted a note of congratulations about that landing April 8 from President Barack Obama, adding the hashtag "#thanksobama."

After a slow start, Trump's transition efforts have ramped up in the last week, with landing teams assigned to most cabinet-level departments and many other agencies. SN

SPACEX / FOUNDERS FUND

"In a transition period, folks need to maintain their integrity, and be forthcoming."
CHRIS SHANK

Trump names insider to lead NASA landing team

The transition team for U.S. President-elect Donald Trump has named a congressional staffer and former NASA official to lead the "landing team" overseeing transition planning for the space agency.

In a Nov. 29 statement, the office of President-elect Trump announced that Chris Shank will serve on the landing team for NASA, the first individual named to date to handle transition issues for the space agency. The selection came after the transition team selected several dozen other people to serve on landing teams for cabinet-level departments and other agencies.

Shank has extensive experience with NASA, both working in the agency itself as well as on Capitol Hill. He joins the transition team after serving as policy director for the House Science Committee and, before that, as deputy chief of staff for Rep. Lamar Smith (R-Texas), the chairman of the committee. Shank also served on the committee's staff from 2001 to 2005.

Shank worked for NASA from 2005 to 2009, during the tenure of administrator Mike Griffin. At NASA, he was director of strategic investments, responsible for the development of the agency's budget. He also led the agency's office of strategic communications, working on legislative affairs and public outreach. After leaving NASA, he briefly worked for the Applied Physical Laboratory and Honeywell before returning to Congress.

As part of the incoming administration's landing team for NASA, Shank will get access to agency information and personnel to guide overall transition efforts. Traditionally, new administrations name several people to transition teams for NASA, suggesting that others will join him in the coming weeks.

Shank was on the agency side of the transition process eight years ago, when he was at NASA while the incoming Obama administration brought its transition team into the agency, which included future NASA Deputy Administrator Lori Garver.

"In a transition period, folks need to maintain their integrity, and be forthcoming," Shank advised in a panel session on space policy at the American Astronautical Society's Goddard Memorial Symposium in March that also featured Garver, who argued that NASA was in fact not that forthcoming during the transition after the 2008 election.

While the Trump transition office publically announced the appointment Nov. 29, NASA Associate Administrator Robert Lightfoot said late that day that the agency had not yet received formal notification.

"We expect to finally get an agency review team into place," Lightfoot said, referring to the formal name for a landing team, in an interview prior to accepting an award on NASA's behalf by the Arthur C. Clarke Foundation here. "We're working on, basically, telling the story of what we're going to be doing."

The transition has not caused any major issues for NASA so far, despite the delay in getting a landing team in place for the incoming administration. "It's business as usual for us right now," Lightfoot said, citing work on various agency programs. "When the review team gets in place, we'll have our time with them and get a chance to see what they're thinking, but also share the message of what we're doing."

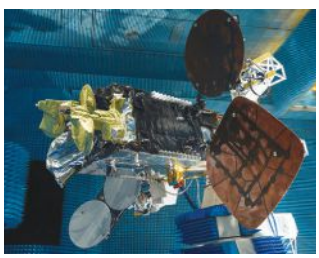
Immediately after Trump won the Nov. 8 election, sources suggested that Mark Albrecht, former executive secretary of the National Space Council and, later, president of International Launch Services, would be named to lead the NASA transition for the president-elect. Instead, the Trump transition team named Albrecht Nov. 29 to the Department of Defense landing team, which now numbers more than a dozen people. SN

JEFF FOUST

NASA / BILL INGALLS

Spacecom borrows AsiaSat-8 to replace satellite lost with Falcon 9

$88 million deal partially replaces Amos-6 but doesn't clarify Facebook relationship.



Amos-6

AsiaSat-8

SSL ARTIST'S CONCEPT / SPACECOM

Israeli satellite operator Spacecom, whose relationship with Facebook could be summed up as "it's complicated" following the loss of its Amos-6 satellite in September, will borrow part of AsiaSat's newest satellite for at least four years.

AsiaSat-8, launched in 2014, will serve as an interim replacement for Spacecom's Amos-6, which was destroyed Sept. 1 when its SpaceX Falcon 9 launcher exploded during fueling.

Facebook, through Eutelsat, leased all of Amos-6 's high-throughput Ka-band capacity to provide internet access to people in Africa. Facebook and Spacecom haven't publicly updated their relationship status since losing Amos-6.

The $88 million deal with AsiaSat, announced Dec. 1, doesn't clarify matters since Spacecom only leased AsiaSat-8's Ku-band payload, not the Ka-band capacity Facebook booked on Amos-6. Eutelsat said in October it was leasing Ka-band capacity on two Yahsat satellites, but made no mention its Facebook deal.

Amos-6, which Israel Aerospace Industries (IAI) touted as the most advanced Israeli-made satellite, was equipped with 39 Ku-band beams and 24 Ka-band spot beams. AsiaSat-8, built by Space Systems Loral, has 24 Ku-band transponders as well as a Ka-band payload.

Spacecom said Dec. 1 it will replace the Ka-band capacity it lost with Amos-6 when it launches its next satellite to the 4 degrees west orbital slot in about four years.

Spacecom's immediate use for AsiaSat-8 is to replace the 13-year-old Amos-2 satellite. Amos-6, had it reached orbit, would have allowed Spacecom to retire Amos-2 while also providing growth capacity.

The loss of Amos-6 added to Spacecom's woes, since the operator unexpectedly lost a core satellite, Amos-5, in 2015 when the four-year-old spacecraft abruptly ceased communicating following a power supply glitch.

It is unclear whether the AsiaSat-8 lease will have any bearing on Spacecom's dealings with Beijing Xinwei Technology Group, the Chinese conglomerate that had agreed this August to purchase the Israeli operator for $285 million. Xinwei stipulated that the successful launch of Amos-6 was a requisite for completing the acquisition.

Spacecom and AsiaSat now intend to relocate AsiaSat-8 from 105.5 degrees west, where it's covering China and its neighbors, to 4 degrees west, where it will join Amos-3 in covering Europe, the Middle East and Africa.

Spacecom will pay AsiaSat $22 million a year for AsiaSat-8's Ku-band payload, according to AsiaSat. The four-year agreement includes an optional 12-month extension.

AsiaSat expects the satellite to reach its new perch over Europe, the Middle East and Africa within 45 days of receiving the necessary regulatory approvals.

The deal makes Spacecom one of AsiaSat's largest customers by revenue. AsiaSat operates a fleet of six satellites, including AsiaSat-8. The Hong Kong-based operator's next satellite, AsiaSat-9, is scheduled to launch in the second quarter of 2017 on an International Launch Services Proton rocket.

Spacecom said in November that it would recover the $196 million cost of Amos-6 under the insurance policy IAI had taken out to cover its handling of the satellite prior to launch. SN

CALEB HENRY

U.S. Marine Corps Cpl. Hunter Buley with Marine Wing Communications Squadron 18 adjusts a radio terminal's trajectory during a September exercise at Andersen Air Force Base in Guam. The military is currently weighing commercial and government-owned solutions for meeting future wideband communications needs, and hoping the Pathfinder series of projects will help inform their decisions.

LANCE CPL. MAKENZIE FALLON / USMC

Staying on the Path

U.S. military presses ahead with satcom Pathfinder program

THE U.S. AIR FORCE is moving ahead with the next step in its Pathfinder satellite communications demo effort – despite the current step hitting major legal issues.

The service posted a Request for Information Oct. 27 for the third part of its series of experimental bandwidth contracts designed to inform how it purchases satellite-communications in the future.

The five planned Pathfinder projects were intended as a series of contracts that would build upon the success of the previous contracts. Pathfinder 3 is designed to test the pre-launch purchase of a commercial satellite transponder for communications outside the continental United States.

But its predecessor, Pathfinder 2, is on hold while the Department of Defense wrestles with legal questions about whether current appropriations law allows the Air Force to barter for the services it needs.

Pathfinder 2 calls for the Air Force to purchase a transponder from a satellite fleet operator, then parlay that purchase into access to the operator's entire constellation.

The intent is to give the Air Force a transponder's worth of bandwidth wherever and whenever it needs it, rather than limiting the service to the geographic coverage area of a specific satellite hosting the leased transponder.

But questions arose as to whether bartering the transponder purchase into a wider use of an existing network was a legal use of the acquisition dollars the Air Force intends to use.

The Air Force Space and Missile Systems Center (SMC), which leads Pathfinder, doesn't see the new sequence as a big problem.

"Although the Pathfinder series of efforts are intended to build on one another,

PHILLIP SWARTS

they are not strictly dependent on the preceding project, therefore SMC does not anticipate any issues," said a statement from SMC commander Lt. Gen. Samuel Greaves e-mailed to *SpaceNews*.

Congress would seem to agree. The National Defense Authorization Act - which both the House and the Senate are set to wrap up this month – includes a roughly $30 million appropriation for Pathfinder 3 as part of the Pentagon's efforts to modernize military satellite communications.

Those modernizing efforts include not just Pathfinder 3, but also the launch of the eighth Wideband Global Satcom (WGS) satellite scheduled at press time for Dec. 7. And experts in the Air Force and other branches are set to start meeting and conducting a yearlong Wideband Analysis of Alternatives to explore commercial and government-owned options for what comes after the 10-satellite WGS system the Air Force expects to finish deploying in 2019.

Pathfinder 3 will also be the first step in the series to start assessing whether the Air Force needs to buy satellite ground services from the same companies providing the in-orbit services.

The RFI closed Nov. 18, and acquisition officials are presumably returning from the Thanksgiving holiday to analyze indsutry's submissions.

Meanwhile, Pathfinder 2 is being reviewed by Pentagon legal experts. The Air Force posted the RFI for it in June 2014 and planned to award a contract this past summer. As 2016 comes to a close, it has not yet selected a winner, or indicated that an announcement will be made soon.

The delay is something that concerns Rebecca Cowen-Hirsch, the senior vice president for government strategy and policy at Inmarsat's U.S. Government Business Unit.

"Speed is definitely not something that we're seeing," she told *SpaceNews*. "Pathfinders, in general, are not supposed to solve yesterday's problems."

But she believes the lessons learned from Pathfinder 2's legal troubles could aid in future programs, helping resolve "some of the obstacles or barriers or impediments, and rolling those lessons into the next opportunity," she said.

"I'm less concerned about not completing Pathfinder 2 before going into Pathfinder 3 than I am interested in the outcome of exploring new relationships and business models that are going to be agile," Cowen-Hirsch said.

The program could be an opportunity to bring the Pentagon and industry into closer cooperation on communications projects, she said.

"Speed is definitely not something that we're seeing. Pathfinders, in general, are not supposed to solve yesterday's problems."

