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Tuesday **SPACENEWS** **SHOW DAILY**



EXCLUSIVE INTERVIEW

ESA working on human spaceflight scenarios for European space summit

The European Space Agency is preparing for a space summit this fall to win support for a new human spaceflight initiative as well as a new launch strategy.

In an April 17 interview, Josef Aschbacher, ESA director general, said the agency is working on developing plans to present to ESA and European Union member states at the second European space summit, scheduled for November in Seville, Spain.

ESA will seek to win political support, although not funding, for future human spaceflight programs as recommended by a high-level advisory group in a report released March 23. That report, "Revolution Space," called on Europe to embark on an ambitious effort to develop its own human spaceflight capabilities, including launching astronauts to low Earth orbit and even the moon.

"It's really a political summit on the way forward for Europe and what ESA should be doing to implement it," Aschbacher said. "I expect a political decision on the European approach to human and robotic spaceflight."

To prepare for the summit, he said ESA is working on "use cases" for European human spaceflight infrastructure in orbit and on the moon. That will lead to scenarios for



European Space Agency Director General Josef Aschbacher hopes to win support this fall for a new human spaceflight strategy.

implementing those use cases, including high-level architectures and cost estimates.

"We will develop scenarios for the decision-makers, and they will tell us, based on those scenarios, what they want us to do and how they want us to proceed," he said.

That political decision will not immediately provide funding for ESA to implement those scenarios, but guide planning ahead of ESA's

next ministerial council meeting in late 2025, where member states will commit to funding specific programs, including potential human spaceflight initiatives.

"There is a lot of work that will need to be done" ahead of the 2025 ministerial council meeting, or CM25, he said. ESA does have >

SEE ESA CHIEF, PAGE 4

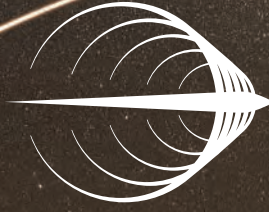
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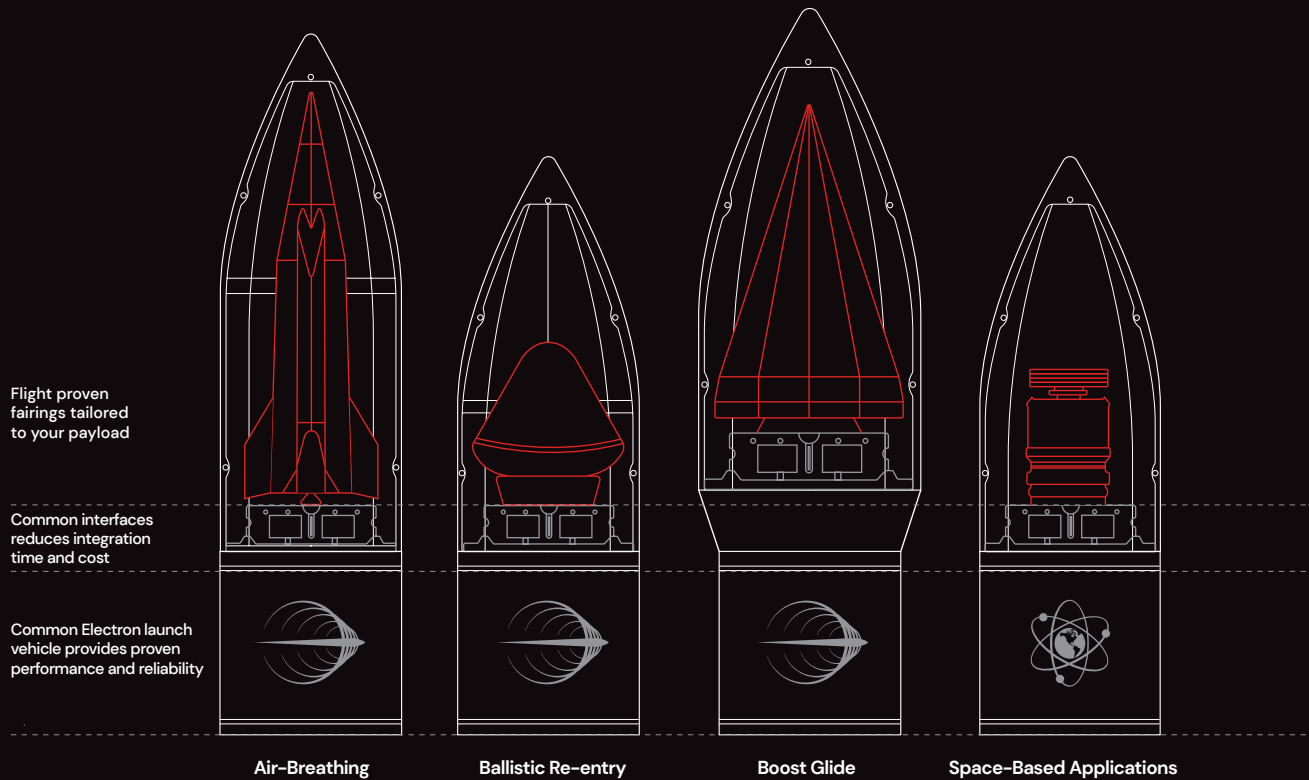


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A NASA artist concept of the lunar Gateway with an Orion crew capsule docked.

NASA to release Artemis architecture details

NASA will release more details this week on its architecture for returning humans to the moon, illustrating how the design choices the agency made fit into its broader plans to go to Mars.

The architecture, developed by the agency over the last several months and scheduled to be unveiled this week at the 38th Space Symposium, will describe in more detail the next several Artemis missions to the moon and how they support overall efforts for both sustainable lunar exploration and future human missions to Mars.

Free said at an April 17 briefing that the architecture is not influenced by what other countries are doing, such as China's plans for a lunar base developed in cooperation with Russia. "My job is to make sure we have a plan that gets us to the moon as quickly as possible and as safely as possible," he said. "If

I take my eye off doing that and worry about what another country is doing, I feel like I'm not doing justice to the people who are going to ride on the vehicles."

The architecture is based on the 63 objectives for lunar and Martian exploration released by NASA in September, an updated version of 50 objectives the agency rolled out four months earlier. Those objectives cover goals in science, transportation, infrastructure and operations for moon and Mars missions.

"We broke down the objectives that are tied to human lunar return into characteristics, needs, use cases, functions and requirements," Jim Free, NASA associate administrator for exploration systems development, said in a recent interview. "We've connected the big picture agency strategy to these near-term missions."

That architecture will focus on the initial segment of NASA's long-term plans, covering Artemis 2 through Artemis 5. That includes

the first human mission to the vicinity of the moon in more than 50 years with Artemis 2 in late 2024, followed by the first human landing since Apollo 17 with Artemis 3 at the end of 2025.

The following missions, Artemis 4 and 5, involve both human lunar landings as well as the buildup of the Gateway and delivery of a lunar rover. That architecture effectively takes NASA's human exploration plans through the end of the decade, with Artemis 4 currently scheduled for late 2028 and Artemis 5 in late 2029.

"In our documentation, you'll actually be able to see in the appendices the breakdowns from objectives to specific parts of the mission and elements of the architecture," Free said.

The architecture, he said, will include some white papers that will offer additional explanations about how key elements of the architecture, like the Gateway and the use of the near-rectilinear halo orbit around the moon, support those objectives. "We're not hiding behind saying we did it, we're trying to show our work," he said.

While Free didn't describe the contents of the architecture, he said he was pleased with the outcome because of how it unified the agency. "Connecting strategy to implementation with the buy-in of the entire agency is something I've never seen done before," he said. "I think we established we can bring the agency together."

Implementing that strategy will be a job for the new Moon to Mars Program Office, established by NASA in late March after Congress directed the agency to do so in an authorization act last year. That includes ensuring those missions continue to support those long-term objectives.

"One of the things we were charged with in the Moon to Mars office was to make sure that the tech developments and the mission modes we're picking were commensurate with potential future Mars-grade activities," said Amit Kshatriya, director of the office, citing work on closed-loop life support as one example of that work.

Free said work has already started on a second round of the architecture concept review, which NASA plans to conduct annually. This new round, to be completed later this year, will examine some of the longer-term Artemis missions. **SN**

Orbit Fab tops off the tank with \$28 million Series A

Orbit Fab, a startup developing in-space satellite refueling services, has raised \$28.5 million to accelerate work on its first missions.

The Colorado-based company announced the Series A funding round April 17 led by 8090 Industries. Others participating in the round include Stride Capital, Industrious Ventures, Lockheed Martin Ventures, Tribe Capital, Good Growth Capital and Massive Capital Partners.

Orbit Fab will use the funding to accelerate work on its first missions to provide satellite refueling services. It will also ramp up production of its RAFTI port for spacecraft, which is designed to enable on-orbit refueling.

“This is going to let us accelerate the deployment of refueling systems,” Daniel Faber, chief executive of Orbit Fab, said in an interview. “This is what the Series A is about. We’ve seen demand. We have four launches booked, and we need to keep up with that.”

Orbit Fab announced in October that 8090 Industries had invested, but the company declined at the time to specify the size of the investment. Faber said that investment was

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part of this Series A round. 8090 Industries invests in “category-leading industrial giants of tomorrow” and is affiliated with the Ozmen family that founded Sierra Nevada Corporation and its space spinoff, Sierra Space.

“We’re excited about the experience they have with industrial companies, and that’s where we see Orbit Fab,” he said. “Their experience of building a company of the scale that we want to build here is super important to us.”

That view is shared by Orbit Fab’s investors. “The emerging space economy cannot grow without adequate refueling infrastructure. Orbit Fab is now executing on a compelling business model to provide mission critical refueling gasses in space,” said Steve Angel, chairman of industrial gas company Linde plc and an advisor at Industrious Ventures, in a statement.

Faber described the Series A as an “up round,” or one that increased the overall valuation of the company, which is now at just over \$100 million.

In addition to the Series A funding, Orbit Fab has secured contracts with military organizations including the Defense Innovation Unit and SpaceWERX, the innovation arm of the Space

Force, worth \$21 million for three missions to demonstrate proximity operations and to refuel spacecraft. The first of those missions scheduled to launch in early 2024. Orbit Fab also has a contract with Astroscale to refuel its Life Extension In-Orbit (LEXI) servicing spacecraft in geostationary orbit.

Demand for refueling is primarily for hydrazine and xenon, the most common fuels for chemical and electric propulsion systems, respectively, Faber said. There is also some interest in non-toxic “green” propellants, particularly in Europe where hydrazine is being phased out.

To meet the growing demand, Orbit Fab has doubled its workforce to 60 employees in the last year, and plans to hire 25 more with the new funding. Most of those employees are in its Colorado headquarters, with a small office in the United Kingdom.

There is a growing interest in satellite refueling, which Faber likened to reusable launch. “If you’ve got a rocket company and your rockets aren’t reusable, you’re not in the game,” he said. “The same is going to become true for satellites. If you have a satellite and you can’t extend its mission or move in a dynamic way in orbit, you’re as good as gone.”

“Fundamentally, our business isn’t too complicated: we build fuel, we launch fuel, we sell fuel,” he said. “We want to become the industrial gas supplier in orbit. Orbit Fab is effectively the Linde of space.” **SN**

ESA CHIEF, FROM PAGE 1

< > a small amount of funding available to support that planning. “With moderate investments, you can prepare well. CM25 will be a key milestone.”

