OUT TO LAUNCH
The small launch industry’s inflection point

GOVERNMENT’S OUTSIZE ROLE IN SMALL LAUNCH

Aiming small for Alcantara
Brazil betting on small launchers to breathe life into idle spaceport

Elevate your competitive edge with Boeing’s family of software-defined satellites. With the ability to reallocate resources on the fly, the revolutionary 702X adapts to evolving market conditions, maximizes return on investment and is ready today.
NASA and ESA outline cost of Mars sample return.
Project Kuiper gets FCC's OK
NASA taps General Atomics to build solar irradiance satellite

Celestial property rights: How we can achieve a new, commerce-fueled space age

Social distancing, self-isolation, and ... space debris?

Like Uber, except for satellite imagery

Developing a “whole-of-government” policy for space exploration and development

Inflection point
From launch failures to global pandemic, a small launch industry long buoyed by optimism is learning just how unforgiving spaceflight can be.

A market force to be reckoned with
The U.S. government, notably DoD, is playing an outsized role in the shaping a small launch market hard pressed to survive on commercial contracts alone.

Exit strategy
As a wave of acquisitions washes over the space industry, NewSpace investors are finally finding the exits — just not where they expected them to be.

Factoring for wider demand
Airbus U.S. Space Systems head Debra Facktor sees government demand for commodity spacecraft as key to getting its Florida factory finally humming.

Aiming small for Alcantara
Can Brazil entice small launch vehicle operators to breathe life into its idle spaceport? The head of the country’s space agency thinks so.

ABOVE: NASA Administrator Jim Bridenstine, right, and United Launch Alliance CEO Tory Bruno take a selfie with the Atlas 5 rocket with NASA’s Mars 2020 Perseverance rover onboard as it rolled out to its launch pad at Cape Canaveral, Florida, ahead of its July 30 launch. Credit: Joel Kowsky/NASA. COVER: Astra’s 3.0 rocket at Pacific Spaceport Complex-Alaska in March. At press time, Astra was scheduled to make an orbital launch attempt Aug. 2. Credit: John Krause/Astra

NEXT ISSUE
Our next issue will be published Sept. 14.
Virgin Galactic announced July 15 that Michael Colglazier would take over as CEO. Colglazier spent more than three decades at Disney, most recently as president and managing director of its theme parks division. He became Virgin Galactic CEO July 20, replacing CEO George Whitesides, who becomes “chief space officer” after a decade leading the company. Whitesides will devote his attention to future business opportunities, such as point-to-point high-speed travel and orbital spaceflight applications. The leadership change comes as the company prepares to move into commercial operations of its SpaceShipTwo suborbital vehicle, with Colglazier focused on developing “an amazing customer experience” for those customers, leveraging his Disney experience.

**JAMES WEBB LAUNCH PUNTED TO LATE 2021**

NASA announced July 16 a seven-month delay for the launch of the James Webb Space Telescope (JWST) due in part to the pandemic. NASA said the observatory is now scheduled for launch Oct. 31, 2021, on an Ariane 5 from French Guiana. NASA had been targeting a launch in late March 2021, but a slowdown in work caused by the pandemic, as well as time added to the schedule for some upcoming test activities, forced the delay. NASA said the cost of the delay should be covered by existing budget reserves, keeping the mission within its cost cap of $8.8 billion.

**LIGADO DISPUTE BLOCKS FCC COMMISSIONER CONFIRMATION**

The Senate Armed Services Committee’s chairman blocked the confirmation of an FCC commissioner because of his support for Ligado. Sen. James Inhofe (R-Okla.) said July 28 he placed a hold on the nomination of Michael O’Rielly for a new five-year term as FCC commissioner because O’Rielly backed the FCC’s decision to allow Ligado to build out a 5G network in a spectrum band adjacent to GPS signals. The Pentagon and others in government and industry have warned that Ligado’s network could interfere with GPS. Inhofe said he would block the nomination until O’Rielly “publicly commits to vote to overturn the current Ligado order.” O’Rielly’s term expired in 2019 but FCC commissioners can serve until the current session of Congress ends. That means O’Rielly can serve until January if Inhofe doesn’t lift the hold.

**SIGNIFICANT DIGITS**

**€13.2B**
The European Commission’s space budget for the next seven years, an amount nearly 20% lower than previously proposed. The budget cut for space came as part of negotiations over a 1.8-trillion-euro budget for the entire European Union that included a pandemic economic recovery package.

**$1.8B**
The size of the claim SES filed against Intelsat for breaking up the C-Band Alliance. SES sued Intelsat on July 14 for breach of contract, breach of fiduciary duties, and unjust enrichment.

**$1.5B**
The amount NASA would receive under a pandemic relief bill introduced in the Senate July 27. NASA Deputy Administrator Jim Morhard said the figure is a “good estimate” of the agency’s pandemic-induced costs, but that it’s subject to change as the pandemic continues.

**€11M**
How much French smallsat technology company ExoTrail has raised in a Series A round from new and existing investors. The company will use its new funding to further product development, increase manufacturing capabilities and hire business development staff in Europe and in North America.

**53**
The number of debris items tracked by the U.S. military after the July 12 break up of a Japanese H2A rocket part left in orbit. The 18th Space Control Squadron said there was no indication the fragmentation event was caused by a collision.
BRITAIN FINALIZES ORDER FOR SKYNET GAPFILLER SATELLITE

The British government agreed to fully fund a Skynet satellite it sole-sourced from Airbus Defence and Space three years ago, signing a $628 million contract for its manufacture and launch, as well as ground segment upgrades. Skynet-6A, based on the Eurostar Neo platform, is slated for launch in 2025 and expected to provide communications services for the British military until at least 2040. The satellite will serve as a gapfiller while the U.K. government decides on the long-term replacement for the existing Skynet-5 system of four X-band and UHF satellites. Those evaluations will now likely consider what role OneWeb could play, now that the U.K. government is working with Bharti Global to acquire the satellite megaconstellation company.

ESA GAINS SECOND ASSOCIATE MEMBER

Latvia signed an agreement to become an associate member of the European Space Agency, allowing it to participate in some ESA programs and secure contracts for Latvian companies. Associate membership is a step below being a full member of the agency. ESA has 22 full members and counts Latvia and Slovenia as associate members. Latvia has had a cooperation agreement with ESA since 2015.

U.S. SPACE COMMAND: RUSSIA TESTED ASAT WEAPON

U.S. Space Command says Russia performed a test of an anti-satellite (ASAT) weapon in mid July. In a statement issued July 23, Space Command said that Russia’s Cosmos-2543 spacecraft released an object July 15. That deployment, Space Command concluded, was a non-destructive test of an ASAT system. Cosmos-2543 is the same spacecraft that maneuvered close to a classified American satellite early this year. Russia also fired a direct-ascent ASAT missile in another non-destructive test in April.

GLOBAL EAGLE FILES FOR CHAPTER 11, BLAMING PANDEMIC

Global Eagle Entertainment, which provides satellite connectivity services for aircraft, boats and remote locations, filed for Chapter 11 bankruptcy protection July 22. The company said it lost revenue because most of its airline and cruise line customers have curtailed service. The company’s list of top unsecured creditors includes several major satellite operators that sold capacity to Global Eagle. The company plans to continue operating through a restructuring it expects to complete by the end of the year.
NASA and ESA outline cost of Mars sample return

NASA and the European Space Agency expect to spend at least $7 billion to collect samples of Mars and return them to Earth, a process that began in earnest July 30 with the successful launch of NASA’s Mars 2020 mission.

Mars 2020 will deliver to the surface of Mars a rover named Perseverance, whose primary mission will be to collect up to three dozen rock samples, placing them in tubes cached on the Martian surface or on the rover itself.

Those samples will be returned by two future missions, currently projected to launch in 2026. One will be a NASA-developed lander carrying a European “fetch rover” that will pick up the sample tubes and return them to the lander. Perseverance may also deliver some sample tubes directly to the lander. Those tubes will be loaded into a container that is launched into orbit by a small rocket, called a Mars Ascent Vehicle.

The second mission will be the ESA-led Earth Return Orbiter mission, which will collect that sample container in Mars orbit using a containment system provided by NASA. The orbiter will then leave Mars orbit and head back to Earth. A capsule carrying the sample container will land in the Utah desert in 2031.

David Parker, director of human and robotic exploration at ESA, announced at a July 28 NASA press conference that the agency plans to award a contract to Airbus Defence and Space of France to build the Earth Return Orbiter. Airbus will partner with Thales Alenia Space of Italy on the spacecraft.

“Together they’re kind of the European ‘dream team,’” he said, because of their experience on a range of other ESA science missions. Terms of the contract, which is still subject to negotiation, were not disclosed.