REBECCA COWEN-HIRSCH, SVP FOR GOVERNMENT STRATEGY AND POLICY AT INMARSAT'S U.S. GOVERNMENT BUSINESS UNIT

"Don't view milsat as an entity unto itself and commercial satcom as an entity unto itself," Cowen-Hirsch said.

Myland Pride, the director of legislative and government affairs for Intelsat General Corp., and a 25-year Air Force veteran, agreed, saying there's a great possibility for partnership between industry and the federal government.

"Our industry believes there needs to be a greater emphasis on commercial capability, for a variety of reasons — from affordability to resilience to flexibility in architecture both space based and terrestrial," he said, adding that government agencies "almost don't need to be in that business any more."

"We're not talking about protected nuclear command-and-control communications," he said. "Those are clearly in the realm of government. But for wideband, we believe there's a much greater role for commercial."

Some of the Pentagon's acquisition culture, however, is a "difficult ship to change course," Pride said.

"It's hard to change those paradigms," he said. "When you're used to owning stuff, it's difficult to not own stuff."

The Pathfinder effort is supposed to help change some of that rigid culture, and Pride said he believes DoD will have learned from the legal issues of Pathfinder 2.

"We know [what] some of the hurdles are, so I think [DoD] will be more proactive with Pathfinder 3," he said.

Still, Pride said there was hope that more of the Pathfinder project would have been completed before the Pentagon started its Wideband Analysis of Alternatives.

"It's a little disappointing because we wanted to get at least one or two of these Pathfinders under our belt before the Wideband Analysis of Alternatives was well under way," he said. "We may get Pathfinder 2 on contract by then, but there are some other concepts that we thought we were going to accelerate in Pathfinder 2 — specifically, pooled portable bandwidth, those sorts of contracts, some integration of ground activities, some enterprise level work — but it just got derailed."

SMC and commercial fleet operators are banking on Pathfinder to show DoD how to break with traditional acquisition strategies that many critics say are slow and outdated.

The project has also given SMC the opportunity to directly control purchasing of satcom services, something that's normally handled by the Defense Information Systems Agency. SN

Spaceport America's new boss

Long before Spaceport America took shape in the desert of southern New Mexico, Daniel Hicks was thinking about a spaceport there.

"About 16 years ago, I started the Business Development Directorate, and at that time we were working with kind of the predecessor to the spaceport," he said, recalling his career at the U.S. Army White Sands Missile Range. That was a concept then known as the Southwest Regional Spaceport, one of a number of sites proposed in the 1990s to host Lockheed Martin's VentureStar reusable launch vehicle.

VentureStar never got off the ground, but the spaceport, renamed and repurposed for suborbital launches, eventually got built. Hicks continued to play a supporting role in its development, helping identify the best locations for it and, later, serving as an ex officio member of the board of the New Mexico Spaceport Authority to coordinate its activities with those at White Sands. "I kind of tracked it all along," he said.

Now, Hicks is running the spaceport. In September, the board on which he once sat named him as the new chief executive of Spaceport America, succeeding Christine Anderson, who retired in August.

Hicks, in a Nov. 18 interview at the end of his first week on the job, described taking over the spaceport as something of a dream come true after spending more than 30 years working at White Sands. "A couple years ago, I was at that point where I became eligible to retire, and my wife asked, 'What do you want to do?'" he recalled. "I was always interested in space. I wanted to be an astronaut years ago, when I was a young engineer."

He seized the opportunity when Anderson retired, taking advantage of his extensive experience working with the spaceport while at White Sands, where he served in positions from test engineer up to deputy executive director. "It put me in a good position to come over here and become the CEO," he said.

He inherits a spaceport that is largely complete and looking for new business. "What I'm excited about is that now we're moving into more of a continued operations phase," he said, praising Anderson and others for their efforts over the last several years to complete the spaceport's facilities and seek out additional business.

Hicks said he planned to continue that strategy of diversifying the spaceport's customer base. "I think in any kind of spaceport, particularly one devoted to commercial space at this time, it's important to be diversified," he said. "It's important to not put all your eggs in one basket."

While Anderson worked to bring in non-aerospace business into the spaceport, from tourism to film shoots, Hicks said he's particularly interested in the suborbital and small launch markets. He declined to name specific companies he is talking with, citing non-disclosure agreements. However, the small launch market would be particularly challenging for an inland launch site like Spaceport America.

"One of the things that makes sense to me is to look at our business plan, and then look strategically how we want to focus the spaceport activities, our staff, and our infrastructure to get ahead of the game," he said. That effort, he said, may last up to a year to understand the emerging suborbital and small launch industries "and what makes sense for this part of the country to be able to support those industries."

The spaceport, though, can't ignore its anchor tenant, Virgin Galactic. The beginning of operations of the company's SpaceShipTwo suborbital vehicle from the spaceport is years behind schedule, thanks to delays in its development exacerbated by a fatal test-flight

JEFF FOUST

Daniel Hicks

- Graduate of New Mexico State University in mechanical engineering
- Began career at White Sands Missile Range in 1982 as a test conductor
- Established a Business Development Directorate at White Sands responsible for strategic planning
- Named Deputy Executive Director of White Sands in 2013

SPACEPORT AMERICA

accident in October 2014. The company was scheduled to begin glide flights of its new SpaceShipTwo in early November, but those have been delayed by an unspecified technical problem encountered during a Nov. 3 test flight.

Hicks said that, on the first day on the job as Spaceport America chief executive, he contacted Virgin Galactic president Mike Moses and chief executive George Whitesides. "I just wanted to let them know how excited I am to be here and to understand where they're at in their operations," he said. He added he was planning a follow-up visit in the coming weeks to Virgin Galactic's headquarters in Mojave, California.

He also said he's moving ahead with a series of "signature events" at the spaceport announced in August. He arrived just after the first such event, the Spaceport America Drone Summit that included workshops and competitions for drone developers. Future events include a relay race, where teams of runners will go from El Paso, Texas, to the spaceport, as well as the Spaceport America Cup, a student rocketry competition scheduled for next June.

Hicks said he expects more than 70 universities to participate in the rocketry >

SPACEPORT AMERICA BOULEVARD

The scenic main access road invites the first-time visitor to admire the western perspective of Spaceport America and its ability to blend into the natural desert setting.

Report: commercial spaceports confused about insurance

A new report recommends that the Federal Aviation Administration do more to assist commercial spaceports in determining their insurance requirements, but stops short of calling for regulatory changes regarding coverage for facilities not owned by the federal government.

The report, prepared by the U.S. Government Accountability Office under a provision of the Commercial Space Launch Competitiveness Act signed into law one year ago, said that operators of launch sites licensed by the FAA are often puzzled about whether and how their facilities are covered by insurance in the event of an accident.

The request for the report came out of the aftermath of the October 2014 Antares launch failure at the Mid-Atlantic Regional Spaceport (MARS) on Wallops Island, Virginia, that caused $15 million in damage to the launch site. Orbital Sciences Corp. and the Virginia Commercial Space Flight Authority, which operates MARS, disputed who was liable >

JEFF FOUST

DANIEL HICKS

< > competition. "The thing I really like about the Spaceport America Cup is getting the excitement in our colleges and universities. They're the future of our space exploration program," he said.

Those signature events help in Spaceport America's public outreach efforts, and also show local and state lawmakers that the spaceport has value even while waiting for Virgin Galactic to begin operations. Hicks said he expects to leverage relationships with legislators he created while at White Sands to secure continued support for the spaceport, including additional state funding to cover operations costs.

"They're expecting us to be self-sufficient and self-supporting," he said of state legislators. He noted that Spaceport America plans to cover 71 percent of its operations costs through user fees and other payments in 2017, growing to 92 percent in 2018. "By 2019, we'll be totally self-sufficient and won't need to go to the state legislature for any of their general funds. We'll be a spaceport authority able to operate fairly independently."

There are also, he suggested, opportunities for Spaceport America to collaborate with his former employer. In his last couple of years at White Sands, he said he was involved in long-term studies about future technologies it could be involved with, including some space-related efforts.

"As we look to where they're going in the future," he said of White Sands, "I know there's more potential to help them offload some of their work." That could, he said, include supporting some of the testing NASA does at its own facility at White Sands.

But a week into the job, Hicks admitted he was still getting up to speed on all the spaceport's issues. "Right now I feel like I'm drinking from a fire hose," he said. "I've got a lot more to learn about the spaceport." SN

< > for damages to the pad. Ultimately, each paid $5 million, with NASA contributing an additional $5 million by increasing the value of an existing contract with the authority.

In interviews with nine of the 10 FAA-licensed spaceports, the GAO found that many of them had experienced problems getting property and liability insurance. Five of the nine, according to the report, "reported encountering difficulties in obtaining these kinds of insurance for commercial space launches or expressed concerns about their affordability."

One example came from one of the three spaceports that has hosted launches licensed or permitted by the FAA in the last five years — MARS, Mojave Air and Space Port in California and Spaceport America in New Mexico — but not specifically identified. When it attempted to purchase coverage, the report said, "insurance providers either declined to provide quotations, provided quotations exceeding or similar to the site's launch fees, or included substantial deductibles."

The GAO report also found uncertainty among launch site operators about whether they needed coverage. Some said they were not sure if they were considered "involved parties" in launches, thus requiring them to obtain insurance, or "third parties" that would be covered by the insurance the launch provider is required to carry under federal law.

A congressional watchdog agency says the FAA needs to do a better job communicating with commercial spaceports about insurance requirements.

The GAO recommended in its report that the FAA do a better job communicating with spaceports insurance requirements. "FAA has not issued guidance to spaceport operators to clarify when it considers them third parties and when it considers them involved parties," the report stated, adding that agency officials told them that such guidance "has not been a high priority" for them.

The report, though, did not recommend a change in policy on insurance for spaceports, citing a lack of consensus on the topic. Spaceport operators and other industry stakeholders, including launch providers and insurers, were split on whether the current approach should be continued. They also disagreed that, if it should be changed, whether the responsibility for procuring insurance belonged to the launch operator or the spaceport.

The GAO report was limited to spaceports licensed by the FAA, and did not include launch sites on federal ranges, like Cape Canaveral Air Force Station in Florida and Vandenberg Air Force Base in California, that can also host commercial launches. Space Launch Complex 40 at Cape Canaveral, one such facility, was damaged in the Sept. 1 SpaceX Falcon 9 pad explosion, and neither the Air Force nor SpaceX has disclosed the extent of the damages.

In the case of MARS, the pad was repaired and hosted the return to flight of the Antares on Oct. 17, this time with an insurance policy in place. "We are covered by insurance up to what we believe the maximum possible damage is," Dale Nash, executive director of the Virginia Commercial Space Flight Authority, said at a pre-launch press conference Oct. 15. "We have that in our agreements with Orbital ATK and with the concurrence of NASA." SN

An Earth-to-LEO comms revolution in the making

An avalanche of commercial spacecraft are bound for orbit. Will they need commercial data-relay networks to keep in touch? These firms think so.