Aschbacher said he was pleasantly surprised by the Revolution Space report. The advisory group consisted almost entirely of people without space industry experience, ranging from a former NATO secretary general to an artist. “They really developed a very clear picture,” he said, of where Europe stood in human spaceflight and what it should do. “It was very surprising for me — a very positive surprise — that this comes out in the report in clear, strong language.”

“Europe cannot stay out of this,” he said of human spaceflight. “Quite the opposite: Europe has to reinforce its effort and be very bold in engaging in this.”

LAUNCH STRATEGY

The space summit will cover issues in addition to human spaceflight, such as the role space can play in addressing climate change. It will also address a European launch strategy that goes beyond development of the Ariane 6 and Vega C vehicles.

“It’s really the larger picture of how Europe wants to establish itself in access to space,” he said. That includes support for “microlaunchers” or small launch vehicles being developed by several European companies as well as a longer-term evaluation of space access.

“It’s clear that the current situation needs a deeper reflection on the launcher sector in Europe,” he said, including how to achieve guaranteed access to space for Europe.

That discussion comes amid delays in the introduction of the Ariane 6 and efforts to return Vega C to flight after a launch failure

in December. He said work is in progress to have the Vega C launch again by the end of the year after implementing changes such as a new nozzle insert that was the cause of the December failure.

Aschbacher declined to give a target date for the first Ariane 6 launch, which ESA said last fall would take place no earlier than the fourth quarter of 2023 after extensive development delays. Work is proceeding in several areas, including a hotfire test planned for early July.

He said he was working with the industrial partners on the Ariane 6 project to offer a regular series of public updates on the progress towards that first launch. By the time of the hotfire test in July, he said, the Ariane 6 partners should know enough “that we can then make a much better prediction of the maiden flight date.” **SN**

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The U.S. Space Force awarded a contract in August to Millennium Space Systems, a Boeing company, to deliver the Victus Nox satellite and ground segment for the Tactically Responsive Space-3 mission.

TRADITIONAL TIMELINES

The prior mission, Tactically Responsive Launch-2, focused on slashing the timeline for sending a satellite aloft.

While the Space Force succeeded in sending a satellite to orbit in 21 days, “one of the big takeaways was that it is much more than just about launch,” Birchenough said. “More focus needs to go into the specific SV [space vehicle] development and getting the ground approvals ahead of time. There’s a lot of things that happen behind the scenes to put together a space mission.”

Normally, military agencies spend several years drafting requirements for new satellites, acquiring them, establishing the ground infrastructure, obtaining the necessary regulatory approvals and preparing for launch.

“Oftentimes you know your launch date, or pretty close to it, months, if not more ahead of time,” Birchenough said. “We are definitely shrinking things very drastically from basically months to years down to days to months.”

VICTUS NOX

Victus Nox is the space segment of the Tactically Responsive Space-3 mission, known as TacRS-3. The Space Force awarded contracts in August to Millennium, a Boeing company, to produce Victus Nox and Firefly to launch the spacecraft.

Millennium has nearly finished building and testing the Victus Nox satellite. Work on the satellite could be completed in a matter of months because Millennium was “founded in 2001 to do fast-paced national security missions,” said Millennium CEO Jason Kim.

“We are truly end-to-end,” Kim said. “We have an active satellite production line.”

Millennium also produces 22 satellite components in-house, which comprise about 80 percent of the company’s satellites, and runs Mission Operations Centers.

“We’ve operated several constellations and single spacecraft as well,” Kim said. “All

Crunchtime ahead for Victus Nox

Millennium Space’s 60-hour race to deliver Space Force smallsat to Firefly launch pad

At some point during the next six months, the U.S. Space Force will conduct an important test of its ability to rapidly respond to world events.

When a group of Space Force leaders says, “Go,” Millennium Space Systems and the Space Systems Command’s Space Safari program office will have 60 hours to transport the Victus Nox small satellite to Vandenberg Space Force Base and integrate it with a Firefly Aerospace rocket.

Sometime after that, again the timing is unclear, Space Force leaders will give orders for Victus Nox, to be prepared to launch within 24 hours.

“Those are incredibly challenging timelines,” Space Force Lt. Col. MacKenzie Birchenough, Space Safari materiel leader, said April 12

during a news briefing at Millennium in El Segundo, California. “We intentionally are trying to push the limits.”

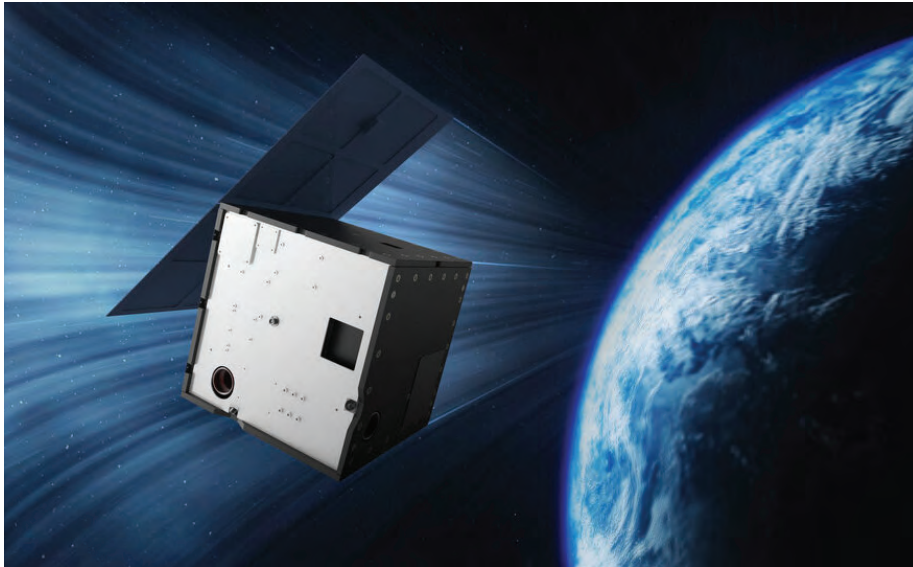
TACTICALLY RESPONSIVE SPACE

Tactically Responsive Space, which the Space Force defines as the capability to respond to on-orbit needs on operationally relevant timelines, is not a new idea. For more than a decade, military and congressional leaders have looked for ways to develop and launch satellites quickly in response to military threats or intelligence demands.

What’s new is that current technology is bringing that goal within reach. Millennium is one of several companies rapidly producing small satellites. Meanwhile, startups are developing, and some are flying, small rockets.

“The state of technology and how industry works these days is what’s allowing us to make it a reality,” Birchenough said.

DEBRA WERNER



Millennium Space Systems has nearly finished building and testing the Victus Nox satellite for the Tactically Responsive Space-3 program.

those things combined enabled us to deliver the space vehicle and the ground portion.”

DRESS REHEARSAL

Still, Victus Nox poses challenges. Another

TacRS-3 goal is commissioning the new satellite within 48 hours of launch.

“It doesn’t do us much good to get something on orbit quick if we can’t use it very fast as well,” Birchenough said.

Millennium plans to rehearse many elements of the TacRS-3 mission.

“We’re going to be executing what’s called a dry run or a dress rehearsal to essentially stress test our interfaces,” said Andrew Chau, Millennium’s Victus Nox program manager.

Rehearsals will cover transporting the satellite to the Vandenberg payload processing facility, fueling, charging batteries, conducting baseline functional testing of the spacecraft and handing it off to Firefly.

Millennium and Firefly also plan to simulate the launch phase, including transporting Victus Nox to the launch pad.

RAPID TRANSPORT

It’s not yet clear how the Victus Nox satellite will travel north 300 kilometers from El Segundo to Vandenberg. It may fly on a C-17 military transport jet.

“You don’t necessarily need a C-17 to fly from Los Angeles to Vandenberg,” Birchenough said. “But we wanted to test out that ability so that if in the future we needed to fly it to the Cape [Canaveral] or to some other location, we know that we can do that.” **SN**

Options for Tactically Responsive Space

The U.S. Space Force is considering a variety of ways to rapidly respond to changing threats. One option is storing a satellite like Victus Nox, the satellite Millennium Space Systems is supplying for the Tactically Responsive Space-3 mission, on the ground. On-orbit satellite spares are another possibility.

“Then also we always have the option to purchase commercial data or commercial assets at the time of need,” Space Force Lt. Col. MacKenzie Birchenough, Space Safari materiel leader, said April 12 during a news briefing at Millennium headquarters in El Segundo, California. “We’re definitely still looking into all of the different options.”

DEBRA WERNER

Rather than embracing one approach, the Space Force is likely to adopt them all to meet its goals for Tactically Responsive Space, which the military service defines as the capability to respond to on-orbit needs on operationally relevant timelines.

“Depending on what the mission is, it might make more sense to use one versus the other,” Birchenough said.

Through the Tactically Responsive Space-3 mission, for example, the Space Force is preparing to launch a Millennium-built satellite on a Firefly Aerospace rocket.

“The ability to launch into a specific orbit provides some extra benefits that having something stored on orbit might not,” Birchenough said. “Working very closely with our commercial partners obviously provides a lot of advantages too.”

One of the keys to close cooperation

with industry will be contracting. In a time of crisis, military leaders will need flexible contracting mechanisms that allow them to rapidly acquire whatever they need.

That approach is preferable to establishing depots to store dozens of satellites on the ground or having a launch vehicle waiting on a pad, Birchenough said. Still, the Space Force might purchase some minimal number of satellites that could be launched quickly, Birchenough added.

For launch vehicles, the Space Safari office is considering contracts that would allow companies to “build some extra capacity into their production lines so that there’s one [rocket] that can be ready,” Birchenough said. “If we don’t need it, they can launch it for one of their commercial missions. Then another one would be available.” **SN**

Aerospace CEO: More startups seeking DoD work amid cash crunch



Aerospace Corp. Space Warfighting Center in Colorado Springs.

Isakowitz: "Companies that had been raising rounds of funding are now looking much more to the government as an important customer."

Aerospace Corp.'s commercial space office, established to facilitate connections between startups and government technology buyers, is seeing a surge in activity.

With a downturn in venture capital, a growing number of companies are turning to the government for opportunities, Aerospace CEO Steve Isakowitz told SpaceNews.

Aerospace is a federally-funded non-profit based in El Segundo, California, that provides technical guidance and advice to military and civil space agencies.

In light of a somewhat cooled-off space economy, "more and more we're finding that companies that had been raising rounds of funding are now looking much more to the government as an important customer," he said.

SANDRA ERWIN

As a result, Aerospace's Commercial Space Futures office, created approximately one year ago, has been inundated with an increased workload. The office serves in a go-between role, assisting the U.S. Space Force and other agencies in identifying potential commercial solutions that align with national needs.

It also conducts due diligence assessments of companies interested in working with the government and provides guidance to startups on how to navigate the intricate regulatory environment.

Companies interested in working with the Space Force send email queries through SSCFrontDoor@spaceforce.mil. Aerospace's commercial office handles those inquiries. Additionally, Isakowitz said he personally gets a lot of calls and emails requesting assistance "on a whole range of matters."

Small businesses and startups are asking

for help on regulatory issues and evaluating their products. They also are looking to "better understand what it is the Space Force or the intelligence community are looking for," he said.

"We have so many requests," he said. "You don't want to say no to anybody, but there's only so much we can do."