The orbiter, Parker said, will be a large spacecraft, weighing 6.5 metric tons and with a solar panel “wingspan” of more than 35 meters. The large solar panels are required for the spacecraft’s electric propulsion system that will allow the spacecraft to raise and lower its orbit around Mars and head back to Earth.

ESA previously awarded study contracts to Airbus Defence and Space in the United Kingdom for the fetch rover that will fly on the NASA lander mission. Parker said the rover will leverage the work done on the Rosalind Franklin rover built for the ExoMars mission, whose launch was delayed from 2020 to 2022 because of other technical issues as well as impacts of the coronavirus pandemic. The fetch rover will be about the half the mass of Rosalind Franklin rover but will be able to move quickly.

Parker estimated the total cost of ESA’s involvement in the overall Mars sample return campaign at 1.5 billion euros ($1.75 billion) over the next decade. ESA received the first third of that funding at its Space19+ ministerial meeting last November.

NASA is still in the early phases of developing its contributions to Mars sample return beyond Mars 2020. At the NASA briefing, Thomas Zurbuchen, NASA associate administrator for science, said the agency’s fiscal year 2021 budget proposal had a “first guess” for the cost of future Mars
sample return missions at $2.5 billion to $3 billion. A firm cost estimate won’t come until a confirmation review later in the development of the lander mission. Mars 2020 cost $2.4 billion to develop, and the agency has budgeted $300 million for the mission’s first Martian year — 687 Earth days — of operations. That would bring the overall cost of Mars sample return, when including all three missions and the contributions by both NASA and ESA, to at least $7 billion.

That estimate, Zurbuchen said, doesn’t include the cost of a sample return facility that will host the samples after they return to Earth for analysis. There will be opportunities for international collaboration in developing and using that facility, he said.

That facility will require a sophisticated design to protect the samples from being contaminated by the terrestrial environment, and vice versa. Lisa Pratt, NASA’s planetary protection officer, said the facility will have biosafety protections similar to those of the most advanced facilities for dealing with pathogens. “Not that we really think there will be anything pathogenic or highly dangerous from Mars, but we’re going to be extremely cautious,” she said.

Despite the expense and challenges of Mars sample return, scientists say it’s critical to bring samples back to Earth where they can be studied in laboratories far more advanced than any instrument that can be sent to Mars on a spacecraft. Doing so, they argue, is needed to conclusively identify any biosignatures, or evidence of past Martian life.

“As capable as the rover is, we’ll have really intriguing evidence” of past life, said Chris Herd, Mars sample return participating scientist at the University of Alberta, during the briefing. “But to have that definitive proof, we need to bring those samples back and see them in the lab.”

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**Project Kuiper gets FCC’s OK**

The U.S. Federal Communications Commission on July 30 approved Amazon’s request to operate a constellation of roughly 3,200 internet satellites in low Earth orbit.

The FCC said Amazon has until July 30, 2026, to launch at least 50% of its satellites in order to maintain its authorization, and until July 30, 2029, to orbit the full constellation. Amazon, in a July 30 blog post, said that it will invest $10 billion in Project Kuiper — the same amount SpaceX has estimated it will need to invest in its rival constellation Starlink, which already has more than 500 small broadband satellites in orbit.

Amazon has not outlined a launch plan for Kuiper, and told the FCC its constellation is still being designed. The company said it anticipates deploying Kuiper satellites in five waves, starting service once the first, comprising 578 satellites, is in orbit.

Amazon’s Ka-band system is “designed to increase the availability of high-speed broadband service to consumers, government, and businesses,” the FCC said.

As a condition of its approval, Amazon is required to submit an updated debris mitigation plan to the FCC once its spacecraft design is finalized. The company plans to operate Kuiper in three layers, one at 590 kilometers, another at 610 kilometers and a third at 630 kilometers.

FCC Chairman Ajit Pai tweeted July 10 that he would ask his fellow commissioners to approve Kuiper. “Satellite constellations like this aim to provide high-speed broadband service to consumers in the U.S. and around the world,” Pai wrote.

Amazon joins SpaceX, Telesat, OneWeb and potentially Viasat in competing to provide high-speed broadband from low Earth orbit using large numbers of satellites.

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**CALEB HENRY**

“There are still too many places where broadband access is unreliable or where it doesn’t exist at all,” Limp said. “Kuiper will change that. Our $10 billion investment will create jobs and infrastructure around the United States that will help us close this gap.”

Kuiper, in addition to beaming internet directly to ground stations, will also expand 4G and 5G coverage areas by enabling low latency backhaul services for cellular network operators, according to Amazon.

Rajeev Badyal, vice president of technology for Project Kuiper, said Amazon is “doing an incredible amount of invention” so that its constellation can provide consumer-priced broadband — a feat experts say hinges on the availability of cheap, mass-produced flat-panel antennas that don’t yet exist.

Amazon said in December it is setting up a research and development headquarters for Kuiper in Redmond, Washington, with laboratories, prototype manufacturing facilities, and office and design space. The company also plans to open a Redmond office for its Web Services division in 2021 with capacity for more than 600 employees.

Amazon Web Services has a ground station business focused on connecting satellites in low Earth orbit, and in June created a dedicated division to sell cloud services to the space industry.

Amazon founder Jeff Bezos also owns launch company Blue Origin, though Blue Origin has said it will have to compete for Kuiper launch contracts. Blue Origin has several commercial orders for its satellite-launching New Glenn rocket, which is still in development, and is competing against SpaceX, United Launch Alliance and Northrop Grumman for two long-term launch deals the U.S. Defense Department is expected to award this year.
General Atomics Electromagnetic Systems won a $32.9 million contract to build NASA’s Total and Spectral solar Irradiance-2 (TSIS-2) spacecraft, a small satellite scheduled to launch in 2023.

Under the firm-fixed price, time and materials contract awarded July 6, General Atomics will develop and test the TSIS-2 spacecraft, integrate instruments, and support the launch and in-orbit operations for three years. TSIS-2 will be equipped with the Total Irradiance Monitor and Spectral the Irradiance Monitor built by the University of Colorado Laboratory for Atmospheric and Space Physics.

“TSIS-2 will observe the sun and its evolution over time to better inform climate models and improve understanding of solar events,” Nick Bucci, vice president of GAEMS Missile Defense and Space Systems, told SpaceNews.

General Atomics is basing the TSIS-2 design on its Orbital Test Bed, a scalable, modular platform designed to accommodate multiple payloads from a single customer or hosted payloads from multiple customers.

The TSIS-2 spacecraft competition pitted General Atomics against the Southwest Research Institute. The Southwest Research Institute submitted a very strong proposal but General Atomics won the contract largely because it’s bid was 40% lower than the Southwest Research Institute’s, according to the TSIS-2 Spacecraft Selection Statement.

Bucci said in a statement, “Our spacecraft designs provide lower-cost access to space helping customers keep pace with the demand to provide for missions like TSIS-2.”

General Atomics plans to design, manufacture, assemble, integrate and test the TSIS-2 satellite at its existing facilities in the Denver area and at its new spacecraft development, integration and test factory in Centennial, Colorado, Bucci said in an interview.

The first Orbital Test Bed, which launched in 2019 on a SpaceX Falcon Heavy, housed five distinct payloads for commercial, government and academic customers, including the Deep Space Atomic Clock developed by the NASA Jet Propulsion Laboratory.

NASA awarded General Atomics a $38.5 million contract in 2018 to send the Multi-Angle Imager for Aerosols, an instrument developed by the Jet Propulsion Laboratory, into orbit on Orbital Test Bed-2. General Atomics Electromagnetic Systems won a $37.9 million contract in 2018 to fly the National Oceanic and Atmospheric Administration’s Argos Advanced Data Collection System on the third Orbital Test Bed.

“We are extremely pleased to expand our relationship with NASA and to continue supporting their research goals with our flexible, modular OTB platforms,” Scott Forney, General Atomics Electromagnetic Systems president said in a statement. “This contract is another exciting opportunity that demonstrates [General Atomics’] ability to deliver satellites on an aggressive schedule. The OTB platform will allow us to quickly and affordably integrate the TSIS-2 payload suite onto a free-flying spacecraft that will operate in a sun-synchronous orbit and allow NASA continuous solar monitoring capabilities throughout its mission life cycle.”

DEBRA WERNER
R&D FUNDING PROGRAM

The National Reconnaissance Office Director’s Innovation Initiative (DII) Program funds cutting-edge scientific research in a high-risk, high-payoff environment to discover innovative concepts and creative ideas that transform overhead intelligence capabilities and systems for future national security intelligence needs. The program seeks the brightest minds and breakthrough technologies from industry, academia, national laboratories, and U.S. government agencies.