ALPH EWIG WAS COORDINATING communications for SpaceX Dragon cargo flights to the International Space Station when he realized the growing commercial space industry would need its own data-relay network.

As a mission operations engineer working in SpaceX's mission control room, Ewig was responsible for coordinating communications between the Dragon capsule and SpaceX's mission operations center, NASA's mission operations center, the International Space Station, NASA's Tracking and Data Relay Satellites (TDRS) and multiple ground stations. When TDRS was available to provide continuous communications links, SpaceX could monitor the spacecraft round-the-clock, detect problems and quickly resolve them. When SpaceX could not use TDRS because the constellation's time was claimed by other NASA missions, Ewig had to wait for the spacecraft to pass over one of about a dozen ground stations before he could send or retrieve data.

"Without continuous telemetry, tracking and control, a potentially hazardous trend can occur during a communications gap and go unnoticed," Ewig said by email. "So you sit and wait for your spacecraft to check in; only when it re-establishes communication at the next scheduled pass (and only if it re-establishes communication), do you suddenly find out what happened." Then, it may too late to recover the spacecraft, he added.

As part of NASA's Space Network, TDRS time is used primarily by NASA missions in low Earth orbit, including the International Space Station. It is not designed to serve the growing commercial space industry, which includes dozens of companies planning to launch thousands of communications and Earth-imaging satellites into low Earth orbit in the next decade. Communications for all the new spacecraft will be a billion-dollar market, Ewig said.

Ewig and his two co-founders, who met at Stanford University's Graduate School of Business, established Audacy in 2015 in Mountain View, California, to create a commercial version of TDRS to give people on the ground constant access to their satellites and launch vehicles.

"We like to think of ourselves as a cellphone network in space," said James Spicer, Audacy co-founder and head of engineering.

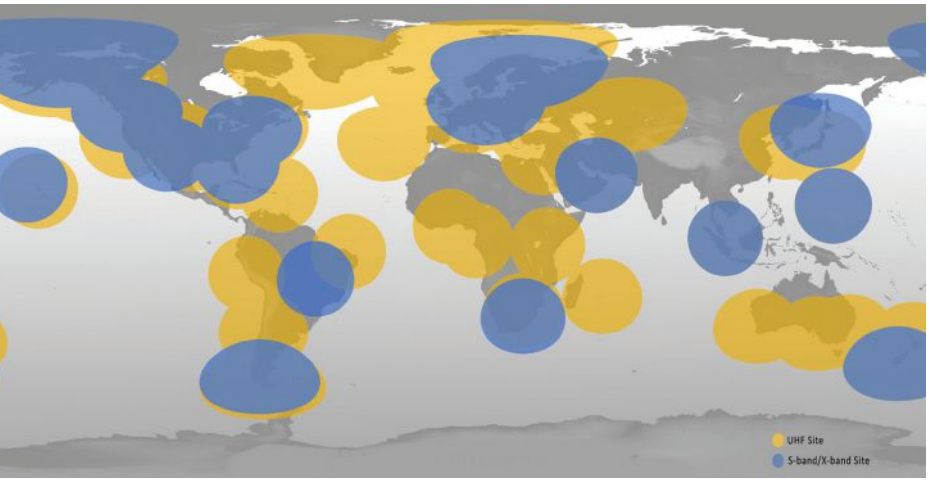
Audacy is not alone in seeking to claim this potentially lucrative market. Spaceflight Networks of Seattle, and Solstar Space Co. of Santa Fe, New Mexico, also are developing networks to relay communications for commercial spacecraft, spaceflight passengers and launch vehicles, although each company is taking a different approach.

COMMUNICATIONS REVOLUTION

Spaceflight Networks, a subsidiary of Spaceflight Industries, already operates ground stations in Tukwila, Washington; Fairbanks, Alaska; and Invercargill, New Zealand, to downlink data from Spaceflight Industries' BlackSky Pathfinder-1, an Earth-observation satellite launched in September.

"We wanted to makes sure we had an >

DEBRA WERNER



Spaceflight Networks' 2017 operational sites.

< > operational, reliable service before we signed up a lot of other people," said Jason Andrews, Spaceflight Industries chief executive.

Spaceflight Networks plans to begin providing communications services to "a few early adopters in 2017 and make the service available to the broader market in 2018," Jodi Sorensen, Spaceflight Industries vice president for marketing and communications, said by email.

By 2018, Spaceflight Networks plans to operate between 40 and 50 high-throughput antennas at 17 locations around the world to offer communication services to companies operating constellations of small satellites.

Because of the wide geographic distribution of the ground stations, customers who purchase compatible radios and Spaceflight Networks data plans will be able to obtain web-based access to their imagery within a few minutes of its capture, Andrews said.

Customers can select from a variety of radios, ranging from low-data-rate UHF devices designed to provide telemetry, tracking and control for cubesats to microsatellite X-band radios to transmit data at speeds of hundreds of megabits per second.

"Ultimately it is about helping customers get their data back," Andrews said. "We are building the infrastructure for this small satellite constellation revolution."

Solstar hired high school students to send texts to the firm's communications payload that was launched on an UpP Aerospace rocket in November 2013. This was a test of the firm's ability to send data to suborbital vehicles.

TEXTS TO SPACE

In contrast, Solstar is focusing initially on providing continuous voice and data communications for people and machines traveling on suborbital vehicles. Solstar is a spin-off of Solstar Energy Devices, a division of mobile satellite service provider Satwest LLC.

In 2013, NASA selected Satwest to participate in the Flight Opportunities Program, a space agency initiative that pays launch providers to fly research payloads selected by NASA. An UP Aerospace rocket launched from New Mexico's Spaceport America carried Satwest's communications payload to an altitude of 117 kilometers in November 2013.

During the flight, Satwest sent text messages from computers and cellphones on the ground through Iridium communications satellites in low Earth orbit to its payload on the UP Aerospace rocket.

"We used commercial computers and cellphones to send text messages from our commercial payload operations center through commercial satellites to a commercial rocket," Brian Barnett, Solstar president and chief executive. "That was the first time that had ever been done."

The success of that experiment prompted Barnett to establish Solstar and begin setting up a company to provide communications for people and machines in space.

Through NASA's Flight Opportunities Program, Solstar plans to conduct additional tests in 2017 to demonstrate it can offer voice and Internet connections for suborbital flights. NASA has not yet matched Solstar with launch providers for future experiments, but the company informed NASA that it wants to conduct tests in 2017 on Virgin Galactic's SpaceShipTwo and Blue Origin's New Shepard suborbital rocket.

"We can't wait to fly again," Barnett said. "We want to fly as often as we can."

Barnett's ultimate goal is to establish a commercial communications service to provide "24/7 access to people and machines in space from people on the ground," he said. "I could log into my smartphone and talk to a friend or colleague in space or check out what's going on with my satellite or payload."

Since the 2013 test flight, Barnett, along with Solstar co-founders Michael Potter, an entrepreneur and documentary filmmaker, and aerospace engineer Mark Matossian, have been raising money and developing communications products, ranging from low-data-rate models for small satellites to more capable devices that could be installed in government or commercial space stations to provide Internet service for passengers.

SPACEFLIGHT NETWORKS GRAPHIC / SOLSTAR

AN AUDACIOUS PLAN

Audacy also is raising money for its space-based network, which includes three communications satellites roughly the size of Mini Cooper automobiles and three global gateways. The firm raised $2 million in a seed round in 2015 and is currently seeking to raise additional funds to begin building its satellites.

From a medium Earth orbit of roughly 13,000 kilometers, Audacy satellites will be close enough to low Earth orbit to send and receive data from small satellites operating there, including cubesats. At the same time, the Audacy constellation will be distant enough from Earth to allow engineers to maintain continuous contact through only three gateways, Spicer said.

Audacy plans to establish a relay network to offer simultaneous access to thousands of Earth observation satellites, launch vehicles, broadband satellites, and suborbital and orbital human spaceflight vehicles.

Although the cost of establishing a space-based communications network is higher than the cost of setting up a ground-based network, Spicer said the expense will be more than offset by the volume of users Audacy will serve as well as by the added value the firm will offer customers by providing them with instantaneous, round-the-clock access to data.

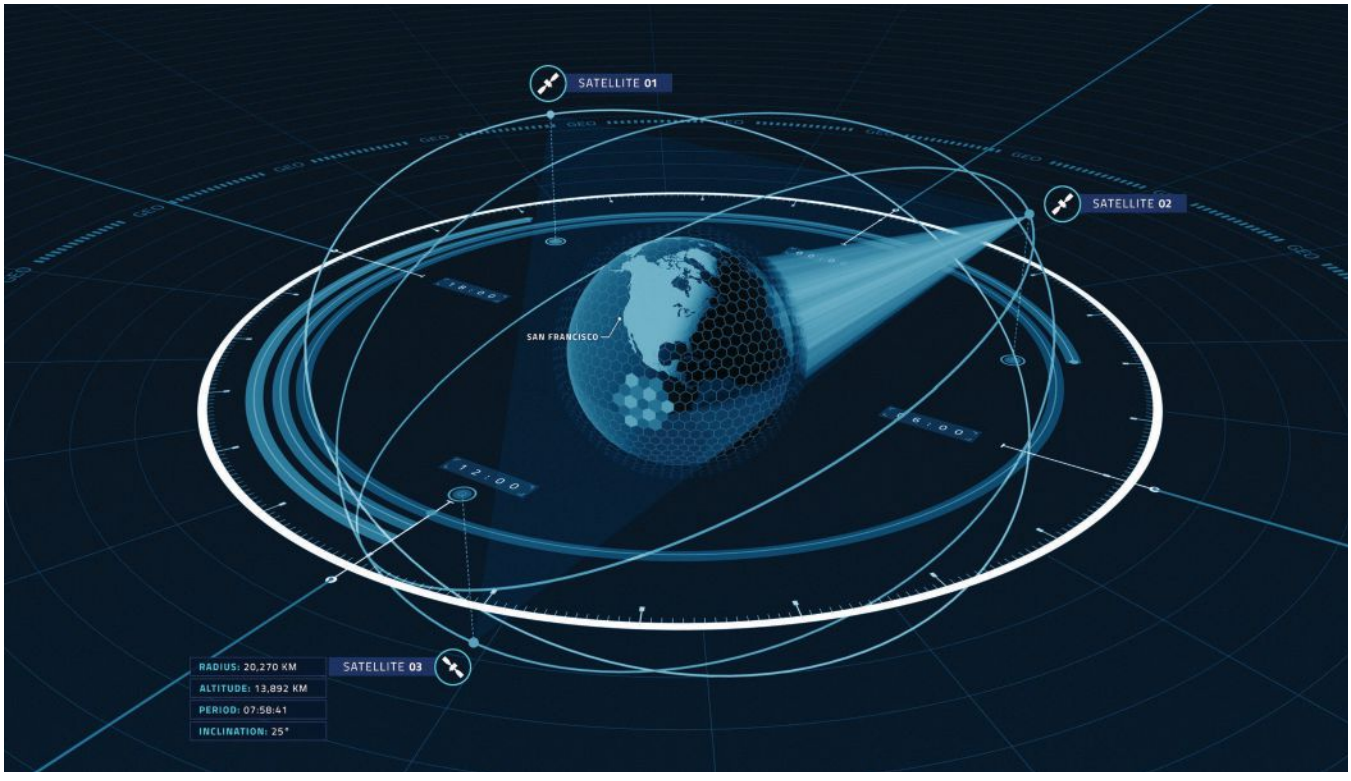
"We want to enable real-time communications so that you can download spacecraft data, for example photos or videos, only seconds after they are acquired by the satellite," Spicer said. "This real-time satellite imagery has vastly more value than imagery downloaded hours or even days later using traditional ground stations."