Opportunities for DoD to capture tech

The space economy in 2022 saw private investment decline by 58% after a record \$47 billion invested in 2021, according to Space Capital, a market research firm.

The economic climate, while not great for venture-funded startups, is a "great opportunity for the government to try to leverage what's happening out there" and tap valuable technologies, Isakowitz said.

DoD and the Space Force have created a large ecosystem of organizations that fund research and prototyping projects, including the Defense Innovation Unit, SpaceWERX, AFWERX and the Space Enterprise Consortium.

These organizations want to work with new entrants in the industry, he said. That is driving Aerospace's workload doing due diligence on these companies, he said. "The government is constantly asking questions."

Program offices want to know if technologies being pitched to the government are more than just a PowerPoint slide. Beyond the technical maturity of a product and the financial health of the company, the government also asks for a review of companies' cybersecurity practices and supply chains.

Concerns about launch sector

Isakowitz, who previously led the commercial spaceflight company Virgin Galactic, said recent financial trouble experienced by launch services provider Virgin Orbit is a reminder of why DoD wants a diversity of suppliers.

The small launch sector is especially volatile and there are always risks that a supplier could go out of business, he said. Aerospace, for years, has promoted the use of standard interfaces for small satellites and cubesats so they are compatible with different launch systems. "You want to have that assured access to space and be able to move your satellites across multiple providers," said Isakowitz. **SN**

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COMMENTARY SHELLI BRUNSWICK

From Galileo to the lunar Gateway

Mapping Italy's Growing Space Industry



More than 400 years ago, Italian astronomer Galileo Galilei peered at Jupiter through his telescope, inspecting what he thought were three stars. In looking, he realized they were not stars but, in fact, objects orbiting the gas giant, what are today known as the Galilean moons. Centuries later, spacefaring nations are about to launch a sophisticated spacecraft, the Jupiter Icy Moons Explorer, to study these alluring celestial bodies. It is fitting that many of the instruments on this spacecraft were built and will be commanded by Italians.

Today, Italy plays a vital role in space missions and activities worldwide, far more so than is often acknowledged. In 1964, Italy was only the third nation (after the United States and the USSR) to build a satellite and manage its launch. Much of the International Space Station was built

by Italian companies under the direction of the Italian Space Agency (ASI), and Italian astronauts were the first Europeans to join an ISS mission. Italy also manufactures much of the Cygnus spacecraft, which is a major part of the ISS commercial re-supply program.

Italy boasts the second greatest number of assets in orbit among European nations, and it is an essential contributor to European Space Agency (ESA) and NASA missions. This global space leadership is the result of decades of intense and thoughtful development of the Italian space ecosystem and its relationships with the rest of the world. The country's space maturity and economic activity signal that Italy is heading into an exciting new era of its space story.

To understand its potential and where it may be headed next, we need to understand the country's domestic space ecosystem, the state of its private sector

development, and the implications for workforce development.

CIVIL SPACE ON A TRAJECTORY TO THE MOON AND BEYOND

European space efforts are often presented only through the lens of the European Space Agency (ESA), with less attention given to the individual European space agencies and companies that make ESA missions possible. Unlike space programs in places like Canada, Japan, and the United States, in Europe, each member country contributes to the continent's space program and receives contracts whose value is ideally commensurate with the contribution. This ESA policy of geographical return (aka geo-return) is intended to have a 1:1 ratio of contribution to contract awards, and while ESA Director General Josef Aschbacher wrote in March 2023 that there is room for improvement in geo-return to catalyze greater competition in Europe, Italy is actually exceeding the ideal ratio.

In 2022, Italy contributed €680.2 billion to ESA, the third largest contribution after France and Germany. At the ESA Industrial Policy Committee meeting, Italy won contracts totaling €1.6 billion, with expected net revenue of about €800 million. The contracts include: the development of two Earth observation satellites for ESA's Copernicus program; the development of the International Habitation Module for the Lunar Gateway; and the creation of contributing technologies to the Earth Return Orbiter, which will someday carry back to Earth the rocky samples being collected by NASA's Perseverance rover.

These are major contributions to global space missions, and Italy's track record inspires confidence that it will succeed with its many contracts and activities. ASI runs the satellite constellation COSMO-SkyMed, with satellites in polar orbits observing the Mediterranean basin. Italian aerospace contractors built or contributed to building four modules for the ISS, as well as the iconic Cupola. And Italy has contributed to breakthrough space missions, including the Mercury-bound BepiColombo

spacecraft, which will study the innermost planet and whose design has important elements for the Earth Return Orbiter.

Outside of ESA spending, Italy's space budget is modest, rising to €400 million in 2021, according to The Space Report. With this level of funding, it might be expected that Italy would specialize its space economy and supply chain, focusing on a few areas of excellence rather than trying to compete and succeed across every space arena. We have seen this approach from other nations, such as Canada. Yet, that may not be the case in Italy.

"There is a theory of comparative advantage by David Ricardo according to which each country should compete on what it can do best," said Mattia Pianorsi, researcher at the Space Economy Evolution (SEE) Lab of the SDA Bocconi School of Management. "When European-level space programs are mirrored by national agencies, innovations brought by high specialization are limited. For instance, in Italy, while the space value chain is complete, more leverage on specialized capabilities could create even more powerful bargaining power at the global level, as per a capital budgeting, whereby public resources are carefully addressed in programs that create sustained growth. Rather, a 'helicopter view' of disbursing financial resources to support (and sometimes, maintain) the entire value chain seems to be taking place. It is clear that the financial reasoning works at the commercial level, but space is still a matter of strategic interests."

This points to one product of Italy's long history in space activities and the maturity of its space economy. It has a complete value chain, and it is anchored in the private sector.

TRANSITIONING PRIVATE SECTOR SPACE FOR NEW MARKETS

There are some 200 companies in the Italian space sector, and as in other spacefaring nations, the private sector is made up of a small number of prime contractors and a larger number of small and medium-sized enterprises. The larger aerospace businesses in the value chain can be categorized as "upstream" and "downstream."

The upstream sector includes Thales Alenia Space, a joint French-Italian venture focused on technology development and construction, as well as the Italian aerospace company Avio, which provides ESA's Vega launch system. The

downstream sector is focused on the management and use of space assets (e.g., satellites), and includes companies like Telespazio (co-owned by French and Italian enterprises) and ALTEC (a venture between Thales Alenia Space and ASI). It also includes companies focused on space-to-Earth applications. An example is Planetek Italia, which provides geospatial data management and analysis for things like environmental monitoring and defense and security.

This upstream and downstream maturity is part of what allows Italy to not only make significant contributions to space missions but also capitalize on the benefits for domestic industry. The emerging story is the growth of small and medium-sized businesses, which constitute some 80% of companies in Italy's space economy. These organizations are encountering some of the same headwinds challenging space companies worldwide, notably access to funding and the challenge of retaining talent.

"The risk appetite has slowed down" among venture capital, said Elias Montanari, an angel investor and the founder of SpaceBrainx. "Suddenly, people are realizing that not everything is shining. Space is much more long-term. But you are cutting the dead branches, the weaker companies that did not develop sufficient cash flows. There will be strong consolidation, but the underlying strategic need [for space access] is not going to go away."

Part of the challenge, as Pianorsi said, is for companies to transition from delivering products for public missions to selling general services in commercial markets.

"We have several entrepreneurs," he said. "We have financial resources from public expenditure (less from private capital) and technological capabilities, but the European environment does not give the sense of competition (to achieve progressive innovation and efficiency). Therefore, there is the need to scale up by looking into global markets and partners to sell specialized capabilities and to strategically position European companies worldwide. Most of all, there is the need to transform the value created under the strategic directions of governments to an economic value for commercial markets."

Recent geopolitical events may serve to expand investment, in Italy and across the European continent. Montanari noted how the

Russian invasion of Ukraine put on display the strategic value of space capabilities, including the clarity of U.S. intelligence (owing to Earth-observation satellites) and the strategic importance of secure connectivity, as seen in the case of SpaceX's delivery of Starlink services in Ukraine.

"Suddenly, more people are starting to awaken to how strategic space is," said Montanari. "I think the government will put a lot of funding for next-gen Earth observation and secure satellite connectivity. We will see a big amount of money poured into that, and that will spin the wheel...Italy is like a wheel that keeps spinning, slower or faster, but it doesn't stop."

As those in the global space community know, funding and access to new markets are not enough. Success in space requires talent, and in that area, Italy faces both opportunities and challenges.

COLLABORATING FOR SPACE WORKFORCE DEVELOPMENT

Among OECD countries, Italy has the largest share of teachers older than 50, and the lowest share of teachers 25-34 years old. As such, Italy will require many more teachers nationwide in the years ahead. What is more, at the collegiate level, earning a bachelor's degree in Italy can take longer than in other nations, and on average, about 50% of graduates take nearly six years to begin working after graduation. On top of that, about a quarter of Italians aged 15-29 are not employed, studying, or in training at all.

Looking more closely at the curriculum, there are also questions about the balance of education in the humanities and the science, technology, engineering, and mathematics (STEM) fields.

"Italy has a great primary school system," said Dr. Gioia Rau, an astrophysicist as well as a research scientist at NASA. "In particular, the public high school system I have attended is focused on classical studies, which gives a 360-degree view on ancient Greek, ancient Latin, and the humanities, broadening and deepening the capacity for critical thinking. Italy enriches the person at the most receptive point in their life. However, Italy will need to develop a stronger STEM-oriented curriculum, while also keeping the humanity curriculum."

Meanwhile, there is also the persistent >

< > need to retain the highly skilled talent that is available. Italy faces similar challenges to other spacefaring nations, in that if there is not enough professional or business opportunity in the domestic space economy, skilled talent will go where those opportunities do exist, which in many instances means the United States.

Dr. Rau herself left Italy after earning her Master's in Physics and Astrophysics, going on to Austria to earn her Ph.D. in astrophysics, to the European Southern Observatory to continue her research and finally to NASA's Goddard Space Flight Center. She said, "After getting a higher degree, people are attracted to what a system can give them in terms of personal and professional development. Many jobs are still abroad, and many people leave after an excellent education. This is a huge loss for the system, which should do more to retain these talents and also to attract new ones from abroad."

The path ahead may lay in domestic education efforts. Montanari's organization, SpaceBrainx, for example, raises funds and invests them in STEM education and funding for students, as well as investment in space companies. Workforce development is also about ensuring next-gen capabilities are developed and that the companies creating them are supported in their goals. Indeed, beyond a skilled workforce, established companies also need capabilities from smaller and agile companies to partner to maintain a competitive edge.

To help foster this, in December 2022, Space Foundation's Space Commerce Institute partnered with the Italian Embassy in Washington, D.C. and the Italian Trade Agency for the first U.S.-based Italian National Space Day. Bringing space companies and organizations together to explore opportunities helps forge valuable relationships and highlights current and aspiring space businesses.

Even with talent and funding challenges, the Italian space ecosystem enjoys everything it needs to continue its leadership in space. Where it goes from here – and where Italy takes all of us – will be exciting to watch, on Earth, on the Moon, and soon enough, around the moons Galileo spotted centuries ago. **SN**

SHELLI BRUNSWICK IS THE SPACE FOUNDATION'S CHIEF OPERATING OFFICER.