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The small launch industry’s inflection point

From launch failures and financial setbacks to a pandemic and pitiless competition, an industry long buoyed by optimism is learning how unforgiving spaceflight can be

The first sign of a problem during last month’s Electron launch was when the numbers that should have been going up started going down.

Like many other launch companies, Rocket Lab displays basic telemetry during webcasts of its missions, showing the vehicle’s altitude and speed. As the Electron took off from the company’s launch site in New Zealand on the morning of July 5 on a flight dubbed “Pics or It Didn’t Happen” — six of the seven payloads on the rocket were imaging satellites for Canon Electronics and Planet — those numbers increased as the rocket lifted off and headed for orbit.

However, about 5 minutes, 45 seconds after liftoff, the rocket’s velocity topped out at nearly 13,700 kilometers per hour, well short of orbital velocity, and started to decrease. A short time later, the velocity started increasing again, but only as the rocket’s altitude started falling from 195 kilometers. By the time the company took the telemetry off the screen a couple minutes later, the rocket had fallen 30 kilometers.

A short time later, the company confirmed the obvious: the launch had failed. “After 12 consecutive launches to space, today’s issue was a reminder that spaceflight can be very unforgiving,” Peter Beck, chief executive of Rocket Lab, said in a statement later that day.

An entire industry is learning how unforgiving spaceflight can be. For the last few years, the small launch vehicle industry has been based on potential: of low-cost rockets that launch frequently to serve a burgeoning market, a dream fueled by hundreds of millions of dollars of investment. But PowerPoint rockets never fail. Real ones can and, for new companies, often do.

“THRILLED, AND A BIT DISAPPOINTED”

Virgin Orbit knew the odds, historically, were against them as they prepared for their first flight of LauncherOne, its air-launched rocket. “History has not been kind to maiden flights,” Will Pomerantz, vice president of special projects at Virgin Orbit, said at a briefing before the May 25 launch. “About half of maiden flights fail.”

LauncherOne, unfortunately, joined that club. “We succeeded in getting through our countdown and our launch seamlessly — really flawlessly — and dropped the rocket,” said Dan Hart, chief executive of Virgin Orbit, during a webinar two months later. The rocket handled as expected as it fell away from its Boeing 747 and, a few seconds later, ignited the NewtonThree engine in its first stage.

“We were pretty stoked at that point,” he said. “We had, at that moment, proven all of the new aspects of air launch.”

JEFF FOUST
But, seconds later, the engine shut down. Hart said an investigation led the company to conclude that a high-pressure feed line, supplying liquid oxygen, or LOX, to the engine broke. “LOX stopped going into the engine and our flight was terminated.”

The company is taking steps to strengthen those engine components. The second LauncherOne rocket is nearing completion at the company’s Long Beach, California, factory, although upgrades to the NewtonThree engine will continue. “We’ll be targeting our next flight before the end of the year,” he said.

The failure left Hart, and the company’s several hundred employees, with mixed feelings. “We left both incredibly excited and incredibly thrilled, and a bit disappointed that we didn’t get to orbit,” he said.

**ASTRA SHOOTS FOR PAR**

In March, Astra came within a minute of taking a shot at $2 million. The company’s Rocket 3.0 vehicle was on the pad at Pacific Spaceport Complex-Alaska on the last day of the DARPA Launch Challenge. Had it launched and reached orbit, the company would have won a $2 million prize and qualified to make a second launch for $10 million more.

Instead, the company scrubbed the launch. Adam London, the company’s co-founder and chief technical officer, said an “anomalous signal” in guidance, navigation and control equipment forced them to scrub. The problem, he said in a call with reporters July 30, was an issue with a fuel tank that the company corrected with both hardware and software adjustments.

While the DARPA competition was over, Astra tried again to launch the rocket later in March. However, the company said March 23 the rocket had been damaged during prelaunch testing and that the launch would be postponed. The company didn’t comment further, although there was industry speculation that the rocket had, in fact, been destroyed.

London, confirming those rumors, said the problem took place after a “wet dress rehearsal,” when the rocket is loaded with propellant that is then drained. “We were offloading the vehicle and, during that offload, a valve failed,
which led to an overpressurization and, ultimately, the loss of the vehicle.”

The company’s new Rocket 3.1 vehicle has corrected the problem “in three or four different ways,” he said, along with other, unspecified changes. Astra shipped Rocket 3.1 to Alaska in July for a launch now scheduled for no earlier than Aug. 2.

Astra, like Virgin Orbit, is setting expectations for what is officially an orbital launch attempt. “We don’t intend to hit a hole-in-one here,” said Chris Kemp, co-founder and chief executive. “We intend to accomplish enough to ensure that we’re able to get to orbit after three flights.”

The goal for this launch will be to get through the firing of the rocket’s first stage and separation of the upper stage. “We’ll be just delighted if that upper stage lights,” he said.

A LONG-AWAITED SHAKEOUT

The philosophy that both Astra and Virgin Orbit have taken — acknowledging that a first launch attempt is unlikely to succeed but is instead a learning experience to long-term success — is, on the one hand, wise. Betting it all on a successful first launch is dangerous, given the historic record that Virgin Orbit’s Pomerantz noted. SpaceX, after all, suffered failures on its first three Falcon 1 launches before finally making orbit.

Investors, though, may not share that patience. That’s especially true the last several months, as venture capital funds that had been a major source of funding for launch vehicle startups have second thoughts during the pandemic.

“It’s been difficult, especially if you’re early stage,” said Fred Kennedy, vice president of future missions at Astra, in an interview. “I think a lot of people have pulled back.”

That puts companies that already raised large rounds, like Rocket Lab and Relativity, at an advantage. “If you were lucky, you got your big funding round done right before COVID hit. Then you’re squared away,” he said.

Astra was working on a funding round when the pandemic hit, but has put those plans on hold. Kemp said the company furloughed some staff to save money. Most of those have returned with the exception of a few people he said aren’t needed until the company, currently producing one rocket a quarter, returns to a one-a-month rate.

“That was challenging for the team, but it did give us the time we needed to do these three launches before we raise capital again,” Kemp said. Even if the Rocket 3.1 launch is a success, London said the second of that series of three launches would be a few months later “at a minimum” depending on what changes Astra needs to make to the rocket.

Virgin Orbit has been more circumspect about its finances. Hart said in May that the company has a backlog of launch orders “in the hundreds of millions” of dollars, but didn’t otherwise discuss the company’s finances.

The combination of investors tightening their purse strings in the pandemic, while new and existing vehicles suffering failures, might serve as the inflection point for a long-anticipated shakeout in the small launch vehicle industry. If companies that have raised hundreds of millions of dollars are suffering launch failures or business setbacks, why would investors put money into another launch startup?

Even Rocket Lab, with its large order book and $140 million funding round in late 2018, is not immune to stumbles, as its recent launch failure showed. The company said July 31 that a “single anomalous electrical connection” caused a premature engine shutdown.

Beck didn’t bring up the failure when he appeared at the Techweek NZ conference July 27. “We feel like launch is a solved problem,” he said. “We’ve had a bunch of missions and we really feel like launch is, for us, just cranking the handle.”

Launch, though, may be less of a solved problem than a problem that Rocket Lab and others have to solve, one launch at a time. SN
Analysts have warned for some time that the smallsat market cannot support the dozens of companies currently developing small launch vehicles. The consensus is that only a handful will survive, and the U.S. government, particularly the Defense Department, will play a decisive role in selecting the ones that stay in business.

The Pentagon has already signaled its intent to support the industry, even if the means by which it’s sought to do so have invited controversy. Undersecretary of Defense for Acquisition and Sustainment Ellen Lord in April identified small launch as one of the sectors of the defense industrial base most adversely impacted by the coronavirus pandemic’s economic fallout.

The Pentagon in June announced its intent to award $116 million worth of contracts to six small launch providers using funds authorized under the Defense Production Act, a Cold War-era law intended to marshall domestic production during times of need. The Trump administration invoked the Defense Production Act (DPA) in April to ramp up production of medical equipment to combat the pandemic. The law also gives the Pentagon leeway to invest in domestic industries it considers critical to national security.

However, the small launch contracts were withdrawn in July amid an uproar over...
how the recipients were selected, something that the Pentagon never explained. The Air Force’s top procurement official, Will Roper, said DoD decided to reallocate the funds to other priorities and that the small launch contracts would have to wait until funding became available.

Janice Starzyk, vice president of commercial space at the market research firm Bryce Space and Technology, told SpaceNews that the DPA small launch affair was “bizarre, to say the least.”

The process and criteria for the selection of the six companies — Aevum, Astra, X-Bow, Rocket Lab, Space Vector and VOX Space — remains a mystery, Starzyk said.