It's too early to tell whether one or more of the new communications networks will strike it rich providing data links for satellites, launch vehicles and passenger spacecraft, but executives of all three companies anticipate strong demand.

The market to provide communications for the thousands of communications- and Earth-observation satellites scheduled to travel into low Earth orbit over the next decade will "absolutely" be worth a billion dollars, Ewig said.

"The current revenue being generated by commercial satellite imagery already exceeds $5 billion a year, and most companies spend five to ten percent of that on communications solutions to deliver their products to their customers," Ewig said. "The market for non-geostationary satellite communications services will easily be in the billions by 2020, if it isn't already." SN

Audacy's unique network architecture enables always on, real-time data access for satellites in non-geostationary orbits.



AUDACY GRAPHIC

Avio's CEO on sharing the pie with Germany

Giulio Ranzo

The recent German-Italian agreement to divide production of casings for the future Ariane 6 rocket's strap-on boosters, which also serve as the first stage of the Italian-led Vega-C small-satellite launcher, was a victory for political harmony in Europe.

But what about the Ariane 6 and Vega business models? Scrapping a single producer of casings, Avio SpA of Colleferro, Italy, in favor of dual sourcing with OHB-owned MT Aerospace of Augsburg, Germany, will reduce the scale economies that are part of the overall Ariane 6/Vega cost equation.

The German side argued that a new technology will reduce casing cost by 30 percent, compensating for the costs incurred in creating and maintaining two separate production lines.

In an interview, Avio Chief Executive Giulio Ranzo conceded the cost penalty with a divided production line but said the German technology, in addition to achieving political consensus in Europe, is worth the effort.

The current-generation Vega has successfully conducted its first seven missions. The eighth launch, of Turkey's Gokturk optical Earth observation satellite, is scheduled for Dec. 5.

Starting in 2019, the upgraded Vega-C is expected to be operational. It has 50 percent more payload-carrying power than the current Vega, capable of placing 2,300 kilograms of satellite payload into a sun-synchronous orbit.

Ranzo discussed the ongoing effort to reduce Vega's production and operating costs, the bittersweet agreement with Germany and what he said was his firm intention to help Arianespace win contracts to launch Italy's two Cosmo-SkyMed-2 radar reconnaissance satellites.

PETER B. de SELDING

To get Vega costs down you need to launch at least three times at year?

Yes, and even more than three. We already did three last year. The flight frequency is mainly a case of whether the satellites are delivered on time. Arianespace has already sold 10 Vega launchers for the next three years so we presume an average rate of three per year

What about Vega operating costs at the European spaceport in French Guiana?

In each of the seven flights we have managed, we've reduced systematically the duration of the launch campaign, including the launcher's integration, down to a point where we have no more capacity bottlenecks at the launch site and can do four launches in a given year, perhaps even five.

How long is the campaign now?

Around 23 days. We can possibly trim it a little bit more. Arianespace has demonstrated it can do 12 launches a year between Ariane 5, Soyuz and Vega, and we think we can do 15.

What is Avio's ambition in Arianespace?

We have an important partner in Arianespace and with Airbus Safran Launchers, the Ariane 6 prime contractor. We want to realize as many synergies as we can between the two prime contractors, Avio and ASL, to optimize cost and make the offer more competitive.

We have reached a consensus on the synergies. Vega-C and Ariane 6 will be so linked to each other with the first stage of Vega being the strap-on booster for Ariane 6 that both are incentivized together. The more we optimize

ERIC VANDEVILLE

one launcher, the more we optimize the other.

You are a big industrial player, but a small Arianespace shareholder.

We are a 3 percent shareholder in Arianespace. The issue here is not one of equity ownership. Arianespace is our selected gateway to the market. The equity share is irrelevant. It makes sense for ASL to have the majority stake. And once they have the majority it doesn't matter whether we have a 25 percent share or a 3 percent.

Italy and Germany agreed to divide production of the P120 casing between you and MT Aerospace of Germany on the assumption that MT's technology ultimately lowers production cost. What if it doesn't?

If we knew all the answers to new technology and new programs that would mean there is no challenge. This decision signals that European industry is truly making an effort for change, and even pointing at a target which they are not necessarily sure they will reach.

European member states have agreed to build a new family of launchers that needs to be much more cost competitive. The decision on the second production line doesn't surprise me. It's similar to other challenges were are having in many other parts of the launcher and the cost of ground operations.

We have big challenges and we accept them. We are confident that we can achieve good results.

Doesn't consolidating production all at one site reduce unit costs compared to running two separate facilities?

Yes, but I am an industrialist, not a policymaker. These are political-level decisions, not industrial. If Ariane 6 was mine, I would be doing it all in one place. But Ariane 6 is a European program that has the participation of many countries. We need to take that into account.

You sized the industrial plant in Colleferro for 35-40 boosters per year and gave Airbus Safran Launchers price quotes based on that. Now production will be divided. What is the effect on your operation?

It's more complicated than that. Avio has full responsibility for the integrated motor case, which is composed of many different parts — all ultimately assembled in Colleferro. So our production capacity is not cut by half.

Certain activities are going to be procured from Germany, hopefully with a more competitive technology that, overall, will make it more cost competitive. This is viable, and why not?

But the production activities will not be 50-50 between Germany and Italy. Only certain activities will be split 50-50. For example, the overall assembly of the insulated motor cases for P120, the external insulation, all the other equipment installed externally, will be done in Italy and then shipped to the launch site.

So all the production in Germany will be shipped to Colleferro before final departure?

That's correct. They will primarily be doing the booster case in carbon fiber material with a slightly different technology than ours. Then, for practical reasons, they will also apply the internal thermal protection. But to complete an insulated motor case, there are different parts that need to be assembled together, including the liner for the internal part of the motor case, which separates the internal core of the case from the propellant. It's a very delicate part and we are familiar with this because of course we manufacture propellant. We will install this for all the booster cases.

The external thermal production will also be installed by us as we have significant experience with that, as well as the overall finishing of the product, which will be done here.

The German minister responsible for space applauded the agreement as being a boost for Germany's return and great news for Germany.

Certainly it is good news for Germany that they are doing one-half of the carbon-fiber booster cases and the application of the internal thermal protection. If they are successful with this innovative technology, they will come up to speed being competitive and state of the art.

That's good for us as well, and all of European industry. Otherwise the current technology >

< > would very soon become obsolete. And I think for them it is good to stay in the game.

And if the cost savings don't materialize? Someone presumably will pay the bill, and I guess it's not Avio.

You can rest assured of that. The member states will at that point analyze the situation and determine what to do. But we will not just go to sleep and then wake up in 2025 and find out that unfortunately the cost is too high. It's a development path. As we approach different milestones, we will assess issues and define corrective actions.

The same question could be raised about any part of the Ariane 6 program, which is based on being extremely cost competitive: Are we sure that the cost targets will be met? If not, then what?

If we only set targets we were sure we could meet, I would tell you we are not building a competitive launcher.

When does the new production line start in Germany?

They will start to manufacture flight items by 2021, or 2022, depending on when their development is completed and qualified. Bu we have intermediate milestones to see how we're doing — in particular, in mid-2018, when we have an important milestone review. We will see then where we stand.

So the full-up production capacity at Augsburg won't occur until Vega-C has been in operation for three years?

Around there, yes. The first first flight items for both Ariane 6 and Vega-C will be produced by us.

You sound remarkably cheerful about all this.

Look, every one of us would like to be king. We all would love to have everything for ourselves. But then we would not be participating in a cooperative effort in Europe. Again: If Ariane 6 was mine, I would want it all here! But that would not work because then you would not have sufficient financial resources for development.

Our system is very simple: collaboration and competitiveness. There's no way we can be successful if we don't apply the two. At this juncture, Germany will contribute significant resources for development and contribute resources to achieve more competitiveness. If these two things work together, I will be happy. If they don't, then we will analyze the situation.

Is Vega-C is still on schedule for a 2019 flight?

Yes, mid-2019 for the first flight.

Could Vega-C lift a second-generation Cosmo-SkyMed radar Earth observation satellite being built for the Italian government?

Vega-C will be fit for either of the two satellites being built. But we need to see when the first of them is actually ready for flight. And then we will see whether it will fly with Vega-C or with Soyuz or something else.

Like SpaceX?

Or SpaceX. But that would surprise me. The customer will analyze the tradeoffs between reliability and price and the European nature of the deal. I would happily advertise for the choice of Vega-C — no doubt about it. My role in marketing is within Arianespace and believe me, they are very vocal in advertising our products.

But on purely technical terms, you have done the engineering and Vega-C can lift a second-generation Cosmo-SkyMed?

Correct, and we definitely want to fly Cosmo-SkyMed. I will be very vocal with my Italian customer to make that happen. I will promote, with Arianespace, the idea that we will do the impossible to make it happen.

There have been tweets about SpaceX from Italy after a visit to SpaceX by ASI, the Italian space agency.

Yes, but they come more often to visit me than to SpaceX in California. And a tweet is not a contract. Cosmo-SkyMed is a cooperation between ASI and the Italian Ministry of Defense. The decision probably won't be based on tweets. SN

MDA Corp. (nearly) ready to take another run

Canada's robotics specialist has added SSL to the mix since sending satellite servicing to the sidelines. But it's also given up its lead.

MDA Corp. is on the verge of taking another run at satellite servicing five years after putting efforts on hold when its first attempt did not generate enough commercial or government interest.

When MDA bought satellite-builder Space Systems Loral in 2012, the Canadian company was quick to point out that its new U.S. holding could revive its dream of having a servicing venture. Now, four years after the acquisition, MDA — through SSL — says it is close to deciding whether to jump back in.