Italy's post-pandemic space industry boost



A rendering of the optical and radar satellites that are part of Thales Alenia Space's contribution to IRIDE's "constellation of constellations."

An Italian Earth observation project funded by pandemic relief euros has ordered at least 34 satellites and a pair of Vega launches in recent months.

More than 47 Italian companies have secured contracts for the 1.1 billion euro (\$1.2 billion) IRIDE constellation, or International Report for Innovative Defense of Earth, as part of the Italian government's National Plan for Recovery and Resilience.

The low Earth orbit network would use optical, radar, and other imaging payloads to monitor Italy's critical infrastructure, air quality, and meteorological conditions.

Arianespace has a contract from the European Space Agency, acting on behalf of the Italian government, for two Vega C rockets to start launching IRIDE satellites in late 2025, with an option for a third to complete the constellation in 2026. Italy-based Avio is the prime contractor for Vega launch vehicles.

THE SATELLITE MAKERS

ESA has awarded IRIDE satellite manufacturing contracts to Italy-based teams led by Thales Alenia Space, Argotec, Sitael, OHB, and space logistics company D-Orbit perhaps best

known for its last-mile space tug services.

Thales Alenia Space said March 27 it won IRIDE contracts from ESA for six small satellites with synthetic aperture radars (SAR) and one based on optical technology.

The contracts are worth 141 million euros for all seven satellites. They also include options for another four SAR satellites and an extra optical satellite that altogether would bring in an additional 94 million euros.

Thales Alenia Space said each SAR and optical satellite would weigh about 170 kilograms and be based on its modular NIMBUS (New Italian Micro Bus) platform.

OHB Italy and Argotec announced their IRIDE contract wins in December for a total 22 multispectral satellites worth a combined 68 million euros. The contracts include options for an additional 12 and 15 satellites, respectively, for an extra 58 million euros combined.

D-Orbit announced April 5 it had secured a 26 million euro contract to build a SAR satellite for IRIDE, which would be based on the ION Satellite Carrier orbital transfer vehicle (OTV) it builds in-house.

Italian technology developer MetaSensing is supplying the radar for this satellite.

D-Orbit's contract includes a 24 million euro option for an additional SAR satellite.

A decision on a second satellite "should

JASON RAINBOW

be made by the end of this year,” a D-Orbit spokesperson said, “depending on the performance of the work” on its first IRIDE satellite.

The company declined to discuss specifications for the Earth observation satellite but said it expects to release more details about the project in a few months.

Sitael has a contract for four hyperspectral IRIDE satellites in a deal covering options for another two spacecraft that “may host a payload yet to be selected by ESA,” ESA IRIDE program manager Guido Levrini told *SpaceNews*. Italian multinational aerospace company Leonardo is providing the instruments for Sitael, which is basing the satellites on its 200-kilogram all-electric satellite platform Platino.

Altogether, that puts IRIDE at 34 commissioned satellites with options for 35 more.

“In addition, nothing prevents us (budget and schedule permitting) to add satellites through extensions of the scope of the current contracts,” Levrini said via email.

SPACE TUG

D-Orbit’s business primarily revolves around an OTV delivery service that it first demonstrated in 2020.

“ION is an OTV, but it is also a satellite platform which can carry out in-orbit experiments, accommodate edge computing applications and space cloud services,” said Stefano Antonetti, D-Orbit’s vice president of business development and institutional sales.

The company says it has transported around 100 payloads in orbit over eight missions to date, including 73 satellites deployed from ION and additional payloads hosted onboard the spacecraft.

This is also not the first time the company has secured a contract to develop a standalone satellite.

The company is prime contractor for a 10 million euro SAR satellite project secured in 2019 called NOCTUA Landscape Monitoring, which aims to keep tabs on infrastructure in Italy’s northern Lombardia region for government agencies and residents. Meta-Sensing is also part of the consortium for this project.

D-Orbit’s first satellite, a spacecraft the size of three cubesats, was launched in 2017 to validate the company’s propulsive technologies. **SN**

Arianespace wins Vega contract for IRIDE



A Vega C rocket lifts off July 13, 2022, on its first and so far only successful launch.

National Plan for Recovery and Resilience, or PNRR, an initiative by the Italian government to help the country recover from the pandemic. The contract is the first for the Vega C announced since the completion of the investigation into the December 2022 launch failure on the vehicle’s second mission, destroying two Airbus imaging satellites. That investigation concluded that a carbon-carbon component of the nozzle of the rocket’s second stage solid-fuel motor degraded after ignition, causing a loss of thrust that doomed the rocket.

With this contract “ESA repays the trust of the Italian government while confirming its confidence in Arianespace and in the Vega C launch system,” said Simonetta Cheli, director of Earth observation at ESA, in a statement. ESA is supporting the Italian government on the development of IRIDE.

During a panel at the Satellite 2023 conference last month in Washington, Stéphane Israël, chief executive of Arianespace, confirmed plans announced earlier in the month to return the Vega C to flight by the end of the year with launch of the Sentinel-1C radar imaging satellite for Europe’s Copernicus program. That will be preceded by a launch of the original Vega vehicle, likely by late summer.

“We are very mobilized with our partners to make sure that Vega will be a success,” he said, referring to a team that includes Avio, the prime contractor for Vega, as well as ESA.

With this contract, he noted that Vega C’s backlog was now at 15 launches. He added that there were “commercial negotiations ongoing” for the vehicle as well with unidentified customers. **SN**

In a vote of confidence for a troubled launch vehicle, Arianespace won a contract from the Italian government for up to three Vega C launches of an Earth observation constellation.

Arianespace announced March 14 it signed a contract with the European Space Agency, acting on behalf of the Italian government, for launching the IRIDE constellation of imaging satellites. The contract includes two firm Vega C launches, starting in late 2025, with an option for a third.

The IRIDE constellation, funded by the Italian government, will include three dozen satellites built by a consortium of Italian companies that will be equipped with a range of imaging payloads, including optical and radar. The constellation is named after the Italian word for iris.

The value of the launch contract was not disclosed. The overall IRIDE system, including satellites, launch and ground systems, is estimated at more than 1 billion euros and is funded by Italy’s

JEFF FOUST

OPEN LETTER

Our Pledge to Diversify the Space Industry Workforce Continues

One year ago on the space industry’s largest stage — Space Symposium — the leaders of two dozen space companies pledged to support Space Workforce 2030, a new, collaborative effort to advance diversity, equity and inclusion in our industry over the long-term.

This effort was born of the recognition that our success at this pivotal time in space — as we reimagine low Earth orbit, return humans to the moon and expand our horizons further into the universe — depends on our ability to harness the talents and ideas of a diverse, vibrant workforce. And for all our worthwhile individual efforts, we knew that we could accomplish more not on our own, but together — in ways that benefit our entire industry.

Specifically, Space Workforce 2030 (SWF2030) companies pledged to:

1. Boost the number of women and employees from underrepresented groups in the collective technical workforce;
2. Grow the representation of the same groups in senior leadership positions in the collective technical workforce;
3. Increase percentages of women and students from underrepresented groups receiving aerospace engineering degrees to be commensurate with overall engineering programs; and
4. Sponsor K-12 programs to reach over 5 million underrepresented students annually.

The results from the first year of SWF2030 activity are in and we are trending in a positive direction. We are optimistic about our path forward, even as we remain realistic about the challenges we face and the work still to

be done to make space more representative of everyone—by and beyond the year 2030.

Perhaps our most important Year 1 measurement was 100 percent transparency. Each of the 30 companies that signed on to the pledge during its first year kept its promise to provide data to track our collective progress and to share best practices for recruitment, retention, representation and STEM outreach. This accountability is fundamental to our effort and will help drive SWF2030 forward until our goals are met.

SWF2030 companies reported statistically significant increases in six of eight tracked categories, including the percentage of women and people of color in our technical workforces, and increases in the number of people of color in our leadership ranks and intern classes. While more progress is needed across all these measures, the initial data showed additional focus is needed to increase the number of women in senior technical leadership positions and in our intern classes.

Collectively, we also surpassed our annual goal of connecting with more than 5 million students through STEM outreach. We hope to surpass this performance going forward, in part through a new partnership with the Girl Scouts of the USA. With over 2 million Girl Scouts in the United States, we are excited to work with this organization to inspire young women to pursue a career in the space industry.

We have found no shortage of like-minded partners during this first year, starting at the highest levels of our nation’s government. At the second convening of the National Space

Council, U.S. Vice President Kamala Harris unveiled space-related STEM initiatives to “Inspire, Prepare and Employ” the next generation of the space workforce. We adopted these three pillars to structure our own work, and SWF2030 has established working groups to drive activities supporting these national goals.

During her remarks, Vice President Harris also highlighted SWF2030 and one of our early signature initiatives, the National Space Intern Program, which expands the pipeline for diverse talent by offering a single registration portal for internship opportunities at any of our coalition companies. The program provides students with exposure, mentorship and networking opportunities, and we received nearly 1,000 diverse applicants in the program’s first year, an encouraging start as we strive to meet our goal of having 3,000 National Space Interns by the end of this decade.

The challenges our industry faces around diversity did not arise overnight, and we do not expect to solve them in a single year. We know it will take a sustained, industry-wide effort over many years to build a workforce for the future, and we feel strongly that Space Workforce 2030 can be a part of the solution.

When we launched this effort a year ago, we were inspired by the words of President John F. Kennedy and chose to take on this challenge not because it is easy, but because it is hard—and because this challenge is one we are unwilling to postpone. All of us have a role to play in our success. Together, we can ensure that everyone has the opportunity to be a part of our future in space.

On behalf of Space Workforce 2030,

Payam Banazadeh
Peter Beck
Dave Broadbent
Tory Bruno
Peter Cannito
Michael Colglazier