Chuck Beames, chairman of the SmallSat Alliance, an trade group that counts several of those launch providers among its members, said DoD wants to support the industry but unfortunately mishandled the DPA contracts.

“I think they messed up,” Beames said during a recent Mitchell Institute webinar. The contracts, he said, should have been competed so the selection process would have been more transparent.

Fred Kennedy, vice president of future missions at Astra, one of the six originally selected for a DPA contract, agreed that DoD had noble intentions but failed at the implementation.

“It’s one thing to say you want to help the industry and it’s another to actually do it in the appropriate process,” Kennedy told SpaceNews. “Do we think DoD wants to help the industry? We’ll believe it when we see it.”

Mandy Vaughn, president of VOX Space, another company picked for a DPA award, said the Pentagon sent “mixed signals” to the industry by saying it wants to help and then rescinding the contracts. Doing so, she said during a virtual forum hosted by the Center for Strategic and International Studies, showed “a little bit of discombobulation.”

**NASA JOINS THE FRAY**

The Defense Department is not the only government agency shaping the small launch vehicle industry. NASA is playing a supporting role with a new launch procurement.

NASA released in early July a draft request for proposals for its Venture Class Launch Service (VCLS) Demonstration 2 program, seeking proposals for launches of clusters of small satellites. A final version is slated for release at the end of July, with proposals due by late August.

VCLS Demo 2 is a revival of the agency’s original VCLS program, which NASA started in 2015 to help promote development of small launch vehicles. It awarded contracts to Firefly Space, Rocket Lab and Virgin Galactic in 2015 for one launch from each company.

The results of that program are mixed. Rocket Lab performed its VCLS mission in December 2018, successfully launching 10 cubesats for NASA’s CubeSat Launch Initiative program and three more for other customers. Virgin Orbit, the smallsat launch company spun out of Virgin Galactic, plans to carry out its VCLS mission shortly after its LauncherOne enters commercial service. But Firefly Space lost its VCLS award in 2016 as it filed for bankruptcy, emerging in 2017 as Firefly Aerospace.

The VCLS Demo 2 program looks to take advantage of an expanding small launch vehicle industry. One of the objectives of the program, besides the actual launch of satellites, is to “allow NASA to understand the new launch industry’s commercial practices for future mission planning,” according to the draft request.

The request outlines two separate missions. The first would be a dedicated launch of 50 kilograms of cubesats into a mid-inclination orbit. The second would deploy two separate constellations of cubesats, one weighing 75 kilograms and the other 20 kilograms, into sun-synchronous orbits.

NASA expects the winning companies to perform the launches by June 2022. Unlike the original VCLS awards, though, which had no real penalties for delays, the Demo 2 program will require companies to perform free “consideration flights” of satellites if they miss the deadline, starting with a three-unit cubesat and growing to as many as 12 units of cubesats depending on the length of the delay.

NASA hasn’t identified what satellites it plans to fly on those missions, or why it chose that particular combination of payload masses and orbits. An industry day in early July, though, attracted about two dozen companies, including small launch vehicle developers as well as larger companies like Northrop Grumman and SpaceX.

NASA’s requirements may differ from what the Pentagon wants, which could force companies to make decisions on which government markets to pursue. Kennedy said that such conflicts are inevitable, although “there’s probably more overlap than not” between NASA and the Pentagon when it comes to small launch.

“Will the private sector be kind of pushed and pulled by various signals from civil or defense, or their own customer bases? Absolutely,” he said.

**SMALL LAUNCHERS STRUGGLE TO FIND A MARKET FOOTHOLD**

Some analysts say government agencies must support small launch developers because there isn’t enough demand from the private sector alone.

“Small launch capability is important to the government and has become more of a national security asset,” Starzyk said. “They...
cannot count on the commercial market supporting these companies. They have to know that without the government as an anchor tenant these companies won’t survive.”

A rush of private investment into the small launch industry in recent years was fueled by the belief that there would be both significant commercial and government demand, she noted. But Starzyk argued that circumstances have changed. “There’s no commercial market that is going to support multiple small launchers by any means.”

The most disruptive event has been SpaceX offering rideshare services at a cadence and price point that small launch providers could not possibly compete against, she said.

A key selling point for small launchers is that it give satellite operators more control over orbit and schedules compared to secondary payload opportunities that traditionally have been few and far between. “That advantage is wiped out by SpaceX offering flights every two weeks,” she added. “SpaceX answers most of the wants of the smallsat community. So where is the value added of the small launch on the commercial side?”

Roper said the thinking inside DoD is that the small launch industry needs government support because the commercial market is uncertain. “I’m very aware that this market is early to need,” he said. “It’s here anticipating the very large proliferated LEO [low Earth orbit] constellations,” Roper added. “Small launch providers will be the ones putting up satellites in small quantities to deal with attrition.”

But until those large constellations materialize, “how the government interacts with the small launch sector will have a huge bearing on how the market evolves,” Roper said.

Both government and commercial megaconstellations, though, are unlikely to use small launchers for initial deployment, opting instead to use larger rockets to launch them in big batches. “It’s a lot cheaper for them to launch dozens of spares than it is to buy a small launcher and put up one,” said Chris Quilty of Quilty Analytics.

He said he does not see a large demand for commercial small launch other than perhaps a handful of operators building remote sensing or device-connectivity constellations that generally require fewer satellites than broadband systems. “There might be opportunities down the road to selectively launch a satellite here or there.”

WHY THE GOVERNMENT IS STEPPING IN

The Defense Advanced Research Projects Agency sponsored a competition in 2018 offering prizes for responsive launch systems that could get satellites to orbit quickly and inexpensively.

“I thought the DARPA Challenge was important then because I believe there’s a significant role for responsive launch,” said Kennedy, who established the competition as director of DARPA’s Tactical Technology Office. Responsive launch is going to be “critical to the national security space architecture that I believe is going to have a significant amount of small, inexpensive satellites.”

“And responsiveness is sort of inversely proportional to size and complexity,” he said. “What is most likely to be launched responsively are small things on small rockets.”

Rocket Lab so far is the only new U.S. small launch provider that has deployed satellites to orbit but DoD will need more than one supplier, Kennedy said. “We probably want a more resilient launch industry than just one or two.”

Kennedy said the industry is healthier when it has a mix of government and commercial work. DoD can be a customer and still “steer the industry just a little bit” because it has specific requirements that commercial operators do not.

Government support can also make it easier for launch companies to attract private investors, Quilty said. “Government funding incentivizes investors to follow up with an additional equity round.”

Even government support, from the Defense Department or NASA, won’t prevent a long-awaited winnowing of the market, with a few launch providers emerging from the dozens of contenders today. The question is how many will make it.

VOX Space’s Vaughn agrees with analysts who predict a major shakeout in the industry, “but I don’t believe it’s necessarily a bubble where nobody succeeds,” she said.

There will be mergers, acquisitions and “some contraction,” she predicted. While there is military utility for small launch, “there is no room for 100 competitors.”

“I’m very aware that this market is early to need. It’s here anticipating the very large proliferated LEO constellations.”

Will Roper, U.S. Air Force assistant secretary for acquisition, technology and logistics
AIMING SMALL FOR ALCANTARA

After a string of canceled launch programs, Brazil is pinning its hopes on the small launch vehicle operator sector to bring life to its Alcantara Launch Center.

Brazil looks abroad for small rockets seeking a little extra boost

Can Brazil draw small launch vehicle operators to Alcantara? Its space agency thinks so.

For about three decades, Brazil has sought to draw international launch companies to the Alcantara Launch Center, a spaceport with an ideal coastal location but no successful orbital launches to show for it.

The Alcantara Launch Center is 300 kilometers closer to the equator than any active spaceport, meaning rockets launched into equatorial orbits from there would get an extra boost compared to Cape Canaveral or even the Guiana Space Center.

The Brazilian spaceport has an area for sounding rockets, a runway for air-launched vehicles and two finished launchpads. One of the pads can support rockets weighing up to 10,000 kilograms — a little less than the liftoff mass of Rocket Lab’s operational Electron rocket. The other launchpad can handle rockets up to 50,000 kilograms — not quite enough for the advertised mass of Firefly’s still-in-development Alpha rocket. Alcantara also has a third, unfinished pad where Brazil and Ukraine once planned to launch the hypergolic-fueled Cyclone-4 rocket before ending their partnership in 2015.

Brazil built Alcantara in the 1980s for the development and operations of the solid-fueled VLS rocket, but the long-struggling program suffered a string of failures and never regained traction after a 2003 pre-launch explosion killed 21 people. The VLS program formally ended in 2016.