MDA purchased SSL just six months after scrapping an in-orbit servicing agreement with satellite operator Intelsat, which had committed to using MDA's Space Infrastructure Services (SIS) system to refuel multiple satellites. Steve Oldham, the former president of MDA's Space Infrastructure Services division, now senior vice president of strategic business development at SSL, said the companies recognized a clear synergy post-merger that could lead to the resurrection of a similar business venture. That vision today would leverage the combined skills of SSL and its parent company to create a robotic spacecraft based on SSL's flagship S1300 satellite platform.

If MDA jumps back it, it stands to return to a more crowded satellite-servicing market than the one it left. At least two other ventures expect to launch servicer spacecraft in 2018. MDA doesn't expect to have its vehicle ready sooner than 2020.

> **"No one has built a satellite that goes around and services other satellites, so having a government and commercial partnership I think makes a lot of sense."**
>
> 
>
> **STEVE OLDAM,** SENIOR VICE PRESIDENT OF STRATEGIC BUSINESS DEVELOPMENT AT MDA'S SSL

Orbital ATK, through its wholly owned Space Logistics LLC subsidiary, signed Intelsat in April as the first customer for its revived satellite-servicing business and has since booked a 2018 launch for its Mission Extension Vehicle (MEV) aboard an International Launch Services Proton Medium rocket.

Work on the MEV dates back to around 2010 when ATK — still several years before merging its space business with Orbital Sciences Corp. — formed the ViviSat venture with U.S. Space LLC to develop and commercialize a satellite serving system. This past April, Orbital ATK dissolved ViviSat and announced that its new venture, Space Logistics, in a joint press conference with Intelsat. U.S. Space promptly sued Orbital ATK, claiming Orbital improperly shut down the joint venture >

CALEB HENRY

SSL

< > to pursue the servicing business on its own.

Despite the ongoing lawsuit, Tom Wilson, president of Space Logistics and vice president of Orbital ATK's Space Systems Group, said "everything is progressing well," and that the program-level Preliminary Design Review for MEV-1 is scheduled for early December. Wilson told *SpaceNews* that all long-lead hardware for the first two MEVs have already been ordered.

Across the Atlantic, startup Effective Space Solutions also has a servicer spacecraft planned for launch in 2018. Founded in Israel but headquartered in the U.K., the company has been working with a manufacturer on a 350-kilogram spacecraft since 2015, according to the company's vice president of marketing and business development, Daniel Campbell, and now has two letters of intent from satellite operator customers for multi-year life-extension and deorbiting. Campbell said those letters are in the process of being converted to contracts. He declined to identify the customers or the launch provider, but said the mission would launch via rideshare.

MDA Corp. intends to bring the same robotic chops to satellite servicing that it used to build Canadarm2, shown here moving the International Space Station's Quest airlock into place in 2001.

NASA

DECISION POINT

MDA has not fully committed to launching its SSL satellite servicing business, but in an interview with *SpaceNews*, Oldham said the company has lots of customer interest, and expects the program will begin in the first half of 2017 if it receives the green light. Following approval by MDA's board of directors, he estimated it would take three to four years to build the servicer, thus putting the start date for the service around 2020 or 2021.

Oldham said SSL has identified three markets it would like to pursue through an in-orbit servicing business: satellite refueling, satellite repair and relocation, and in-orbit assembly and manufacturing.

"We have had advanced discussions with a variety of commercial operators for two of those markets that aren't opportunistic; those are refueling and in-orbit construction," said Oldham. "Those discussions with some operators are very well advanced into quite detailed contractual language, and others are in the early stages."

Oldham wouldn't say how many customer commitments would constitute the critical mass MDA needs to go ahead with the program.

"The question would be: what are the conditions that we need to achieve before proceeding ahead with the program? As many signed up customers as you can get is a requirement," he said.

He listed customers, insurance and political assurances as necessary go-ahead criteria. Oldham said SSL met with insurance underwriters in November to discuss the servicer. He said that the company has already performed "a detailed amount of work" on the necessary regulatory regime.

BRIGHTER FORECASTS?

In-orbit servicing has been on the satellite industry's wish list for years, but would-be service providers have scarcely lined up anything more than nonbinding letters of intent.

Space Logistics' signature of a firm contract with Intelsat in April for a five-year life extension mission changed the tone of the conversation from wishful to believable.

David Belcher, analysis manager at the research firm Avascent, said he is "slightly more optimistic" about the potential of in-orbit servicing as an industry than he was a couple of years ago "simply because once someone signs a contract,

it helps clarify things."

Though citing potential pitfalls including regulatory confusion (since in-orbit servicing is uncharted waters for both industry and governments) and the determination of fault in the event of in-space damage, Belcher said he believes there could be room for several regional players in a manner not all too dissimilar from the launch sector. That is, multiple players could arise to service commercial and government satellites, but with a certain level of government favoritism based on geopolitical factors.

Also like the launch sector, Belcher said government business — the absence of which contributed to the demise of MDA's previous in-orbit servicing venture — will probably contribute an appreciable amount of demand.

"I think that the potential market for commercial servicers is probably pretty good largely due to the fact that I think there probably be demand from governments for the service," he explained.

THE GOVERNMENT LYNCHPIN?

SSL has performed ground-based demonstrations of the technology needed for a servicer with NASA, the U.S. Air Force, the Defense Advanced Research Projects Agency (DARPA) and the Canadian Space Agency. Oldham said there would also be a degree of on-orbit testing prior to acting on the first commercial contract, assuming MDA moves forward with the program.

Much of the work SSL has done related to in-orbit servicing has been through government programs, notably DARPA's Dragonfly program, which focuses on in-orbit assembly of spacecraft, and DARPA's Robotic Servicing of Geosynchronous Satellites program, which focuses on the repair, repositioning and possible upgrading of satellites.

Oldham downplayed the concern that government programs might cannibalize commercial efforts in this field.

"No one has built a satellite that goes around and services other satellites, so having a government and commercial partnership I think makes a lot of sense. That's the way DARPA is going and we are good with that," he said.

He added that these government programs are less focused on refueling and life extension, which would be one of SSL's primary services. But will government, particularly the Defense Department, become more than a technology partner? Back around 2011, MDA's satellite-servicing venture faced challenges in this domain because it was difficult to gauge how DoD felt about such a business coming from a Canadian company. Furthermore, DoD was refreshing multiple constellations with new satellites.

Today DoD is studying what assets it will leverage in a future architecture. That undisclosed future could include in-orbit servicing, and now that MDA has SSL, the company could bid as an American entity. It's also not unreasonable to envision government customers using life-extension services to prevent service gaps in between fielding new spacecraft. Compared to the SIS days, these variables could maybe make the case for MDA once more.

FIELD OF COMPETITION

MDA is taking a different approach from Space Logistics and Effective Space Solutions. Oldham said the principal difference from Space Logistics is that SSL's servicer would not dock with a client satellite for multi-year periods. Rather, the SSL servicer would dock, refuel the satellite in about a month's time or less, and move on to another customer, reducing the number of servicers needed compared to Space Logistics' plan.

Currently MDA's take is that it will only require one vehicle to meet the initial demand. Should in-orbit servicing prove wildly successful, Oldham said the number could grow to two or three.

Compared to Effective Space Solutions, which aims to offer life extension, satellite relocation and deorbiting using a highly dextrous small satellite, MDA intends to provide a wider range of services. Oldham estimated that if the value of life extension is $10 million to $15 million a year, then a business built around such a service would need multiple clients per year or need to be supplemented by other capabilities to create a constant revenue stream.

Oldham estimated that over the next 10 years, roughly 150 satellites would become candidates for life extension. Candidate spacecraft are limited to those relying on chemical propulsion. SN

The Fate of ABS-8

EX-IM'S LENDING TIMEOUT WAS "BLESSING IN DISGUISE" FOR FAST-GROWING ABS

When the U.S. Congress shuttered the Ex-Im Bank in 2015, an untold number of commercial satellite orders stalled out or changed hands. ABS-8 was the first to publicly fall apart. After announcing the deal with Boeing that June, ABS rescinded its order six weeks later.

The all-electric, tri-band satellite was to replace ABS-7, a now 17-year-old Lockheed Martin satellite that ABS bought from Korea Telecom in 2010. ABS is still in discussions with Boeing about building ABS-8, though ABS Chief Executive Tom Choi said he's also considering competing offers. But in the 16 months since ABS canceled its order, the Bermuda-based operator has radically changed its future satellite plans.

ABS is taking ABS-8 back to the drawing board after concluding that competitor ViaSat's forthcoming ViaSat-3 satellites will set a new industry benchmark for high-throughput capacity. In an interview with *SpaceNews*, Choi said Ex-Im's lending timeout has turned out to be a "blessing in disguise" for ABS.

It was only after the bank's closure put the brakes on the ABS-8 deal that Carlsbad, California-based ViaSat fully revealed its intentions to cover the globe with three enormous broadband satellites each promising a blistering 1-terabit-per-second of throughput.

"The ABS-8 we designed in 2015 would have been made obsolete by ViaSat-3," Choi said, praising ViaSat Chief Executive Mark Dankberg for going all-in on the high capacity front.

"He has set the bar very high, and unfortunately for all the other satellite operators who have launched or are currently building lower-capacity high-throughput satellites, their satellites are not going to be cost-competitive versus ViaSat-3," Choi said. "This means ABS-8 and all of our future satellites designed for data services will have to meet the cost-per-gigabit bar set by ViaSat-3."

ViaSat contracted with Boeing in February for two ViaSat-3 satellites built around high-throughput Ka-band payloads ViaSat is building in-house. The first two satellites will cover the Americas, Europe, the Middle East and Africa; a third satellite, for Asia, hasn't been ordered.

ViaSat's announcement shook up a lot of operators, but none have been as candid as ABS about how they intend to adapt their businesses. Choi said ABS has good ideas on how to obtain bandwidth economics that will be competitive with ViaSat-3, and "not in the obvious ways people are thinking about."

One of the selling features ABS has in mind for ABS-8 and its successors is the introduction of what it calls ultra-high throughput, or UTS, capacity. Choi expects UTS satellites, combined with a "rainproof VSAT" ABS has patented, will raise the bar even higher than ViaSat-3.

"Our future UTS systems will be comparable in price/Mbps [to] ViaSat-3 but it will be rainproof because we can deliver 99.9 percent availability. In this way it will be far superior to ViaSat-3 or any other Ka - or Ku-band-only HTS system," he said.

Choi described UTS as a combination of extremely low per-gigabit costs and high levels of availability for end users. When it comes to data services (broadcast TV was 45 percent of ABS's business in 2016), ABS has its eyes chiefly on consumer broadband and telco customers, markets Choi said dwarf aeronautical and maritime. Excluding aero mobility due to the lack of a need for C/Ku-band load balancing, he said satellite operators bringing HTS capacity to bear should be worried about more than just ViaSat-3.

"Once our UTS satellites launch, we will be ourselves 'obsoleting' other HTS satellites because only our terminals will be delivering the low cost per gigabit while giving extremely high availability," he said.