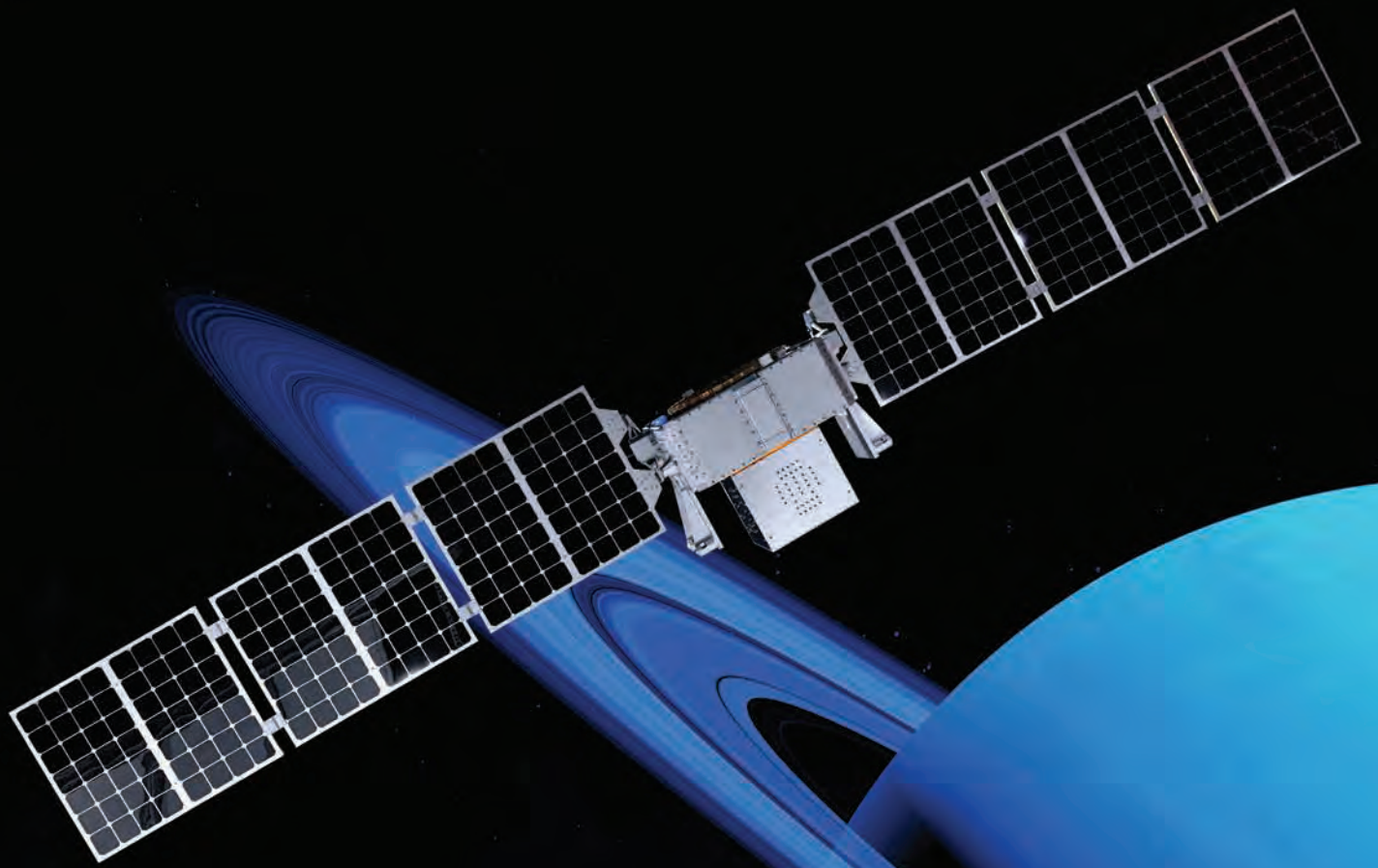
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John Serafini

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Bob Smith
Melanie Stricklan
Dylan Taylor
Kelle Wendling
Tom Wilson

For more information about Space Workforce 2030, to review an annual report detailing the progress made over the pledge’s first full year, or to inquire about joining the pledge, visit www.swf2030.org. For more information about the National Space Intern Program, visit www.NationalSpaceInterns.org.



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KEYNOTE

US SPACECOM tries to satisfy global military demand for satellite services

U.S. Space Command, a combatant command responsible for military operations in outer space, is seeking more funding and resources from the Pentagon to defend the nation's spacecraft and fill growing demands for satellite services, the head of the command Gen. James Dickinson said April 18.

"The command is putting out demand signals," he said in a keynote speech at the 38th Space Symposium.

The development of so-called "initial capabilities documents," or ICDs, has been a priority for the command since it was established in 2019, Dickinson said. Those documents outline the "requirements and the capabilities that we need not only today but also in the future."

The ICDs are extensively reviewed by the Pentagon's joint chiefs of staff and must be validated so funding can be requested and justified in DoD budget proposals. This is a complex task, Dickinson said, as they have to take into account global military needs for satellite services like communications, GPS navigation and early warnings of missile launches. These requirements documents also are shaped by security concerns driven by the proliferation of anti-satellite weapons.



Gen. James Dickinson, commander of U.S. Space Command, speaks April 18 at the 38th Space Symposium in Colorado Springs.

U.S. Space Command has to ensure DoD has uninterrupted access to all these services, said Dickinson.

So far, Space Command has submitted four ICDs, and more are in the works, he said. The four documents focus on requirements for space domain awareness, space combat power, joint space command and control, and a joint space communications layer.

The ICDs are "critical," Dickinson said. "In

order to get the funding, in order for the services to provide capabilities to us, they need to understand what our requirements are."

UKRAINE WAR DEMANDS

The demand for space services has soared since Russia invaded Ukraine nearly 14 months ago, he said.

As part of the United States' support of NATO's operations, Space Command has increased satellite communications services, said Dickinson. "We've provided more than an additional gigabyte of data to support communications across the European continent." Since the beginning of the conflict, he said, Space Command has also provided more than 11,000 indications and warnings of missile launches to NATO allies and other partners.

"We now have our first-ever integrated plan for defending critical space assets and delivering space capabilities to the rest of the joint force," he said.

Having an integrated plan is significant, he said, because it formalizes the process for synchronizing operations with the Pentagon's other combatant commands during contingencies. For example, Space Command needs to coordinate operations with U.S. Cyber Command to protect space assets and ground systems.

SEE DICKINSON, PAGE 3

SANDRA ERWIN

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A massive cultural shift on the way

Plum: Pentagon should consider space like any other operational domain

The Department of Defense is striving to normalize space as an operational domain, which requires “a massive cultural shift,” said John Plum, Department of Defense assistant secretary for space policy.

“To normalize space as an operational domain, we need to provide a frame of reference for our national security leaders who have spent most of their careers considering the air, sea and land domains,” Plum said April 18 at the Space Symposium. “By treating space as we do every other operational domain, we will enhance our ability to deter conflict and to preserve a secure and stable space.”

Publicly sharing and declassifying information about international threats to space systems is an important step, Plum said.

PACING THREATS

“China and Russia have both developed a variety of means to attack our space systems,” Plum said. “In just the last few years, the quantity and quality of counterspace threats has grown significantly.”

China’s goal, in particular, is “to challenge the U.S. military’s ability to intervene in a regional conflict in the Indo-Pacific,” Plum said. “China is not only developing systems to kill our satellites, it is building a wartime



John Plum, assistant defense secretary for space policy.

space architecture to fight and win a modern military conflict.”

Plum noted China’s growing reconnaissance capabilities, and communications and data relay satellites to convey critical targeting data gathered by space-based sensors.

“Together, these capabilities allow the PLA [People’s Liberation Army] to better track, target and strike our joint force,” Plum said.

ACHIEVING RESILIENCE

In spite of the threat, the Defense Department “will assure the joint force has access to those space services we need even if we are attacked so they can fight through,” Plum

said. “We will also ensure the space services the president needs to support homeland defense, strategic-level decision making up to and including command and control of our own nuclear forces.”

Along with allies and commercial partners, the Defense Department is investing in making U.S. space capabilities more resilient.

“Cooperation with like-minded nations contributes to our collective ability to deter aggression,” Plum said. “Cooperation broadens the number of systems available for space operations and expands our options for diplomatic or military response.”

Plum warned that overclassification is a “significant barrier” to cooperation with partners.

ABSORBING BLOWS

“We must expect to take punches in a near-peer conflict,” Plum said. “But a resilient space architecture means we will be prepared to absorb those blows. In fact, with sufficient resilience, we hope to deter an adversary from attacking us in the first place because the value of any such attack would be greatly diminished.”

Still, resilience is not a panacea, Plum said.

“We will still need to defend our systems as we would in any domain,” Plum said. “The Department of Defense will protect and defend our national security interests in space. It would be irresponsible not to.” **SN**

DEBRA WERNER

DICKINSON FROM PAGE 1

COMMAND GROWING, MORE ALLIED AGREEMENTS

U.S. Space Command is currently based at Peterson Space Force Base, Colorado. Dickinson said the command is close to reaching its staffing goals, with more than 1,200 military personnel and civilians assigned to it. That includes several members of allied military forces.

Much larger workforces are located at Space Command’s operational field units at Schriever Space Force Base, Colorado, and at Vandenberg Space Force Base, California. At these locations,

military leaders work with foreign allies, civilians and private contractors to monitor space objects and identify potential threats.

International collaboration is essential for space security because no one country can handle the enormous demand for data and intelligence about the space domain, he said. U.S. Space Command has signed 169 space situational awareness data-sharing agreements.

Of those, 33 are with nations and international organizations, 129 with commercial companies and seven with universities.

Separately the command has signed “enhanced space cooperation” agreements with the U.S. closest allies, the United Kingdom and Canada. On April 20 the command will announce a new enhanced space cooperation pact with Australia. **SN**

“We now have our first ever integrated plan for defending critical space assets and delivering space capabilities to the rest of the joint force.”

— Gen. James Dickinson, commander of U.S. Space Command

THOMAS KIMMELL PHOTOGRAPHY



"We're going to learn a lot on the way."

— Pam Melroy, NASA deputy administrator

the moon are going to reduce the risk for future Mars missions," Melroy said of the white papers.

At a higher level, the document extends to future phases of Artemis with sustained lunar exploration and later human missions to Mars. "We're going to learn a lot on the way so we're not ready to talk about sustained presence yet on Mars," she explained, "but we have the shape there."

Other NASA officials have noted tweaks to earlier plans for later phases of Artemis, such as a shift from a single "base camp" at the lunar south pole to several sites that could be visited on later Artemis missions.

Jim Free, NASA associate administrator for exploration systems development, said at an April 17 briefing that, because of changing lighting conditions at the south pole, missing a launch window for a particular site might delay a mission there by months. "We could maybe have two or three sites to go to that help our science diversity," he said.

NASA Deputy Administrator Pam Melroy said the architecture document and supporting white papers explain how upcoming Artemis mission help it achieve its long-term objectives for moon and Mars exploration.

NASA releases revised moon-to-Mars roadmap

PARTNER INPUT

The architecture was developed internally at NASA, but Melroy said there will be opportunities for industry and international partners to provide input. "We identified some areas for collaboration," she said, although the architecture doesn't spell out specific procurement plans. "It does help show where we are and where we're headed, and we know how important that is for our industry and international partners."

Melroy said that NASA plans forums this summer where those commercial and international partners will be able to offer feedback on the architecture, as well as workshops organized by professional societies. That feedback will assist NASA's next round of architecture development, which will be done on annual cycles starting in November to work on later missions.

"NASA has positioned this strategy for longevity and success," she said. "This is a critical milestone for us in our moon-to-Mars strategy. We feel very aligned with our partners. We want to continue to stay that way." **SN**

NASA has released new details on the initial phases of its architecture to return humans to the moon as a step towards eventual missions to Mars.

Speaking at the 38th Space Symposium April 18, NASA Deputy Administrator Pam Melroy rolled out a 150-page document describing its plans for the initial series of Artemis missions to the moon and how they fit into a set of more than 60 objectives for its long-term plans for human missions to the moon and Mars.

"The architecture concept review details plans for early human exploration of the moon's south pole," she said. "It provides

more definition for plans through Artemis 4 and sets the stage for the first crewed missions to Mars."

The document describes how the various programs in development fit together to carry out those missions, such as the Space Launch System, Orion, Gateway and Human Landing System. Those programs are linked to specific objectives, functions and use cases for those missions.

Along with the architecture document, NASA released several white papers to explain aspects of the architecture, such as the use of the near-rectilinear halo orbit around the moon and the Gateway that will operate in it.

"I think they provide a very succinct description of why we're doing what we're doing, and especially how the Artemis missions to

JEFF FOUST

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The LinQuest logo features the word "LINQUEST" in a bold, white, sans-serif font. The letter "Q" is stylized with a red, glowing ring or orbital path around it. The background of the entire page is a dark, futuristic space-themed graphic with a network of white and blue nodes connected by lines, and a blue wireframe hand reaching out from the bottom right. There are also green and red light effects and some faint numbers like 48, 49, 50, 53, 54, 51, 32, 33, 35, 36 scattered throughout the scene.