In tandem with the VLS development
effort, Brazil sought to launch Ukrainian-built Cyclone-4 rockets from Alcantara, but that decade-plus endeavor ended after a litany of financial, technical and political challenges. Among them was growing doubt about the medium-lift rocket’s market viability. Cyclone-4 was designed to lift around 1,600 kilograms to geostationary transfer orbit — too little to support the heavy communications satellites typically launched to that orbit — or 5,200 kilograms to low Earth orbit, far more than most dedicated LEO missions.

Brazilian Space Agency President Carlos Augusto Teixeira de Moura says the agency is now focused on attracting small launch vehicles to Alcantara, which it views as having a greater chance of financial success. In November, a mix of seven launch, mission operations and satellite communications companies visited Alcantara through a trip arranged by U.S.-based trade association CompTIA’s Space Enterprise Council.

Moura said that among interested companies is Virgin Orbit, which confirmed to SpaceNews that Alcantara is on the list of potential expansion sites for its LauncherOne system.

“In the case of Brazil, we’re seeing some promising features where air-launch can enable access to literally any inclination and with a fairly turnkey approach,” said John Fuller, Virgin Orbit’s director of advanced concepts.

On the political front, Brazil signed a technology safeguards agreement with the United States in March to streamline the regulatory process for American companies to launch from Alcantara, and is willing to do the same for other countries, he said.

Alcantara isn’t exactly move-in ready for all rockets. The launch center wasn’t built to support liquid-fueled launchers, a point Moura readily acknowledges. Until there’s enough launch activity to justify the required infrastructure investments, liquid propellants could be brought in from nearby São Luís, he said.

The Brazilian Space Agency issued a public call May 25 for companies and organizations to apply for a launch license to use the Alcantara spaceport. Registrations were required by July 31, with initial proposals due Aug. 31 and final proposals Oct. 30.

Moura spoke with SpaceNews about the Brazilian Space Agency’s renewed effort to draw launch business to Alcantara. The interview has been edited for length and clarity.

What lessons did the Brazilian Space Agency learn from trying to commercialize the Cyclone-4 rocket with Ukraine?

We should go to the early 1990s when Ukraine had the capability to design and construct launchers but did not have a launch site. Brazil had a launch site without any vehicles, so we had a good idea: let’s join our capabilities and do some business.

The idea was good but we failed in some aspects. One of the main lessons is that we should focus on a market and then structure the whole process to be competitive. Now we believe micro- and nanosatellites could be successfully exploited by Alcantara. We could also be competitive with bigger satellites, but the micro- and nanosat niche should be first.

The second lesson concerns the initial share of responsibilities and the development of business plans suited to each of our capabilities. Some of the points not well clarified at the beginning between Brazil and Ukraine brought a lot of problems during the execution of the program. So we should take more care in the initial share of responsibility.

Third is the legal environment. As it occurs in other industries, the ecosystem should be stable. We should have a fertile ground to develop a business. Other space markets are moving with NewSpace and private actors. We believe that the Ukraine-Brazilian treaty signed in 2003 would not be feasible in 2020. We have a new market and new actors, so now anything we do should concern how the business could be sustainable, and then from that point of view derive the other details.

What conditions do companies have to meet to launch from Alcantara?

International companies will come to Brazil only if they really believe that we can be competitive.

Discussing with the U.S. Federal Aviation Administration, we found that the licensing process is a little bit awkward. It takes a long time and is difficult for a company to get all the approvals. We are trying to do here in Brazil something that is safe, of course, but possibly easier and faster.

The first step is to pass the inscription process, to present some very short information. The requirement is that a company have a resident in the country. That may be a legal representation, a joint venture, or even a Brazilian branch or subsidiary. It will be important that the representation have an ID number; in Brazil we call that a CNPJ, or National Registry of Legal Entities number.

Then the second step is to apply for an operator’s license. As a space agency, we should perform that activity.

The other part of the process will be done by the Brazilian Air Force. >
AIMING SMALL FOR ALCANTARA

They have the infrastructure and the means, so they will provide the technical and logistical support. The contracts should be discussed with the Air Force.

How much will companies have to pay to launch from Alcantara?
In this initial implementation phase we will perform a kind of soft open. The Brazilian Space Agency will take care of the licensing process and the companies will discuss the contracts with the Brazilian Air Force. According to our rules, the Brazilian Air Force cannot get profits from that, so what they will do is mainly discuss the cost of reimbursement. That is some good news.

Another advantage is, at the moment, the exchange rate between U.S. dollars and Brazilian reals is about 5-to-1.

After signing a technology safeguards agreement with the United States, will Brazil seek similar agreements with other governments, such as the European Union, India or China?
We believe the countries you mentioned will not require this kind of agreement with us, but our minister of science and technology has declared that he will personally consult other countries for a similar technology safeguards agreement. Every country can come to Brazil and we will respect and protect their technology.

Did Brazil’s close relationship with China’s space program factor into the need for a technology safeguards agreement with the United States?
The relationship with China continues on a normal basis even after signing the safeguard agreement with the U.S. — the same way the U.S. has technology safeguard agreements with Russia, Ukraine and other countries that [have] some different political postures.

How much new Brazilian investment has happened, or will happen, for Alcantara?
If we consider the long time Brazil has been working on Alcantara, we believe that we have spent some hundreds of millions of dollars. At the moment we are thinking about spending tens of millions of dollars more. For example, we are thinking about $15 million to have a very good airport. In energy, we are investing about $3 million. We believe if we invest something between $20 million to $40 million, the launch center would be in very good shape to support small launch.

If we do accept a company that would bring a medium- or a heavy-lift launcher to Alcantara, that would require hundreds of millions of dollars of investment, but in this case it will not be the Brazilian government that would pay for that. The company should invest its own resources.

Is your focus just on orbital launch, or also suborbital?
We believe we can have a mix.

If someone wanted to land a reusable rocket, like SpaceX does with Falcon 9’s first stage, could they do that at Alcantara?
Yes, that’s something we are telling to everybody. Let’s do good things, but not repeat what is already done everywhere. We can accommodate this kind of operation.

Can the spaceport support solid-fueled and liquid-fueled rockets?
So far, Alcantara provides just for solid-fueled rockets. It has a minimum infrastructure for satellites with small amounts of liquid fuels, but not for the launch vehicles. Plans are to have this capability in the future, since it was planned for Cyclone-4.

Many startups are designing rockets that burn kerosene or methane. What changes are needed for Alcantara to support these rockets?
For now we don’t have the infrastructure to support this kind of fuel and oxidizer, but Alcantara is near São Luís. They have about 1 million people there, so it’s a city with a large industrial sector. We can receive from that city all the propellants we need. But if we consider it a continuous operation, certainly it would require to install in Alcantara this kind of plant. I believe as soon as we have a larger demand, it would be very nice to have this kind of plant in Alcantara.

When do you hope to see a first launch from an international company in Alcantara?
I was planning to have that at the end of this year, but considering all the hurdles and this COVID-19 problem, I believe it would be more conservative to plan for 2021 as the first private launch from Alcantara.

Would the Brazilian Space Agency put its own payloads on an international rocket if it launched from Alcantara?
For the moment we are paying other countries to launch our satellites. Last year we launched a satellite (the China-Brazil Earth Resources Satellite 4A) with China. At the end of this year or the beginning of 2021, we will launch another Brazilian satellite. It’s an American company (Spaceflight Inc.) that won that contract, but it will be launched by the PSLV in India. I believe that it would be better if we could invest that money in Brazil. I believe that everyone would be very glad to know we could launch from our country. SN
The space sector is finally finding its way to the exits

The pace of space industry exits is picking up in the United States where private equity firms and holding companies are scooping up startups and enterprises established decades ago.

Already in 2020, private equity firm AE Industrial Partners acquired Adcole Maryland Aerospace and Deep Space Systems, engineering services and satellite component specialists it combined to form Redwire. Redwire then purchased Made In Space, an in-space manufacturing and assembly pioneer.

Amergent Technologies Holdings, part of Blackstone Tactical Opportunities, bought Raytheon Technologies’ space-based precision optics business, part of its Collins Aerospace unit. Amergent also acquired Tethers Unlimited, a company known for software-defined radios, in-space manufacturing and propulsion technology.

Voyager Space Holdings acquired Pioneer Astronautics, the aerospace research and development firm established by Robert Zubrin, Mars Society founder and president. It was Voyager’s second acquisition since it was founded in October 2019 by prominent space angel investor Dylan Taylor. The first was Altius Space Machines, a robotics and technology startup.

“These groups all see space as a long-term market, or they see that the rest of the world sees that,” said Ian Fichtenbaum, CEO of Bradford Space, part of the American Industrial Acquisition Corp. “There’s more interest in jumping in. That’s driving up equity values.”