Choi said ABS is still trying to close a deal for ABS-8 and has been exploring ways to proceed with or without Ex-Im — which despite reopening last December still can't approve loans in excess of $10 million without further action from Congress.

"We will continue to explore our satellite ideas and design concepts with U.S.-based vendors and a select few outside the U.S. for our future satellite orders," Choi said. "Although we hope for Ex-Im Bank of the U.S. to regain [a] full board to approve future projects, for some of the options for ABS-8, we would not need to rely on Ex-Im financing." SN

SPACENEWS / KATE PATTERSON

"The ABS-8 we designed in 2015 would have been made obsolete by ViaSat-3."

TOM CHOI, ABS CHIEF EXECUTIVE OFFICER

CALEB HENRY

MY TAKE Jim O'Leary

Advancing commercial space through communications

Companies have been working for decades to make the vision of space as the "final frontier" a reality, and the last several years in particular have seen an increase in initiatives aimed at commercial space exploration.

This has been driven by a multitude of factors, from reduced government spending on space exploration to accelerating advances in technology. The recent cultural revival of science fiction-fantasy entertainment, including blockbuster hits like *The Martian*, *Gravity*, *Interstellar* and *Star Wars: The Force Awakens*, also have captured imaginations and ensured that interest in the possibilities of space remains high among the general public, further boosting the momentum of commercial space initiatives.

Combine all of this with a spate of recent breakthroughs by startup companies like SpaceX completing its successful landing of the Falcon 9 reusable launch vehicle – on track to be reused for a second flight next year – and the outstanding in-flight abort test by Blue Origin's New Shepard suborbital vehicle – bringing humans one step closer to commercial spaceflight – and it's no surprise that interest in and possibilities for space exploration continue to rise.

Commercial aerospace has entered a critical and exciting phase of development, and we are closer than ever to space tourism and commercial space exploration, including space settlement and mining. This is an exciting time for the industry.

Earlier this year, I was invited to moderate a panel on advancing commercial aerospace through marketing and communications at the Space Frontier Foundation's annual NewSpace conference. Held in Seattle, a growing hub for commercial space, I was able to sit down with professionals from across the industry to discuss the rise of commercial space exploration and communication and marketing best practices. When combined with what we learned from the recent U.S. presidential election, a few key themes emerged that are particularly relevant to this industry. These include:

- **Decreasing Trust in Institutions:** This year's historical election revealed increasing populism trends in the U.S. and abroad, largely driven by high income inequality and a significant trust gap between the informed public and mass population. While this presents an opportunity for businesses that keep pace with the changing times, it also remains true that government has been the least trusted institution for five years running now, according to the 2016 Edelman Trust Barometer data.
- **The Power of Social Media:** In today's evolved media landscape, social media offers a great means for businesses to communicate directly with audiences and shape narratives online in real time. The power of social media was underscored by the success of President-elect Donald Trump's campaign, even against an opponent who spent far more on traditional advertising.
- **Keep it Simple:** We shape and tell stories by understanding our audiences, the industry landscape and, in many cases, complex technical issues. In an increasingly complicated media ecosystem that includes traditional media outlets, search platforms like Google, social media channels like Twitter and limitless publishers of information and data, effectively engaging your target audience now requires more simplicity and clarity than ever – and less industry jargon.
- **Transparency is Key:** Some aerospace companies are notorious for not communicating clearly during times of crisis. Now more than ever, it's important to be proactive and transparent, to build trust with stakeholders like employees, customers and the public. With the right approach and effective communications, companies can successfully carry out their missions while also remaining publicly accountable.

Whether a successful rocket launch or the formation of a strategic partnership to achieve a common goal in getting one step closer to commercial space exploration, important milestones provide an opportunity to focus attention on the growing promise of space. Given how specialized this subject matter can be – from aerospace manufacturing and assembly, to engineering and mechanics, to launching and operating spacecraft – our job as communicators is to find what brings the story and relevance back to earth, to the earthlings who dream of one day venturing into space. **SN**

JIM O'LEARY LEADS EDELMAN'S CORPORATE COMMUNICATIONS PRACTICE ACROSS 22 OFFICES IN THE U.S., CANADA AND LATIN AMERICA. HE WAS FORMERLY A COMMUNICATIONS LEADER AT HONEYWELL AEROSPACE.

COMMENTARY Len Fisk, Daniel Baker and Nicola Fox

The space weather forecasting imperative

THE INCOMING TRUMP ADMINISTRATION NEEDS TO MAINTAIN THE MOMENTUM SURROUNDING SPACE-WEATHER HAZARD PREPARATION.

With each passing year our society becomes more dependent on the use of satellites. The defense of the nation depends on the utilization of space.

EARTH IS EMBEDDED WITHIN REGIONS of space that contain large fluxes of charged particles along with intense electric and magnetic fields.

These near-Earth regions are termed the ionosphere and magnetosphere and they are extensions of Earth's protective neutral atmosphere. The entire Earth system is continually bathed in variable streams of damaging radiation, energetic particles and hot gases from the sun. The conditions and changes in the connected regions of near-Earth space are referred to as space weather.

Satellites can be damaged by space weather events. Electromagnetic blasts and high-energy charged particle radiation from the sun can cause major disruptions to all modes of communication. Currents generated in the magnetosphere by massive ejections of plasma from the sun can induce currents in the power grid that have severe operational consequences, or can even cause catastrophic damage that imperils not only our economy but also the basic functions of our society.

With each passing year our society becomes more dependent on the use of satellites. The defense of the nation depends on the utilization of space. It is vulnerable to communication outages from space weather events, loss of accurate GPS satellite information for precision-guided munitions, and degradation of situational awareness to determine whether a disruption of satellite operation is due to a natural event or a potential enemy. The power grid, which is already stressed to support our growing economy, can be severely compromised by induced currents from space weather events.

On Oct. 13, President Barack Obama issued an Executive Order entitled "Coordinating Efforts to Prepare the Nation for Space Weather Events." This Executive Order follows upon two other recent notable policy actions. The first of these was the "Space Weather Action Plan" (SWAP) issued by the White House Office of Science and Technology Policy in October 2015. The other was the "Space Weather Research and Forecasting Act" introduced as Senate Bill 2817 in April.

The Oct. 13 presidential order notes that it is the explicit policy of the United States to minimize economic loss and human hardship that can result from space weather. The order states that the U.S. government must be able to continually detect space weather episodes and, quite importantly, must be able to predict such deleterious events before they affect Earth. Thus, alerts and warnings of impending space weather episodes must be provided and mitigation strategies must be developed for both the public and private sectors.

Critical infrastructure must be protected and recovery strategies must be designed to deal with losses and effects for which proper preventive protection is not possible. These requirements pose considerable challenges in order that federal agencies and departments will be suitably coordinated in their actions and plans.

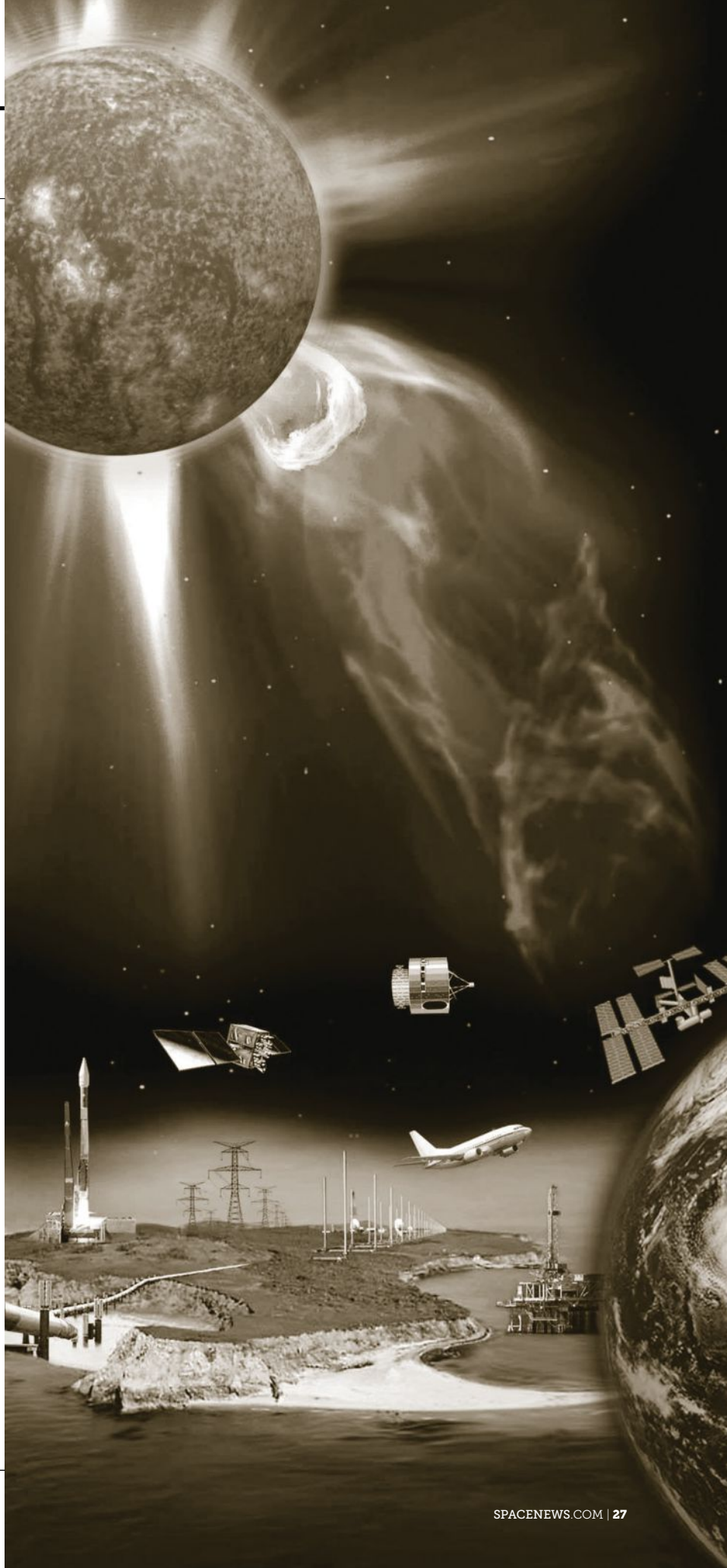
Space weather has the potential to impact critical infrastructure in orbit and on the ground.

We, the authors, are part of a group of practicing space scientists who have written a document to address the imperative of improving our nation's ability to provide space weather forecasting capability. The main conclusions of this document are that space weather solutions are:

IMPERATIVE: There should be no doubt by any policy or decision maker that we are in a race against time. The infrastructure of our technological civilization, in space and on the ground, is increasingly vulnerable to space weather. Yet, we are currently unable to forecast space weather with sufficient accuracy and timeliness to protect the infrastructure and mitigate the impact space weather events have on our economy and the welfare of our people.