LINQUEST

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Axiom offering aid to countries wanting to join the human spaceflight club ASAP

Azerbaijan, New Zealand among first customers for "space program in a box"

Axiom Space has introduced a new program to allow countries to create human spaceflight programs without needing to develop their own infrastructure or other capabilities.

The Axiom Space Access Program, announced April 17, offers countries a tiered approach to conducting research on the International Space Station or Axiom's future commercial space station, as well as flying their own astronauts.

The program is effectively a "space program in a box," said Tejpal Bhatia, chief revenue officer at Axiom, in an interview during the 38th Space Symposium. "The real key is that turnkey access at affordable, sustainable and predictable rates."

In the base tier, Axiom provides countries with advice and insight, and gives those countries priority access on upcoming missions. The second tier enables research and development activities by counties. The third tier offers human spaceflight missions on a regular basis. A fourth tier offers countries the ability to co-develop parts of Axiom's station.

The first country to join the program is Azerbaijan, which will work with Axiom on satellite solutions and inspiring students to pursue space research and development activities. New Zealand and Uzbekistan are also participating, as well as Rakia Mission, an Israeli space education and research organization involved with the Ax-1 private astronaut mission to the ISS a year ago.

Italy is another nation working with Axiom through a partnership that dates back to 2018. An Italian astronaut is slated to fly on Axiom's Ax-3 mission to the ISS, currently scheduled for late 2023. Two astronauts from Saudi Arabia are flying on the Ax-2 mission in May.

"Everything to date has been very a la carte with the customers, and it's built off the old model of cost per kilogram," Bhatia said. "Now we're trying to build long-term relationships

JEFF FOUST



Axiom Space is developing a series of commercial modules it plans to install on the ISS as a precursor to a commercial space station.

with them."

Governments make up one part of the overall customer base Axiom foresees for its commercial ISS modules and future space station. "There's a limited set of customers, you know who the buyers are and they have budgets," he said.

Private astronauts make up the second part of the market. "They want to go. They find us," he said. "It's not about convincing them they should go. It's about how you get them to go."

The third, and potentially biggest, part of the market is corporations. "That's the future of Axiom, where the value really gets created, like the internet," Bhatia said.

The challenge there is convincing companies that they can conduct research and

development in space that will be profitable. "There's a big jump from the science experiments that have been done in space and reports on the potential return to a CEO of a Fortune 100 company being able to go out to Wall Street analysts and say, 'I'm going to make this big investment,'" he said.

The key is convincing companies that space offers an "internet moment" for their industries. "It's still experimental, it's still emotional," he said. One way to open those commercial markets, he suggested, is to find company executives who are personally passionate about space and willing to take a chance on space research.

"As soon as that hits," he said, "everyone in that sector is going to want to do it." **SN**



Sierra Space and ILC Dover partner on inflatable modules and spacesuits

Sierra Space and ILC Dover announced April 18 they will cooperate on developing inflatable space station modules and spacesuits.

Under the partnership, ILC Dover will be the exclusive partner in providing soft goods for Sierra Space's Large Integrated Flexible Environment (LIFE) modules it is developing for commercial space stations. Sierra Space also plans to offer versions of LIFE modules for lunar and Mars applications.

Tom Vice, chief executive of Sierra Space, said in an interview during the 38th Space Symposium that the company is working on a series of progressively larger LIFE modules, including versions with more habitable volume than the entire International Space Station.

The company is also developed ways to integrate windows into inflatable habitats, and will conduct tests of an engineering model of a module with windows in the summer. "We didn't want to go to space and be inside of the habitat but not able to see the Earth," he said.

The discussion with ILC Dover on supporting LIFE work led to collaboration about spacesuit development. "We got into really deep technical

conversations about their heritage in spacesuits," Vice said, which led to expanding their partnership to include spacesuits. "We want to work together to create the world's best suit."

The companies have not disclosed design details about their planned suits, which include versions for use both inside spacecraft and for spacewalks. Vice said that the companies want to address some problems with earlier suit designs. "If you talk to astronauts, there are significant areas of discomfort and significant areas of distraction because of that," he explained.

That suit concept, he said, would allow it to be seamlessly integrated with the crewed version of Dream Chaser the company is developing. "When you're integrated into Dream Chaser, you automatically connect to the systems on board," he said. "It's not about just designing another suit but instead to think about the problem differently."

Sierra Space is currently working on two cargo Dream Chasers, the first of which will ship in July to NASA's Neil Armstrong Test Facility in Ohio for thermal vacuum, acoustics and vibration testing, then go to the Kennedy Space Center in November for launch on a Vulcan Centaur.

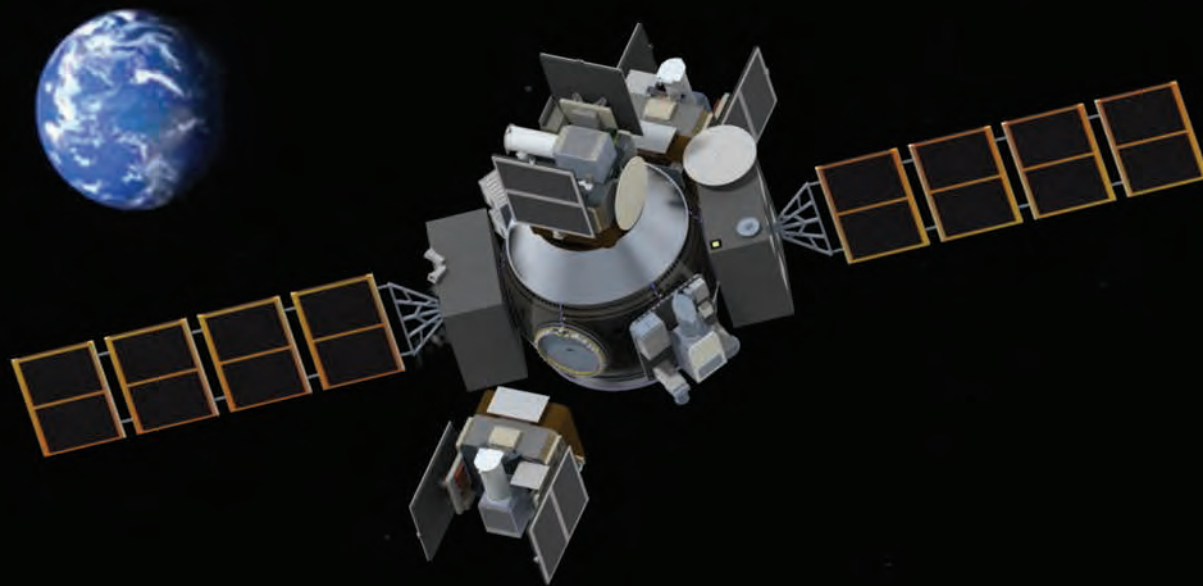
Above: Sierra Space and ILC Dover will work on a series of progressively larger inflatable modules called LIFE for use on commercial space stations and missions to the moon and Mars.

The second-generation Dream Chasers will follow, with both cargo and crew versions. They will support the company's commercial space station development, working with Blue Origin and others on the Orbital Reef station.

Vice said he is seeing the strongest demand for the commercial space stations from the biotechnology sector. "We see our first space station being almost fully dedicated to biotech," citing \$280 billion spent annually on pharmaceutical research and development. "It will be dedicated to research and formulation of new drugs, and we see tremendous pent-up demand for it."

He added that the company anticipated hosting tourism on its stations, but did not see it as a priority. "We'll be in that business, but we really think space is for everyone," he said. "It's not a billionaire playground. It is a place to benefit millions of people, and it really drives our behavior." **SN**

JEFF FOUST



Quantum Space's Ranger transfer vehicle is designed to carry its own Scout spacecraft to cislunar space but can also transport payloads for other customers to both geostationary orbit and cislunar destinations.

Quantum Space moves up development of Ranger transfer vehicle

Quantum Space is accelerating work on a transfer vehicle designed to take payloads to both geostationary orbit and cislunar space to support growing demand from commercial and government customers.

The Rockville, Maryland-based company, established last year to develop spacecraft called Scouts to provide services such as space domain awareness and communications between the Earth and moon, planned to deliver those spacecraft using a tug called Ranger. The company initially proposed to start flying Ranger in late 2025.

Steve Jurczyk, president and chief executive of Quantum Space, said in an interview the company was seeing greater interest in Ranger. "We somewhat accelerated the development plans for Ranger," he said in an interview, with a first flight now planned earlier in 2025.

That demand is coming from customers looking to transport spacecraft to both GEO and cislunar space. Ranger is designed to place

more than 1.5 metric tons into GEO and more than 2.5 metric tons into cislunar space, and features four ports for attaching spacecraft weighing up to 500 kilograms each.

"Ranger is a key part of our future to deliver Scouts," said Phil Bracken, chief strategy officer of Quantum Space. "We assumed that other customers would like to use this service as well, and as we've started conversations with customers we have seen that demand signal."

He said the design of Ranger is based first on what the company needs for its Scout vehicles. That includes a "high-thrust" propulsion system to reduce travel times either to GEO or cislunar destinations, something he said is of interest to other customers. "You don't want to spend months and months spiraling out."

In the near term, there is more interest in going to GEO, with a mix of government and commercial customers. Jurczyk said current interest in cislunar missions is coming from governments but expects that commercial demand will grow over time.

Work on Ranger is still in its initial phases as the company prepares for a preliminary design

review, as well as ordering long-lead items. The company is also securing an integration and test facility in the Washington, DC, suburbs to produce both Ranger and Scout spacecraft.

"Our nominal plan is two vehicles per year right now," Bracken said of production plans for Ranger, "but that can be adjusted to increase capacity as needed."

The company is continuing development of its first Scout spacecraft, QS-1, announced in October. That spacecraft is carrying a space situational awareness payload provided by GEOST that Jurczyk said is nearing its critical design review. QS-1 is set to launch in late 2024.

Work on both Scout and Ranger is supported by a \$15 million Series A round Quantum Space raised in December. Jurczyk said the company is working to raise an additional round of funding this year to continue work on both spacecraft.

That fundraising is more difficult than last year, which he attributed to broader economic issues like bank failures and high interest rates than issues specific to the space industry, like Virgin Orbit's recent bankruptcy filing. "Raising capital has gotten more challenging." **SN**

JEFF FOUST

Speed and safety are top priorities for regulators

Efforts to streamline and accelerate space licensing procedures to keep up with rapid innovation are bearing fruit, according to a Space Symposium panel of regulatory heads here.

The National Oceanic and Atmospheric Administration now takes just 15 days to issue a commercial remote sensing license, said Glenn Tallia, the regulator's chief legal counsel for weather, space services and research.

That's down from 50 to 100 days before NOAA streamlined regulations in 2020 and is "almost embarrassingly short," Tallia quipped.

However, "it's not because it's a rubber stamp," Talia added, but the result of standardizing how different companies and capabilities are treated in the application process.

Julie Kearney, chief of the Federal Communications Commission's recently created Space Bureau, said the regulator hopes to introduce streamlined rules for satellite applications

"really soon" after closing a comment period.