For years space industry entrepreneurs and investors bemoaned the lack of exits, like initial public offerings and acquisitions that offered investors an opportunity to sell their stake in a company. Exits are now on the rise thanks to the spate of acquisitions and Virgin Galactic’s headline-grabbing IPO and reverse merger.

“Aerospace primes also are starting to realize that they need to innovate through acquisition,” said Meagan Crawford, managing partner for SpaceFund, a venture capital and private equity firm established in 2019 to back space startups. “That’s a positive trend. We need that exit activity to help make the case for space venture capital.”

The U.S. market alone racked up 11
Exits tend to occur when the economy is strong. However, the COVID-19 pandemic and recession are doing little to dampen enthusiasm among leaders of the companies shopping in the space sector.

“These are not restaurants or hotels or airlines,” Fichtenbaum said, citing some of the industries hit hardest by stay-at-home orders and social distancing rules aimed at limiting the spread of the coronavirus. “Our companies have been operating throughout. There’s been a little effect in terms of future program delays, but we are executing on all the current programs.”

Space investors say they are looking well beyond the current public health and economic crisis.

“For most exits which are driven by strategic acquisitions or traditional private equity, the near-term returns are important,” Taylor said by email. “Voyager, due to the fact that we are a purpose-built operating company and not an investment fund, is different as we have a longer time horizon.”

### SPACE ACQUISITIONS BY COUNTRY, 2009-2020

<table>
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<tr>
<th>Country</th>
<th>Number of Deals</th>
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<td>United States</td>
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### SPACE COMPANIES ACQUIRED AND YEAR THE DEAL WAS ANNOUNCED

After ups and downs, space company acquisitions around the world peaked in 2019 with 18 deals announced. With 2020 a little more than half over, nine deals have been completed.
for investment. We are less concerned about returns 12-24 months out and are more focused on value creation 5+ years in the future.”

Similarly, Redwire parent AE Industrial Partners, is looking further into the future.

“Our view is that space over the next decade will be a significant growth market,” said Kirk Konert, partner at AE Industrial Partners. “We want to find great businesses and teams to back in that sector.”

CONSOLIDATION AHEAD?

It’s unclear whether the recent wave of acquisitions will lead to significant consolidation.

“It’s just a different type of deal flow,” said Van Espahbodi, Starburst Aerospace co-founder and managing partner. “Rather than seeing hard venture cash going into big idea companies, we’re now seeing a different type of financial transaction that helps early-stage investors and gives these companies that have been around for some time the leg up to continue to grow.”

In some cases, private equity firms may combine subsystem suppliers to form “an integrated solution that becomes a more compelling business,” Espahbodi said. “That business can then become a viable acquisition for a larger company.”

In other cases, small space firms could be merged into vertically integrated businesses meant to stand on their own. That’s the approach favored by Max Polyakov, founder and CEO of Earth Observing System (EOS) and Noosphere Venture Partners managing partner.

Polyakov has a multi-decade plan for EOS that brings together launch vehicles, satellites, sensors, ground segments and data analytics.

“It’s a very expensive, long-term game,” Polyakov said. “In space, exits probably happen in 10 years, 20 years or maybe never. That does not mean you are not going to make money in space.”

THE IPO GAME

For years, venture capitalists saw IPOs as a promising exit strategy. While that worked for Virgin Galactic, few other space companies possess the name recognition and glamour of the suborbital tourism firm founded in 2004 by British billionaire and Virgin Group founder Richard Branson.

What’s more, “the IPO market has been very depressed in the last couple of years,” Crawford said. “IPOs have become very expensive and difficult to do.”

Still, investors muse privately about creating the type of company that could cash in on public interest in space.

“We have some ideas for how to play the IPO game,” said an investor who asked not to be identified. SN

**List of Companies**

- Exelis
- Coherent
- Navigation
- DOT Imaging
- InSync
- Software
- BlackBridge
- Geomatics
- Skywave
- TerraServer
- deCarta
- Rostock System Technik
- Advanced
- Computer
- Systems
- MITEQ
- Openwhere
- Assure Space
- Terra Bella
- Space/Ground
- System
- Solutions
- Garvey
- Spacecraft
- COM DEV
- International
- Wyle
- Laboratories
- Lin Industrial
- OmniEarth
- Noorsat
- Ultisat
- Sea Launch
- Digital Globe
- Honeybee
- Robotics
- Norsat
- International
- e2v
- Peraton
- ECAPS
- TellusLabs
- FeatureX
- NanoAvionics
- Planetary Resources
- Tryo
- Clyde Space
- Applied
- Defense
- Solutions
- Millenium
- Space Systems
- Amos
- Spacecom
- Globecom
- Neptec
- Orbital ATK
- Tencate
- Advanced
- Composites
- SEOPS
- CNIM Air Space
- Novawurks
- Jade Aerospace
- Deep Space Industries
- Stratolaunch
- Altius Space Machines
- PTScientists
- Nuvotronics
- Cobbett Hill
- Earth Station
- Glowlink Communications
- Technology
- Genscape
- Solers
- Hispasat
- Geosys
- Newtec
- Inmarsat
- Schafer
- Made In Space
- Collins
- Aerospace
- precision optics
- Spaceflight
- Inc.
- Deep Space Systems
- Sinclair
- Interplanetary
- Pioneer
- Astronautics
- Tethers
- Unlimited
- Dynetics
- Adcole
- Maryland
- Space

**source:** spacfund venture capital

**graphic:** robin mcdownall /spacenews
Airbus and OneWeb are looking beyond their original customer, the U.K. government, and U.S. government agencies as potential buyers for their in Florida is “absolutely our intent and our plan,” says Airbus U.S. Space Systems head Debra Facktor, who sits on the OneWeb Satellites board of directors. Facktor says the joint venture will be producing satellites for OneWeb as well as for other customers. She sees a growing demand for small, mass-produced spacecraft of the type made at OneWeb Satellites, especially from U.S. government agencies.

OneWeb Satellites, a joint venture of Airbus and OneWeb, inaugurated its $85 million factory in Florida last July with plans to produce hundreds or thousands of low Earth orbit satellites for OneWeb’s broadband megaconstellation at the rate of two per day.

A year later, OneWeb Satellites’ part-owner and main customer has entered bankruptcy protection and last month sold itself at auction to the U.K. government and India’s largest private telecommunications operator. Airbus, which owns 50% of OneWeb Satellites, says the Florida factory remains open for business and is preparing to ramp up production of eight satellites a week later this year.

Continuing to manufacture satellites in Florida is “absolutely our intent and our plan,” says Airbus U.S. Space Systems head Debra Facktor, who sits on the OneWeb Satellites board of directors.

Facktor says the joint venture will be producing satellites for OneWeb as well as for other customers. She sees a growing demand for small, mass-produced spacecraft of the type made at OneWeb Satellites, especially from U.S. government agencies.
That actually provided financing to the joint venture to restart production and engagement with the supply chain so that the next batch gets ready. There is a lot of hardware at the facility, and there is a lot of work to be done.

Of course COVID-19 has had an impact. We have put all the safety procedures in place and operations have run at a lower level.

There is speculation that the U.K. government could move the production of OneWeb satellites to the United Kingdom. If that happened, what is the plan to keep the U.S. factory alive?

We are committed to the U.S. We are in the space market and we've invested in Florida, so keeping our Florida operations is absolutely our intent and our plan.

In terms of customers, we see opportunities in the U.S. government. We have a contract with the Defense Advanced Research Projects Agency for the Blackjack program. OneWeb Satellites is our subcontractor. We have been executing a phase 1 contract for engineering work. In addition, there is demand coming from the U.S. government for proliferated [low Earth orbit] constellations, starting with DARPA but also from the Space Development Agency, the Missile Defense Agency and the Space Force which is very interested in this mission.

We think there is a demand for taking our platform as a commodity bus and serving other defense missions, other commercial capabilities and the space science and exploration side, where NASA is increasingly looking at smaller buses. For their space science programs they are flying miniaturized payloads.

Having a bus that can be leveraged for multiple markets is compelling, and it takes advantage of the investment made to meet OneWeb’s needs. We have 74 spacecraft that the joint venture built for OneWeb that are up and operating. So getting more spacecraft into space means there’s more flight heritage and more experience and more opportunities. What I like is that we’re seeing demand.

Do you expect more satellite orders from OneWeb under its new ownership?

That’s the goal. We are getting ready to start ramping up now that the financing for OneWeb was approved by the bankruptcy court. The court on July 10 approved the acquisition of OneWeb by the U.K. government and Bharti Global.

Do you see the U.S. government becoming a major buyer of commoditized satellites to build LEO constellations?