FEASIBLE: It is clear that improving our capability to forecast space weather, to the level required to protect our infrastructure, is not difficult, provided that we are willing to make the required effort, and secure the needed resources.

COST EFFECTIVE: We should not consider that the cost of this effort is at all prohibitive. The United States spends $5.1 billion a year forecasting terrestrial weather, which, by some studies, has an economic impact on our everyday lives in excess of $30 billion per year. The cost of forecasting space weather will be a small fraction of the amount required for terrestrial weather forecasts. Yet, with each passing year, as our dependence on satellites grows, and our infrastructure becomes more vulnerable to space weather, the economic impact of space weather on our lives will grow to be comparable to that of terrestrial weather. Should a catastrophic space weather event occur, in which there is major damage to our power grid and our orbiting satellites, the economic impact will dwarf that of any >



NASA ARTIST'S CONCEPT

< > hurricane or other such natural disaster.

In the view of our science community, there are three basic principles for a successful and effective space weather forecasting program. The program must be:

OPERATIONAL: The program must be dedicated to yield an operational forecast capability for space weather that serves those who require these forecasts to protect the infrastructure of our nation, support our commerce, protect human life and defend our nation. The task is the same for those who forecast terrestrial weather, and as with terrestrial weather forecasts, to be successful the users of space weather forecasts must be integrally involved in the planning and execution of the program.

COMPREHENSIVE: Space weather events originate on the sun, propagate through the region between the Earth and the sun, impact the Earth's magnetosphere and follow various pathways into regions of the Earth's near-space environment that directly affect our infrastructure. Improving the accuracy of the forecasts, and how early space weather can be predicted, requires knowledge of the origin and evolution of a space weather event in each region of space and the coupling among the regions.

SUSTAINABLE: The effort must contain elements that build a sustainable program, beginning with elements that can be executed immediately and yield demonstrable improvements in forecast accuracy. Given the urgency to close the gap between our current capabilities to deliver timely forecasts of space weather and what is required, the program must contain elements that will yield an immediate improvement in forecast accuracy.

To be successful, there are three basic implementation requirements for an achievable and successful program. The program must:

BE BASED ON AND EMPLOY INNOVATIVE TECHNOLOGIES: We are fortunate that there is a revolution underway in computational capabilities and innovative ground- and space-based technologies, for instruments, spacecraft, data handling, model development, launch costs, etc., all of which should be fully employed to yield the most cost-effective program for delivering the space weather forecasting capability the nation requires.

MOBILIZE THE NATION'S CAPABILITIES: There are vast capabilities available in universities, national laboratories, government agenciesand industry, for instruments and spacecraft data interpretation and model development. This community of scientists and engineers needs to be mobilized to engage fully in this important national effort to improve our space weather forecasting capability.

BE ORGANIZED FOR SUCCESS: The implementation of this important national effort must be able to embrace the requirements of this program: mobilize the requisite community of scientists and engineers to accomplish the program; obtain and utilize all relevant innovative technologies; connect the users of space weather forecasts with the providers of these forecasts, and providers with researchers; and above all be committed to success that is unburdened by bureaucracy. By doing so, the program must develop and implement expeditiously a space weather forecasting program that protects our technological civilization.

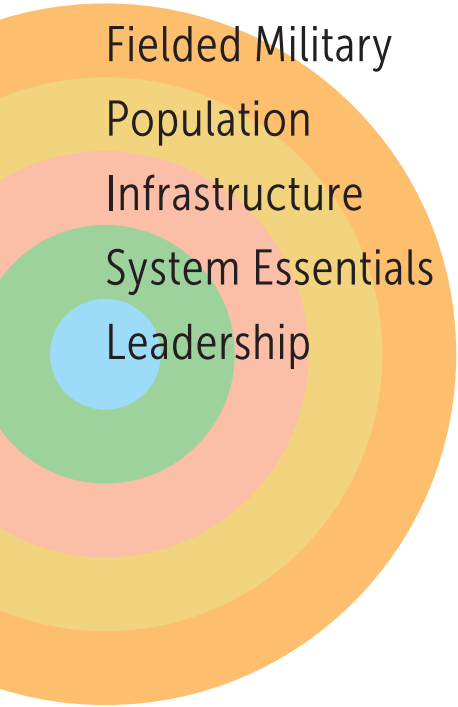
The incoming presidential team needs to maintain the momentum that has built up over recent years concerning preparedness for space weather hazards. The space science community stands ready to serve the national need and will use its talents to help improve forecasts and help protect the nation from space weather impacts into the future. The time for action is now. **SN**

LEN FISK IS THE FORMER CHAIR OF THE NATIONAL ACADEMY OF SCIENCES SPACE STUDIES BOARD. **DANIEL BAKER** IS DIRECTOR OF THE LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS AT THE UNIVERSITY OF COLORADO, BOULDER. **NICOLA FOX** IS THE PRINCIPAL PROFESSIONAL STAFF SCIENTIST AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY.

COMMENTARY Christopher Stone

Defending critical space infrastructure

A memo to U.S. President-elect Trump about a critical national security issue



Warden's Five Rings represent a theory of military strategic attack, based on an enemy's five interconnected centers of gravity. They are named in honor of retired U.S. Air Force Col. John A. Warden, an air power theorist.

One of the most pressing national security issues facing the United States in the next five to 10 years is the vulnerability of its critical space infrastructure to attack.

The nation's critical space infrastructure — both in orbit and on the ground — is a vital center of gravity for U.S. instruments of national power and the American way of life. If the U.S. remains on the course set by current policy and strategy, our nation will remain under the high-risk, low-threshold-use scenarios inherent in first-strike instability with the Chinese and Russians.

First, the United States of the early 21st century is reliant upon its critical space infrastructure unlike any other nation up to this point. It has become a supercenter of gravity for the nation's ability to project power overseas quickly and efficiently. The U.S. financial systems are linked to it, and other critical infrastructures such as transportation, agriculture and energy are dependent upon U.S. spacepower. The larger these interdependencies become, the larger the cost of failure. Because of this, a future adversary could take down, or at least severely degrade all of those vital areas of national defense and commerce — known as Warden's Five Rings —through a well-planned, multi-layered strike against American space infrastructure.

This fact is not lost on potential adversaries, notably China, which has called space the "soft ribs" of U.S. defenses. China's strategists have concluded that unleashing its burgeoning space-attack capabilities in a future crisis could produce a "grave aftermath" for the U.S.

This "grave aftermath" could be at the level of the "space Pearl Harbor" the Rumsfeld Commission envisioned in 2001, resulting in severe economic damages to the U.S. and its trading partners in the West and while degrading U.S. air, land and naval forces in the Pacific to respond in defense of treaty obligations with Japan and policy obligations with friends like Taiwan, the Philippines or Vietnam in the South China Sea. This scenario would enable the Chinese to achieve their objectives via a "rapid, destructive" space engagement that gives sufficient cover for the Chinese to seize territories, or achieve their objectives before the U.S. has a chance to respond. Unfortunately, the current policy posture of the U.S. and its allies is not grounded in reality; it is based instead on concepts rooted in rational-actor assumptions and liberal institutional-based agreements as seen through a mirror-imaged worldview. It is also out of sync with the realities of today's strategic environment.

The National Security Space Strategy (NSSS) was written to account for the growing threat of China's kinetic anti-satellite (ASAT) testing and the tripling of reversible, purposeful interference such as radiofrequency jamming of U.S. forces and commercial providers. However, instead of taking the strategic view of why China is developing and testing these systems (the critical-infrastructure vulnerability), the NSSS focused on the symptoms — namely, orbital debris generation and the weapons themselves. Thus, the senior U.S. leadership who drafted the NSSS were basing it on their experiences as arms-control negotiators and not military or foreign policy expertise. >

< > The NSSS was drafted using a belief that all nations were rational actors that would sign on to rules of responsible behavior in space, following U.S. strategic restraint on developing counterspace systems and providing transparency and confidence building measures to demonstrate good will. These actions were to be based on a "top down diplomatic initiative" utilizing such institutions as the European Union and the United Nations. Initially, the goal was to develop a new treaty-based system that restricted weapons testing and operational use, but the State Department official in charge, also an arms control negotiator by trade, believed that it was "the best way ahead to help strengthen the long-term sustainability ... and promote safe and responsible use of space[.]" As a result, the DoD and State Department, along with their European Union partners, developed a "deterrent through norms" document known as the EU Code of Conduct. This document was non-legally binding and as a result, did not have to go through the governmental politics of interagency coordination or Senate ratification. However, it did have to go through the international equivalent of governmental politics and organizational process models of decision making. This created a situation where the document intended to deter aggression became bogged down in UN circles and other regional forums in Asia and Africa that led to it withering into bureaucratic oblivion at the meeting of the UN Group of Government Experts in New York in 2014.

The current "four deterrents" model is not deterring China, other spacefaring powers and non-state actors because it defines rational actors in a way that does not reflect the varying strategic cultures and worldviews toward the space operating domain and the international system. For example, China has a unique view of themselves, the space domain and treaty negotiation. Transparency is viewed not as a strength for building bridges toward peace, but rather as a strategic trick that seeks to undermine China's security. Negotiation tactics, do not follow the win-win model of American negotiations but rather a "mobile warfare" model that revolves around the ancient principle of "hide a knife behind a smile" and dominate your opponent. Thus, the NSSS has used a false definition of deterrence. As a result, it can be said that this concept has failed to achieve its goal of deterring or dissuading "the development, testing, and employment of counterspace systems and prevent and deter aggression against space systems and supporting infrastructure that support U.S. national security."

The United States should change course to a more realist approach that addresses the strategic problem by assessing the threat from the intent of the state or non-state actor and not the existence of the weapons they plan to wield. First, the United States should develop a strategic picture of the intentions behind the development of counterspace systems by China and Russia.

As U.S. vulnerabilities of our critical space infrastructure come to light through internal analyses, those gaps must be filled as part of the primary mission of the National Security Strategy,which is homeland defense.

One area to mitigate is the first strike instability created by the testing and deployment of Chinese kinetic-energy ASATs. One way to accomplish this is to create a terrestrial first strike capability using already funded programs of record capable of modification. These include the Standard Missile-3 aboard Aegis destroyers and which are part of the European Aegis Ashore missile defense system. A more deployable version could be a weaponized version of the DARPA Airborne Launch Assist Space Access (ALASA) research concept, that would launch small, weaponized satellites off the bottom of an F-15 Eagle. Once this capability is in place, first-strike stability will be achieved as well as a nascent capability (depending on geometries of launch and intercept points) to deny first strikes against our space systems. This should deny the advantage sought by our potential adversaries and give their leadership and strategists pause that the vulnerabilities they were planning to use for strategic advantage in crisis or war is no longer a viable option.