The FCC recently said it is wading through applications for more than 60,000 new satellites as demand soars for constellations in low Earth orbit (LEO).

Kearney also stressed that work to accelerate licensing regimes comes alongside a simultaneous focus on sustainability.

She pointed to how the regulator adopted rules in September that would shorten the time operators must remove defunct LEO satellites from 25 to five years. However, this item is "in a little bit of a holding pattern" while it clears administrative issues.

Jason Kim, acting chief of staff for the U.S. Commerce Department's Office of Space Commerce, said he had hoped new export control rules for spacecraft and launch vehicles would be announced before the Space Symposium. Kim now expects the new rules, which the State Department is still reviewing, to be released by the end of the year.

Julie Zoller, head of global regulatory



Jason Kim, acting chief of staff for Office of Space Commerce

affairs for Amazon's Project Kuiper broadband constellation, welcomed the progress U.S. regulators are making to streamline their licensing regimes.

Space is a global business, she said during the panel, and "other countries and regions follow our lead — and so whatever we do well, those benefits extend to others, whatever we don't get right, those problems magnify." **SN**

JASON RAINBOW

Export control update on the way

Export control rules promised in 2019, when the U.S. State Department Directorate of Defense Trade Controls and the U.S. Commerce Department Bureau of Industry and Security announced plans to revise the U.S. Munitions List, are likely to be published by the end of the year.

The updated rules for launch vehicles, spacecraft and related articles "is still in the works," Jason Kim, acting chief of staff for the U.S. Department of Commerce's Office of Space Commerce, said April 17 during a Space Symposium regulatory panel.

IN-SPACE SERVICING, ASSEMBLY AND MANUFACTURING

One important topic that is likely to be addressed by the new rules is in-space servicing, assembly and manufacturing (ISAM). Startups

and established companies are rapidly developing spacecraft to extend the life of other satellites, repair mechanical issues or remove them from orbit at the end of missions.

In April 2022, the White House's Office of Science and Technology Policy released a national ISAM strategy with goals for supporting the development of technologies and services ranging from refueling and repairing satellites to building new spacecraft in orbit.

Under existing rules, ISAM activities face stringent export controls.

"In general, if you want to sell this capability to a commercial partner that's not in the United States, you're going to need an export license to have that interaction with the other company's spacecraft because there's going to be an exchange of technical information about designs and engineering to ensure that you can interact with that other spacecraft," Kim said.

To share technical information, ISAM companies

will need licenses under existing International Traffic in Arms Regulations.

"That's a cumbersome process," Kim said. "There's a fee. There's a registration process." And it can take a long time.

"It would be much better and much easier for industry if all that can be done at Commerce under the Export Administration Regulation system, which is a lot more business-friendly," Kim said.

NOT TOO LATE TO COMMENT

Although the comment period for the 2019 Advance Notice of Proposed Rulemaking ended years ago, Kim suggested people interested in the subject share their comments and concerns with the State Department.

"Just because the docket has closed, doesn't mean they're not going to accept your comments," Kim said. "They will still accept your inputs and consider them." **SN**

DEBRA WERNER

AWS chooses 14 startups for its third space accelerator program

Amazon Web Services said April 18 it picked 14 U.S. and European startups to join its third annual space accelerator program kicking off in May to boost ventures with solutions for improving space sustainability.

The four-week program provides technical and business support for early-stage space companies looking to develop their businesses using the cloud.

Each participant is eligible for up to \$100,000 worth of technical services from Amazon's cloud subsidiary. The event will culminate July 19 in a demonstration day in San Francisco.

This is the first time AWS has called for applications with proposals for addressing a specific theme, according to AWS director of aerospace and satellite Clint Crosier, although he said space sustainability is a broad area of focus.

"Therefore, we were mindful to consider a broad definition of the term — anything addressing the safe, prosperous, and sustainable future in space; as well as using space insights to address sustainability challenges here on Earth," Crosier said via email.

The winning startups this year are developing businesses across areas including environmental monitoring, aerospace manufacturing, propulsion, satellite operations, and space logistics.

The AWS Space Accelerator 2023 participants are:

- New Castle, Delaware-based **Delta-V Analytics**, which has developed software for automating satellite constellation operations.
- Vienna, Austria-based in-space propulsion provider **GATE Space**.
- Lille, France-based **GRASP** with plans for satellite instruments and products that

JASON RAINBOW



2023 Space Accelerator participants and AWS staff at an onboarding event ahead of the four-week program starting in May.

would tackle climate change and improve air quality.

- Torrance, California-based in-space manufacturing venture **In Orbit Aerospace**.
- Seattle, Washington-based **Integrate Space**, which is building a logistics project management platform for complex space development and deployment tasks.
- Space-based signals intelligence provider **Kawa Space** of San Francisco, California.
- Houston-based near-real-time space analytics provider **Little Place Labs**.
- Subsurface exploration and resource extraction specialist **Lunasonde**, based in Tucson, Arizona.
- Kansas City, Kansas-based **Raven Space Systems**, which is 3D-printing reentry capsules designed to return cargo from space.
- Autonomous space robotic systems

developer **Rogue Space Systems**, based in Laconia, New Hampshire.

- Austin, Texas-based **Nominal**, which is developing software to help companies test and deploy complex space hardware.
- Albuquerque, New Mexico-based electro-mechanical propulsion developer **Space Kinetic**.
- **Violet Labs**, a Minneapolis, Minnesota-based startup building a cloud-based software integration for complex hardware engineering.
- **Xona Space Systems** of Burlingame, California, which is building a small satellite navigation constellation.

A total 34 startups have participated in the AWS Space Accelerator over the last three years, including this latest cohort. **SN**

Space Forge plots expansion into US



Left: Space Forge co-founders Joshua Western and Andrew Bacon. **Above:** Rendering of a ForgeStar satellite like the one lost on Virgin Orbit's failed U.K. launch in January.

Space Forge announced plans April 19 to expand its U.S. presence to include manufacturing. The Cardiff, Wales-based startup focused on fabricating high-value materials in space is looking for a U.S. location for manufacturing ForgeStar satellites and payloads for U.S. customers.

"We are engaged in conversations with multiple states to identify the best location to our new US HQ," Tarek Waked, ForgeStar board member and investor, said by email.

Among potential U.S. customers, Space Forge sees strong interest in on-orbit semiconductor manufacturing.

"We've had a lot of taps on the shoulder from both government and commercial players that are interested in our core capabilities," Space Forge CEO Joshua Western told SpaceNews.

The combination of the war in Ukraine, U.S. passage of the CHIPS Act and reshoring initiatives "is leading to a surge in sovereign and allied semiconductor capability," Western said. "We've seen a strengthening of Five Eyes and the AUKUS Alliance. We're positioning ourselves well across those allied partners to be able to deliver."

Waked, founding partner of Type One

DEBRA WERNER

"We've seen a strengthening of Five Eyes and the AUKUS Alliance. We're positioning ourselves well across those allied partners to be able to deliver."

— Joshua Western, Space Forge co-founder

Ventures, added in a statement, "Space Forge's move to the U.S. couldn't have come at a better moment, what with the CHIPS Act and NASA's enthusiasm for in-space manufacturing. The team's efforts on the ForgeStar platform are paving the way for an 'above shore' capability, which is super cool."

FLOATING BACK

Space Forge raised \$10.2 million in 2021 for its plan to operate ForgeStar, a reusable satellite designed for on-orbit manufacturing and precision return of payloads to Earth. The company intends to take advantage of microgravity, extreme temperatures and the vacuum of space to produce materials that are purer and have fewer defects than materials produced on Earth.

To prevent defects from occurring during the journey back to Earth, ForgeStar will "effectively float from orbit to the ground much more gently than your traditional ablative capsule," Western said.

Space Forge intends to manufacture

semiconductors, alloys and biological materials in orbit.

"We occasionally will be flying ancillary payloads as well," Western said. "They might be doing space domain awareness, space weather, sensing or material science for spacecraft structures."

FORGESTAR-1A LAUNCH

Space Forge lost its first satellite, ForgeStar-0, on the Virgin Orbit launch from the U.K. that failed in January.

An upgraded version, ForgeStar-1A, is scheduled to launch later this year on a SpaceX Falcon 9 rideshare flight. ForgeStar-1A will demonstrate Space Forge's in-space manufacturing capability and gather safety data, Western said.

"We'll be demonstrating a lot of the safety case around being able to return these sorts of platforms to not just North America, but also to Europe and other return locations that we're looking to establish in both hemispheres," Western said. **SN**

The momentum of rebellious rocketry

A radical departure in launch is tucked away at Spaceport New Mexico, the FAA-licensed launch complex that sprawls across 18,000 acres adjacent to the U.S. Army White Sands Missile Range in southern New Mexico.

The inventive company's name, SpinLaunch, is a sure tipoff that rebellious rocketry is being sought. The intent is to build a ground-based, kinetic launch system that would slingshot small satellites into low Earth orbit at a high cadence for a low cost.

Now planted on Spaceport New Mexico real estate is the hefty SpinLaunch Suborbital Accelerator, a 33-meter in diameter structure that houses a vacuum-sealed centrifuge to rapidly rotate a rocket and then hurl it skyward from a launch tunnel – a high-speed mechanical airlock. The mass accelerator is designed to operate up to 8,000 kilometers per hour.

Test cadence

“To date, we have conducted a total of 10 successful launches at the Spaceport, with various vehicles and launch velocities,” said Jonathan Yaney, CEO of SpinLaunch, which he formed in 2014. The group's upcoming flight test cadence is “now more dependent on our customer and partner's requirements and schedule,” he added.

Given the novel technology utilized, but with limited flight testing under their belt, Yaney underscored several technology pluses that have been demonstrated.

“While we've conducted hundreds of tests on our 12-meter Lab Accelerator in our Long Beach Headquarters, the 33-meter Suborbital Accelerator marked our first atmospheric flight tests,” Yaney said. On Oct. 22, 2021, the electric-powered Suborbital Accelerator was first put through its paces. In reviewing the 10 test flights to date, a key triumph, he said, centered on operating the SpinLaunch high-speed airlock system, a critical part in maintaining chamber vacuum during and after launch.

Yaney said that the SpinLaunch team also demonstrated a rapid launch capability by carrying out two flight tests in less than a 48-hour system turnaround between flights 3 and 4, showing that the hardware can be operated by as few as five technicians.

Another major milestone was flight test 10 in September 2022, Yaney said, where payloads from NASA, Airbus U.S., Cornell University, and Outpost Space were flown. The flight test showed that standard satellite components are inherently compatible with the g-forces produced during a SpinLaunch sendoff. As part of the pre-flight qualification process, SpinLaunch accelerated payloads up to 10,000 g's in the company's Lab Accelerator anchored in California. All payloads were flown

and recovered successfully, he said.

GROWTH AND MOMENTUM

The Suborbital Accelerator is viewed as a vital step in advancing SpinLaunch's pathway to orbit using a 100-meter Orbital Launch System in development for 2026. Thrown at high velocity, the unleashed rocket projectile would then ignite its engines at roughly 60 kilometers to lob payloads of up to 200 kilograms into orbit.

According to the company, the first orbital launch site is in final selection in a soon-to-be-disclosed location in a coastal region of the United States. To gain launch site licensing, SpinLaunch is closely working with the Federal Aviation Administration and other governing agencies.