A lot of the philosophy coming out of the U.S. government is that they want to leverage commercial capabilities and they also recognize that if they don’t use 100% the exact commercial model, they can adapt it for their unique purposes. So that is really where we’ve been focusing, showing you can adapt and that the interface that goes to the payload is secure. That’s a pretty important and unique capability.

These are some of the questions that are coming up at the space Development Agency and how they are going to...
build their constellations. It’s sensitive government work, but you also want to bring commercially funded technology. That’s an exciting opportunity.

Airbus U.S. operates under a Special Security Agreement that requires it be run by an independent board of directors that does not report to the parent company in France. Does the SSA impose restrictions on the use of technology developed outside the United States in classified space programs?

We can “reverse engineer” our products and rebuild them using U.S. intellectual property, software or components. We can essentially take the blueprint of a product and leverage our U.S. engineering team or trusted U.S. suppliers to build or recode it here in the U.S.

Our supplier ecosystem remains global and we are working with our suppliers to meet the U.S. government’s needs for their payloads and missions. We have a great supply chain in the U.S. supporting the joint venture and they’ve been great partners throughout COVID, throughout the restructuring process. As we move into new areas like national security programs, we work with our suppliers to make sure that all the conditions and security requirements are met.

What do you think are going to be the major challenges for Airbus working with DoD and the U.S. national security space community?

The first thing is going to be establishing a familiarity with the Airbus U.S. space and defense brand. Airbus has been in the U.S. for over 50 years and has a long history working with NASA in space exploration. And that was new to me before I joined the company. I wasn’t familiar with all the things that we already did.

There’s so much capability that is already in the U.S. so the challenging part is making that known to newer customers who don’t have all that background.

What really attracted me to the opportunity to come here was Airbus having that great history and heritage back in Europe with such a deep set of respected capabilities. There’s great trust in the brand, across defense, commercial and space exploration. The U.S. side of Airbus is super creative and entrepreneurial. With my background, having been in a couple of startups, I love that.
The United States is on the verge of a new space age. Despite civil unrest and the continuing pandemic, the future for space exploration and development looks bright. Provided we successfully navigate the legal and economic challenges, the benefits for humanity can be enormous.

Both the public and private sectors recently made bold moves. NASA announced the Artemis Accords, a series of agreements with other spacefaring nations to create shared procedures and standards for future space missions. Not long after, two NASA astronauts rode a SpaceX rocket into orbit, and aboard SpaceX’s Crew Dragon spacecraft, successfully reached the International Space Station. These events portend a new epoch of space exploration. But unlike the previous era, which was almost entirely government-driven, the era before us needs the entrepreneurial dynamism of for-profit companies. The public sector will set the vision. The private sector will achieve it.

Yet there are significant difficulties. One of the largest hurdles is coming up with a set of legal rules for governing behavior in outer space. Especially as investors consider lucrative celestial activities like asteroid mining, we need to answer the question: who owns what in space?

The issue of celestial property rights is tricky. The foundational document in public international space law, the 1967 Outer Space Treaty, is silent on the question of property rights. Ratified by the spacefaring nations at the height of the Cold War, it makes sense that the treaty envisioned nation-states as the primary agents in space, which partly explains its omission of property rights. The closest it comes is Article II. The Article reads: “Outer space, including the moon and...”
other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”

Every major spacefaring nation signed the Outer Space Treaty. Breaking it would have huge repercussions. Given this, appropriating territory and extending legal jurisdiction to, say, the moon is foolish. But what then of property rights? Don’t we need legal jurisdiction for governments to define and enforce ownership?

To start, it’s not the case that absence of legal jurisdiction means courts can’t enforce property rights. If two U.S. entities have a business dispute while operating in Germany, a U.S. court can hear the dispute without the U.S. asserting jurisdiction over Germany. This is why several national efforts to improve property rights protection, such as the 2015 SPACE Act, do not necessarily violate Article II.

But there’s another, more radical solution. Consider an analogous case to celestial property rights that has a long terrestrial history: international commerce. Modern international trade is largely privately governed. There is no international super-sovereign, after all: if traders have a dispute, their only recourse is arbitration. Yet international commerce works quite well, and the majority of it is based on a self-enforcing body of private law dating back to the High Middle Ages.

Celestial capitalists have the same option. Private actors, such as asteroid miners, can form their own agreements about owning and trading outer space resources. These agreements can ground a self-enforcing body of commercial space law, with private arbitration to resolve disputes, in exactly the same way as private contracts and arbitration agreements work for international commercial law.

As on Earth, so in space: private actors pursuing private interests can overcome many of the difficulties associated with celestial property rights, creating enormous wealth for humanity in the process. But this doesn’t mean the public sector should recede. On the contrary: governments have a crucial role to play in facilitating international cooperation, further creating and clarifying public international space law. They should also police their own nationals in space, making clear that excessively broad ownership claims by whoever first lands on an asteroid or planet will not be tolerated. Finally, there are many near-to-Earth problems, such as orbital debris, that probably cannot be addressed without intelligent government action.

Nevertheless, the playing field has changed. Governments previously were the key players in space. In the near future those players will be private actors, with governments becoming referees. This should be celebrated, not feared. Commerce will be the engine that propels us into the final frontier. Human enrichment and mass flourishing will be the result.

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The pandemic of 2020 has brought great loss and suffering, assuredly impacting every human life on the planet in one way or another. While a number of countries appeared to have the virus under control, we are now seeing second surges of cases and can expect to realize the full impact of COVID-19 for many years to come.

To learn and grow from this, we must continue to question and study the factors that made the virus so deadly and difficult to contain. In addition to better preparing us for the next pandemic, or teaching us how to prevent it altogether, this reflection also reveals lessons we can apply to other issues we face as a collective society.

Already we have seen numerous comparisons of the spread of the virus to other global crises such as climate change — the growing issue of space debris also has some significant parallels worth exploring.

While most of us are not epidemiologists, the quarantine period likely provided ample opportunity (for those of us fortunate enough to have avoided the symptoms) to read countless articles educating us about R0, the effectiveness of masks, and of course, the frightening reality of exponential growth. While new data continued to roll in during the early months of the pandemic and countries applied different policies with varying results, the most decisive factor in beating the virus proved to be taking holistic action and doing so quickly.

If there is one take-away about exponential growth, it is that once it starts, it is extremely hard to contain — and this is our first lesson:
1. Take preventive measures before the growth rate becomes problematic.

Of course, while this seems pain-fully obvious, we have just witnessed firsthand how this principle invokes a paradox in policy implementation. If the problem doesn’t appear to be out of control, then why take action that comes with certain and severe economic impact? Luckily, seeing the future doesn’t require a crystal ball — it simply requires a respect for science and an understanding of the usefulness of simulations.

Any model that simulated the spread of COVID-19 indicated a grim future if no actions were taken, and yet we still saw resistance to implementing safety measures. Will space suffer the same outcome? Many researchers have painted worrying images of the LEO environment which could result from our current trajectory of leaving defunct satellites in orbit. The emergence of more large constellations has also inspired countless variations of the studies and, fortunately, some forward-leaning regulatory action. However, we still see lagging investment in space sustainability and a reluctance to take holistic measures as an industry. Should we not have the equivalent of pandemic response teams and ventilators at the ready?

Part of the issue perhaps, is a skepticism toward current models out there, which brings us to our next lesson:

2. All models are wrong, but some are useful.

This famous phrase is not meant to cast any doubt on simulation work being done; rather it is meant to do the opposite. We must recognize that not only do input parameters never match reality, but researchers often risk back-lash and loss of credibility if pessimistic assumptions or conclusions are singled out and attacked. COVID-19 certainly demonstrated this dynamic in spades. We may expect the space industry to show more respect for appropriate amounts of conservatism, but we are not without our own competitive and capitalistic motivations. In almost all cases, a sustainable tomorrow means additional expense today, which can be a hard pill to swallow (but the key is in understanding that these expenses are actually investments, much like wearing a face mask).

One example of unrealistic optimism in many long-term debris studies is that a single, simulated constellation will operate for a finite time, then one day decommission all of its satellites. The simulation may show that during the operation of said constellation, the environment was negatively impacted, but 150 years later, things are mostly back to normal. One could then conclude that the constellation has a negligible long-term effect on the space environment, and is thus sustainable.

The problem with this model is that it assumes we won’t continue to increase the number of satellites in space, and so the “long-term” analysis paints a positive picture of a false future. We cannot overlook the current growth of the steady state environment we are creating for ourselves right now. Is it safe and sustainable? Does it foster investment and innovation? Or does it look increasingly risky and expensive for everyone involved?