Second, is to develop a deterrence posture for space based on the traditional model of credibility, capability and forward leaning strategic communications. Once this capability is achieved, strategic messaging must be adjusted from what the United States will not do, to what it will do if attacked at any point along the counterspace spectrum. These postures and strategies must focus at the strategic level on the adversary decision maker's mind and not just the threat from their weapons systems. Once this is achieved, spacepower can be better integrated and understood as an inherently strategic part of our great power toolkit, vital to safeguarding our interests and our obligations to protect our friends and allies worldwide.

This is a vital need for our nation. No longer can we view space as a sanctuary from conflict or something extended far away from our way of life, but as the critical infrastructure it is. The deterrence of aggression coupled with the active defense of our critical space infrastructure as part of homeland defense strategy should be a primary focus of this government, given its direct impact to the safety and security of our citizens. SN

CHRISTOPHER STONE IS A FORMER PENTAGON STRATEGIC SPACE ANALYST AT AIR UNIVERSITY IN ALABAMA. STONE IS THE AUTHOR OF *REVERSING THE TAO: A FRAMEWORK FOR CREDIBLE SPACE DETERRENCE*. THE THOUGHTS AND VIEWS ARE OF THE AUTHOR AND NOT OF THE DEPARTMENT OF DEFENSE OR THE U.S. GOVERNMENT.

ON THE HORIZON

DECEMBER

DATE	EVENT	PLACE
6	**GVF High Throughput Satellite (HTS) 2016 London Roundtable** www.uk-emp.co.uk/current-events/hts-london-2016/	London, UK
6-7	**Space Resiliency Summit 2016** dsigroup.org	Alexandria, VA
12-15	**2016 Workshop on Spacecraft Flight Software** www.flightsoftware.org	Pasadena, CA

JANUARY

15-18	**Pacific Telecommunications Conference (PTC 2017)** www.ptc.org	Honolulu, HI

MARCH

6-9	**Satellite 2017** www.satshow.com	Washington, DC
7-9	**Goddard Memorial Symposium** www.astronautical.org	Greenbelt, MD
21-23	**CABSAT 2017** www.cabsat.com	Dubai, UAE
24-25	**2nd European Space Generation Workshop 2017 (E-SGW 2017)** www.spacegeneration.org	Paris, France

APRIL

3-6	**33rd Space Symposium** www.spacesymposium.org	Colorado Springs, CO

MAY

9-11	**Humans to Mars Summit 2017** ExploreMars.org	Washington, DC
23-25	**Space Tech Expo USA** spacetechexpo.com	Pasadena, CA
30-31	**iCubeSat 2017 – the 6th Interplanetary CubeSat Workshop** www.iCubeSat.org	Cambridge, UK

OCTOBER

24-26	**Space Tech Expo Europe** www.spacetechexpo.eu	Bremen, Germany

FOUST FORWARD Jeff Foust

Making a hot planet cool

SCIENTISTS HOPING #UNVEILVENUS CAMPAIGN WILL CONVINCE NASA TO LAUNCH FIRST DEDICATED VENUS MISSION SINCE MAGELLAN'S 1989 VOYAGE.

It's been more than a quarter century since NASA last launched a dedicated Venus mission, the Magellan radar mapper. Could the key to winning funding for a new mission be... a hashtag? Well, it can't hurt.

"We're trying to sort of rebrand ourselves, so you may have seen the hashtag going around, #UnveilVenus," said Bob Grimm, chairman of the Venus Exploration Analysis Group (VEXAG), speaking Nov. 29 at the group's annual meeting at NASA Headquarters. "We're trying to 'social media-ize' this and get more discussion going on about Venus."

Odds are that you hadn't seen that hashtag going around: a Twitter search at the time of his talk turned up only one tweet that used it, from VEXAG's own account, and just a handful since. The good news for Venus scientists is that, regardless of their social media strategy, there is growing optimism that NASA will return there, sooner or later.

The sooner could be quite soon. Two of the five finalists in the ongoing competition in NASA's Discovery program are Venus missions. VERITAS, the Venus Emissivity, Radio Science, InSAR, Topography, and Spectroscopy mission, is an orbiter that would provide high-resolution maps of the planet's surface and information about its composition. DAVINCI, the Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging, would study the composition of the planet's dense atmosphere during an hour-long descent.

Jim Green, director of NASA's planetary science division, said at the VEXAG meeting the selection of one or possibly two proposals for development is on schedule. "There's an excellent chance we'll be able to complete the selection and make that announcement before the end of December," he said.

In January, NASA plans to release the announcement of opportunity for the next mid-sized New Frontiers mission. Among the six categories of missions eligible for this competition is Venus In Situ Explorer, which would study the planet's atmosphere and surface. Initial proposals are due to NASA 90 days after the announcement's release, and the agency expects to select several for additional study by next November, with a final decision coming in May 2019.

Scientists aren't counting on just those competitions. There is cooperation with Japan's Akatsuki spacecraft, which entered orbit around Venus nearly a year ago after an engine malfunction prevented an earlier orbit insertion attempt. There are plans to take advantage of upcoming NASA and ESA spacecraft flying by Venus on gravity-assist maneuvers, efforts which require negotiations to turn on instruments that would otherwise be inactive during the flybys.

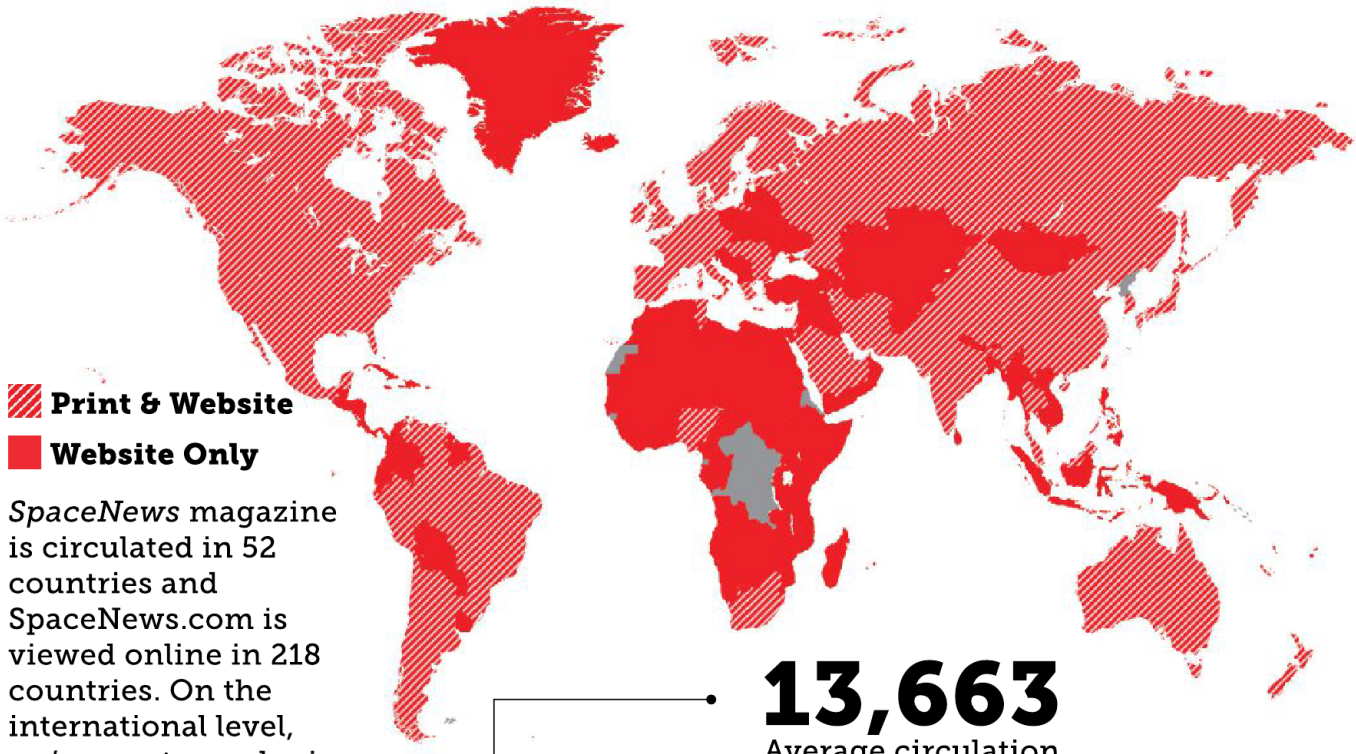
There are also discussions with Russia about participation in Venera-D, an ambitious Venus mission planned for the mid-2020s. Green said any cooperation has been difficult because of the "cool relationship" between the U.S. and Russia, but he did win approval for bilateral discussions with Roscosmos in October. That meeting led to a decision to extend a joint study on ways the two space agencies could cooperate on the mission.

That renewed interest in Venus missions, and the "rebranding" Grimm mentioned, is linked in large part to what's known as comparative planetology. Venus is nearly the same size as the Earth, yet a very different world. "Why is our sister planet so different?" Grimm asked. Understanding what happened to Venus might provide insights to Earth's future as well.

NASA Chief Scientist Ellen Stofan, who previously was deputy project scientist on Magellan, offered words of encouragement to her fellow Venus scientists. "I always reflect on the fact that we're kind of the Galaxy Quest of scientists: Never give up, never surrender," she said at the VEXAG meeting. "We're hanging in there because we are always drawn back to Venus, because it is so significant."

Just don't forget the hashtag. SN

SPACENEWS
Audience & Readership



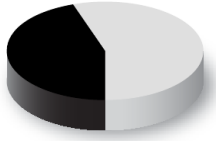
Print & Website

Website Only

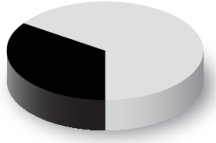
SpaceNews magazine is circulated in 52 countries and SpaceNews.com is viewed online in 218 countries. On the international level, we're most popular in France, Germany, the United Kingdom, Japan and Canada.

13,663
Average circulation

44.9% of our qualified circulation are decision-makers.



34.6% of our qualified circulation works in the commercial space industry. Within this audience segment, 43.01% are decision-makers.



51.1% of our qualified circulation works for the U.S. government or military. Within this audience segment, 50.69% are decision-makers.

2.3% of our qualified circulation works for international governments and militaries. Within this audience segment, 51.4% are decision-makers.

BPA WORLDWIDE

Contact Paige McCullough
+1 571-278-4090 | pmccullough@spacenews.com

Your trusted partner for secure satellite services

With our years of deep technical expertise, global network operations and 24/7 support seamlessly delivered through the Intelsat Globalized Network, we can fly your satellites more efficiently, economically and with the highest levels of mission assurance. Focus on your priorities and leave the management to us, your trusted partner for secure satellites services.

Rely on Intelsat General,
www.intelsatgeneral.com/service-offerings/satellite-related-services

INTELSAT
General Corporation