In a bit of a silver lining, the pandemic proved that reducing personal travel and vehicle use results in cleaner air and a healthier ecosystem overall. It is a bit more difficult, however, to take satellites out of the sky for a few centuries while LEO clears itself up. We must therefore invest in space sustainability simultaneously with space development, not after the fact. Unfortunately, this means we have some catching up to do.

Though, in more good news, many operators and institutions are currently engaging in discussions regarding the best practices that will reverse some of the historical damage and ensure a better future. One of these notions, which seems particularly apt this year, is also becoming harder and harder to abide by. It is also our third lesson:
3. Social distancing and self-isolation work.

If the reader would excuse the insensitivity of the forthcoming analogy, a catastrophic collision in space that causes new space debris can be likened to a cough from an infected person. Anyone near the cougher is at an increased risk of being hit by particles which could then infect that bystander, eventually causing them to become sick and cough themselves. This chain reaction (remember R0) is exacerbated in populations of people in close proximity, such as those in large cities.

Those of you familiar with space debris discussions probably know where this analogy is going: the dreaded Kessler Syndrome, a chain reaction of space debris events catalyzed by dense deployments of satellites in space.

As we have learned, the R0 factor is decreased by keeping our distance from one another. Constellation operators have recognized this as well, and in some cases have even altered their plans to deploy away from other constellations. OneWeb even named this concept a "safety buffer zone." LEO is not infinite, however, and sooner or later this satellite social distancing will cease to be possible. Policymakers such as the U.S. Federal Communications Commission recognize this impending issue, but so far have declined to adopt any rules regarding orbital separation. Of course, it is notoriously difficult to tell the difference between too soon and too late when it comes to implementing new policies.

Space is big, yes, but the region in which most satellites operate is limited. We cannot deny that our orbital environment is steadily becoming more crowded. So, what will we do when we can no longer rely on separation for safety? There are many strategies to consider but, to again reference our pandemic lessons-learned, we know that self-isolation is one of the most effective ways to mitigate the risk. A "sick" or broken satellite that cannot move itself to avoid collisions presents a potential debris risk to the others around it. The best way to reduce its risk is to self-isolate, which in GEO means moving to a graveyard orbit, and in LEO means reentering the atmosphere as quickly as possible. Removing potential sources of new space debris will always be one of the most direct and effective ways to ensure a sustainable space environment.

To close this off, we’ll explore a final lesson that we really hope wouldn’t be true for the space industry, but alas we are not there yet.

4. Without regulation, we cannot expect others to consider more than their own immediate self-interest.

Historically, humanity has not been good at taking proactive measures to solve problems. However, we repeatedly see that sustainability is not only good for humanity’s future, it is also good for business. Even if the tangible return on an investment in sustainability is not immediately apparent to everyone, taking steps toward that goal will yield long-term rewards, both financial and environmental. The difficulty, however, is that this knowledge is in constant conflict with the parts of human nature that make us want what we want, when we want it — whether that’s getting a haircut, going to the beach, or launching thousands of new objects into orbit — with minimal appreciation of the risks and long-term consequences. Let’s not wait until the orbital pandemic hits before taking action. The time to take preventive action is now.

Mike Lindsay is Chief Technology Officer at Astroscale. He previously worked for OneWeb, NASA and Google.
The U.S. military wants timely intelligence from space to be as fast and easy to obtain as hailing an Uber ride.

That is the thinking behind a Space Force plan to connect military, commercial and allied satellites into a hybrid space architecture.

The problem today is the latency of information. Data collected by satellites is not easily or quickly obtainable by troops in the field. It can take hours or days, for example, to get images from national security satellites. That's no help for battlefield commanders who are trying to locate a moving armored vehicle on the ground. They need far more timely intelligence.

There are a variety of commercial remote sensing systems in low Earth orbit that can deliver pictures faster, although they may not be as detailed or as cyber-secure as the ones provided by the intelligence community’s satellites.

The ideal scenario would be to have a mix of sources of space data readily available, says David Voss, chief of the U.S. Space Force Future Technologies Division.

Voss is leading an effort to build a hybrid space architecture that would connect traditional platforms, commercial and allied satellites into a network that would be accessed from a common platform.

In a video presentation posted on YouTube, Voss says the idea is to bring multiple sources of data into an architecture so users can decide what best meets their needs. Then the system would automatically determine how best to meet those demands. If timeliness is the priority, the system would task a small satellite in LEO. If high resolution is what matters more, even if it takes longer, the system would request pictures from a more sophisticated government satellite.

He compares this approach to the way Uber and Lyft rideshare apps manage transportation resources. Customers can decide if they would rather wait longer for a ride to get the specific kind or size car they want. Or they can trade off some demands in order to get a faster ride. Users can also decide if they want to pay more to get their own ride or less if they share it with others.

These are the types of decisions and trade-offs that users of satellite imagery would have to make too, says Voss.

Before taking over as head of the Space Force technology office, Voss spent a decade working on small satellite architectures at the Air Force Research Laboratory. AFRL over the years has demonstrated concepts for hybrid architectures that combine commercial and government assets. Now the challenge is to turn the idea into an operational system that forces in the field can use.

There is an opportunity here for the military to tap into newly developed commercial remote sensing constellations to supplement the traditional military and intelligence community space assets, says Voss. "Simply having more satellite systems in an architecture cuts the average time for a taskable satellite to be in the needed position."

It is too soon to tell how or when this plan might come to fruition. The Space Force and other DoD organizations have been studying hybrid space systems for a long time. But attempts to build hybrid space architectures tend to be derailed by bureaucratic firewalls and technical obstacles.

Voss says the Space Force will keep pushing to realize this vision. "We want to provide better, faster and smarter access to information for the warfighter," he says.

Rideshare apps like Uber and Lyft created a platform that linked millions of drivers with passengers by interconnecting networks and developing the necessary software. Someone needs to successfully apply that same concept to satellites in space. SN
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Every recent presidential administration has put its stamp on space policy through a formal national space policy document. Sometimes that comes fairly early in an administration, like President Obama did with his policy that was released less than a year and a half after taking office. By contrast, President George W. Bush waited until nearly halfway through his second term to release his space policy.

As its first term nears its end, the Trump administration has yet to issue its own national space policy, despite a wave of more specific space policy documents on everything from space traffic management to the Space Force. Perhaps the closest it’s come so far to an overarching policy is the release of a National Space Council report July 23 on space exploration and development.

That topic is usually associated primarily, if not exclusively, with NASA, but the report made the case that space exploration and development is a governmentwide responsibility. “Although NASA is, and will remain, the leader for U.S. government space exploration efforts, other departments and agencies will have increasingly important roles in space,” it states.

“A lot of people aren’t aware of how our approach on space was not just about NASA, was not just about Space Force,” said a senior administration official, speaking on background about the report. “It actually is an approach that we’re looking at across the government.”

The report itself doesn’t set any new policies. Instead, it outlines the ongoing efforts to increase commercial activities in low Earth orbit, send humans back to the moon and, ultimately, on to Mars. While NASA is leading those efforts, the report explains how a “whole-of-government approach” is needed to achieve them.

That approach, the report argues, goes beyond just developing the rockets and spacecraft needed for missions to the moon and Mars. It outlines several roles for various government agencies to support that approach. One is a “secure and predictable space environment” that incorporates elements of Space Policy Directives 2 and 3 on regulatory reform and space traffic management, efforts led by the Commerce and Transportation Departments, not NASA.

Other roles include assisting development of commercial activities and industry in space, supporting research and development, and assisting the creation of private space infrastructure by “being a reliable customer.” All assume a wide range of government agencies will be involved.

To illustrate that, the report included appendices outlining current and proposed programs supporting space exploration and development, organized by agency. NASA had by far the most, but there were entries for many other agencies, including less obvious ones like the Interior Department, whose U.S. Geological Survey has a planetary geologic mapping program, and the State Department, which is assisting NASA on the Artemis Accords and related international agreements. Even the Pentagon and Department of Homeland Security are mentioned for technology development and cybersecurity work.

“It’s not a binding policy document, but it’s something that indicates an exploration rationale for our priorities as we go forward,” that official said, adding it may be particularly useful explaining the administration’s approach with prospective international partners.

The report isn’t a replacement for a national space policy, and leaves out a lot of the national security and other issues such a policy would contain. It does, though, illustrate how agencies would work together to achieve broader goals, at least in theory.

As for a formal national space policy, that’s still reportedly in development at the White House, although given a lower priority because of the ongoing pandemic. The goal is to have that policy completed by the end of the year — which might be just in time, depending on the outcome of the election. Until then, this document offers perhaps the most coordinated view yet on civil and commercial space policy, one that might be worth retaining regardless of who is in the White House next year.
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