Yaney said SpinLaunch's planning horizon for 2024 is all about growth and momentum. It has a new product line of modular satellite buses designed for mass production. “By offering a high-performing space platform at a fraction of the cost, we are addressing a major pain point for customers deploying satellite constellations,” he said. **SN**



Taller than the Statue of Liberty, the SpinLaunch Suborbital Accelerator at Spaceport America in New Mexico has hurled atmospheric flight test vehicles skyward.

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COMMENTARY DOUGLAS LIGOR AND JOSH BECKER

Enter outer space at your own risk?

If you pay a company like SpaceX, Blue Origin, Virgin Galactic, or Boeing to go into space, perhaps even perform your own spacewalk, should those companies be bound by safety regulations issued by the Federal Aviation Administration (FAA)? Currently the answer is “no” thanks to a law that bans federal regulation of commercial space enterprises.

As a result, individuals who choose to go to space, and the general public, may not have sufficient information to reasonably assess the safety of commercial spaceflight. It’s time to allow the moratorium on regulation to expire and allow the development of safety standards, led by the FAA.

Since 2004, federal law has barred most participant safety regulations and leaves nearly all issues of safety procedures, equipment, and standards for commercial spaceflight participants like amateur astronauts up to the discretion of the company providing the service. As a result, companies voluntarily determine and choose to apply safety standards that they deem appropriate. These include basic, critical safety aspects like when passengers should be strapped into the vehicle’s cabin, when they should wear pressurized suits in case of a loss of oxygen and what risk tolerance for serious injury or death they might encounter.

There were several reasons why Congress imposed the moratorium and continued to extend it up to the present. Lawmakers, the commercial space industry, and other stakeholders believed that a “learning period” was necessary to ensure that any regulations eventually issued would necessarily “take into consideration the evolving standards of the commercial space flight industry.” In other words, because the industry was so new, and the number of commercial spaceflights continued to be limited, there was insufficient data, information, testing, and experience to craft effective safety rules.

Another reason is that as different companies designed and developed unique types of vehicles, systems, and equipment to go into space, it would be impractical to impose a single set of rules that would have broad applicability. This has certainly become the case as even the basic designs of the current crop of commercial space vehicles differ significantly.

For example, SpaceX and Blue Origin employ different types of crew capsules and Virgin Galactic employs a fuselage-type crew vehicle rather than a capsule. Each vehicle would naturally require safety standards specific to its design.

However, on Oct. 1, 2023, the moratorium on federal regulation is set to expire. RAND was asked by Congress to assess the state of the development of voluntary safety standards led primarily by industry in coordination with private standards development organizations and the FAA’s Commercial Space Transportation Advisory Committee. RAND was also asked to assess if commercial spaceflight is ready for government regulation.

One significant finding that drove our conclusions is that the current state of participant safety is largely unknowable because sufficient data and information are not available. Three factors contribute to this lack of transparency.

First, companies that offer commercial spaceflight services are not required to share their safety data and information publicly, including incidents or anomalies that may indicate risk. Additionally, companies are reluctant to share this data voluntarily because it may disclose proprietary information that, if revealed, could harm a company’s reputation, or allow its intellectual property to be appropriated by others unfairly. This fact is despite the National Transportation Safety Board (NTSB) recommendation after the 2014 crash of Virgin Galactic’s SpaceShipTwo that the FAA should work in collaboration with the spaceflight industry to develop a database of lessons learned from commercial space mishap investigations, and encourage industry members to voluntarily submit lessons learned.

Second, current regulations direct companies to provide “informed consent” notification to individuals who pay to go to space on their vehicles. The belief underlying the informed consent rule is that if companies provide information to would-be spaceflight participants about the risks and hazards of spaceflight, individuals can judge for themselves whether they are willing to accept the risks. However, these notifications are also not publicly available.

Third, industry and interested stakeholders participate in public and semi-public forums

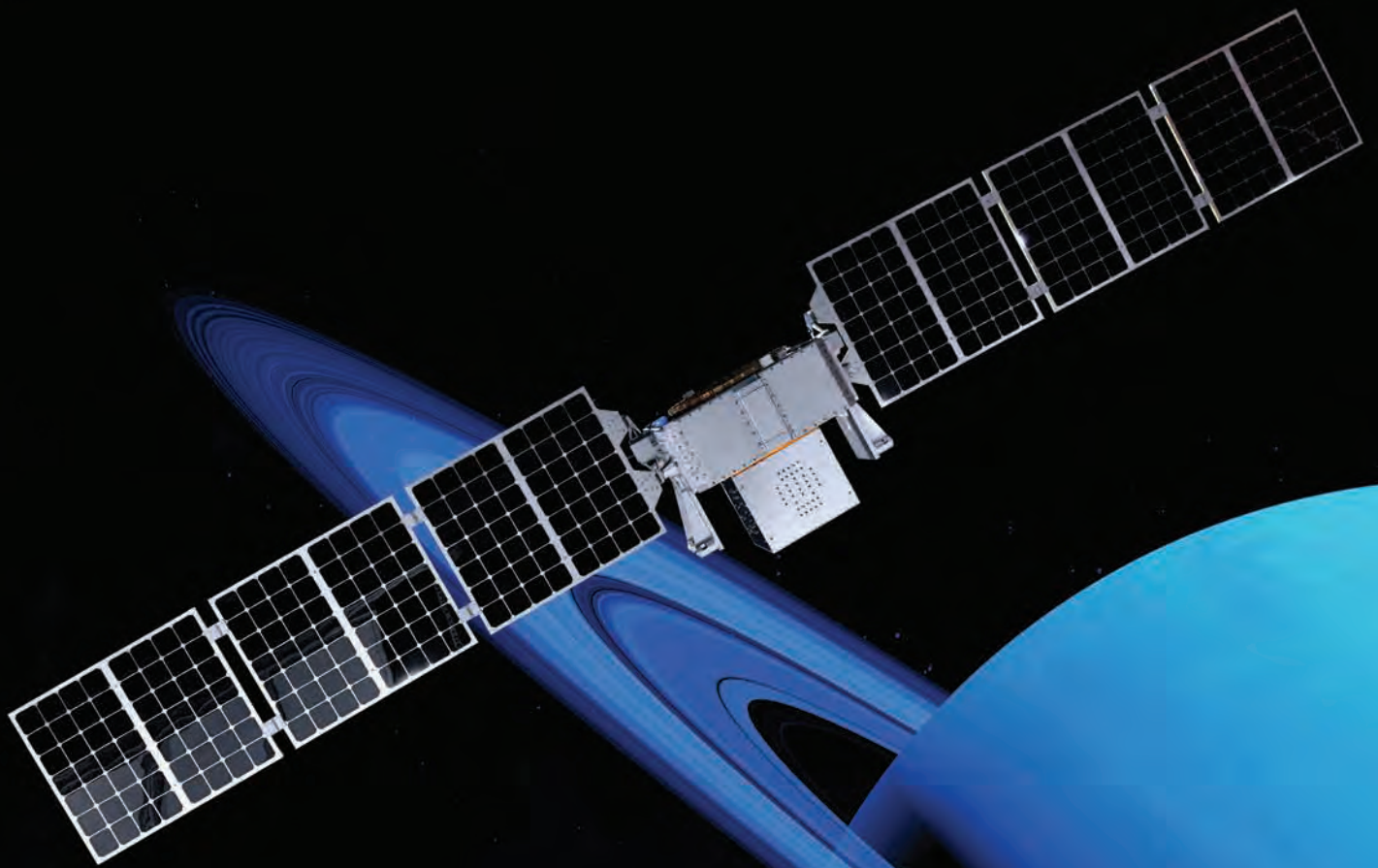
to develop voluntarily agreed-upon, industry-wide, safety standards, but consensus has been elusive. Because of the varied types of companies and stakeholders involved, and because of the diverse interests at stake, some who participate are incentivized to slow the development of safety standards out of a concern that they may be disadvantaged in comparison to competitors. As a result, there have been very few safety standards published that relate to participant safety.

Based on these factors, it is not possible to independently assess and analyze whether policymakers, spaceflight participants, industry, or the public have sufficient information to make reasonably informed decisions about the safety of commercial spaceflight. Allowing the moratorium to expire would clear the way for the FAA to begin informal, publicly accessible, rulemaking activities. As part of these activities, the FAA, industry, standards development organizations, and other interested stakeholders could work in collaboration to determine next steps for the development of safety standards—whether they continue to be developed voluntarily, or whether binding rules should be considered.

While we’re not suggesting any specific types of regulations at this time, our research generally supports considering rules that would increase transparency with respect to the identification, collection, reporting, and analysis of key safety data and information. The current practice of nondisclosure and siloing of data and information may result in gaps or blind spots that could increase the likelihood of a catastrophic event.

A system that would enable the FAA, industry, and stakeholders to develop safety standards more collaboratively, while also providing sufficient protections for sensitive corporate information, may help to enhance the sustainability and growth of the commercial spaceflight industry.

DOUGLAS LIGOR IS A SENIOR BEHAVIORAL/SOCIAL SCIENTIST AT THE NONPROFIT, NONPARTISAN RAND CORPORATION, AND A MEMBER OF RAND’S SPACE ENTERPRISE INITIATIVE. **JOSH BECKER** IS AN ADJUNCT POLICY RESEARCHER AT RAND.



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Ukraine's lessons for military space

"It shows the close relationship we need to have with industry as we move forward"

Ongoing fighting in Ukraine continues to underscore the importance of combining military, civil and commercial space capabilities, international military space leaders said April 18 at the Space Symposium.

Ukraine has been able to fend off Russian forces with the help of space-based weather data, communications, GPS, intelligence, surveillance and reconnaissance, said Lt. Gen. Eric Kenny, Royal Canadian Air Force commander. Even the surface-to-air missiles Canada donated to Ukraine depend on space systems like GPS and satellite communications, he added.

At the outset of the war, commercial satellite imagery played a critical role in helping Ukraine and its allies counter Russian propaganda, said Air Vice-Marshal Paul Godfrey, commander of the U.K. Space Command.

When Russia claimed that Ukrainians killed their fellow civilians in the town of Bucha, Maxar Technologies' unclassified time-stamped satellite imagery appeared on the front pages of newspapers around the world in April 2022 to prove the claim wrong.

"We were able to fend off that false narrative," Godfrey said. "Do not underestimate the deterrent effect that that had on the Russians."

PROTECTING COMMERCIAL ASSETS

The war in Ukraine showed that commercial "entities can provide cost-effective and scalable solutions that meet some of NATO's intelligence requirements," said U.S. Air Force Lt. Gen. David Julazadeh, deputy chief of staff for capability development in NATO's Allied Command Transformation headquarters.



The 2023 Space Symposium international military panel discussion included: U.S. Air Force Lt. Gen. David Julazadeh, deputy chief of staff for capability development for NATO's Supreme Allied Commander; Air Vice-Marshal Paul Godfrey, commander of the United Kingdom Space Command; and Lt. Gen. DeAnna Burt, U.S. Space Force deputy chief of space operations for operations, cyber and nuclear.

Because those contributions are so apparent, the war also "reinforced our need to protect and defend" commercial space assets, said Kelli Seybolt, U.S. Air Force deputy undersecretary for international affairs.

At the war's outset, Russian forces targeted Ukraine's communications infrastructure with missiles and cyberattacks on Viasat's KA-SAT and SpaceX's Starlink networks.

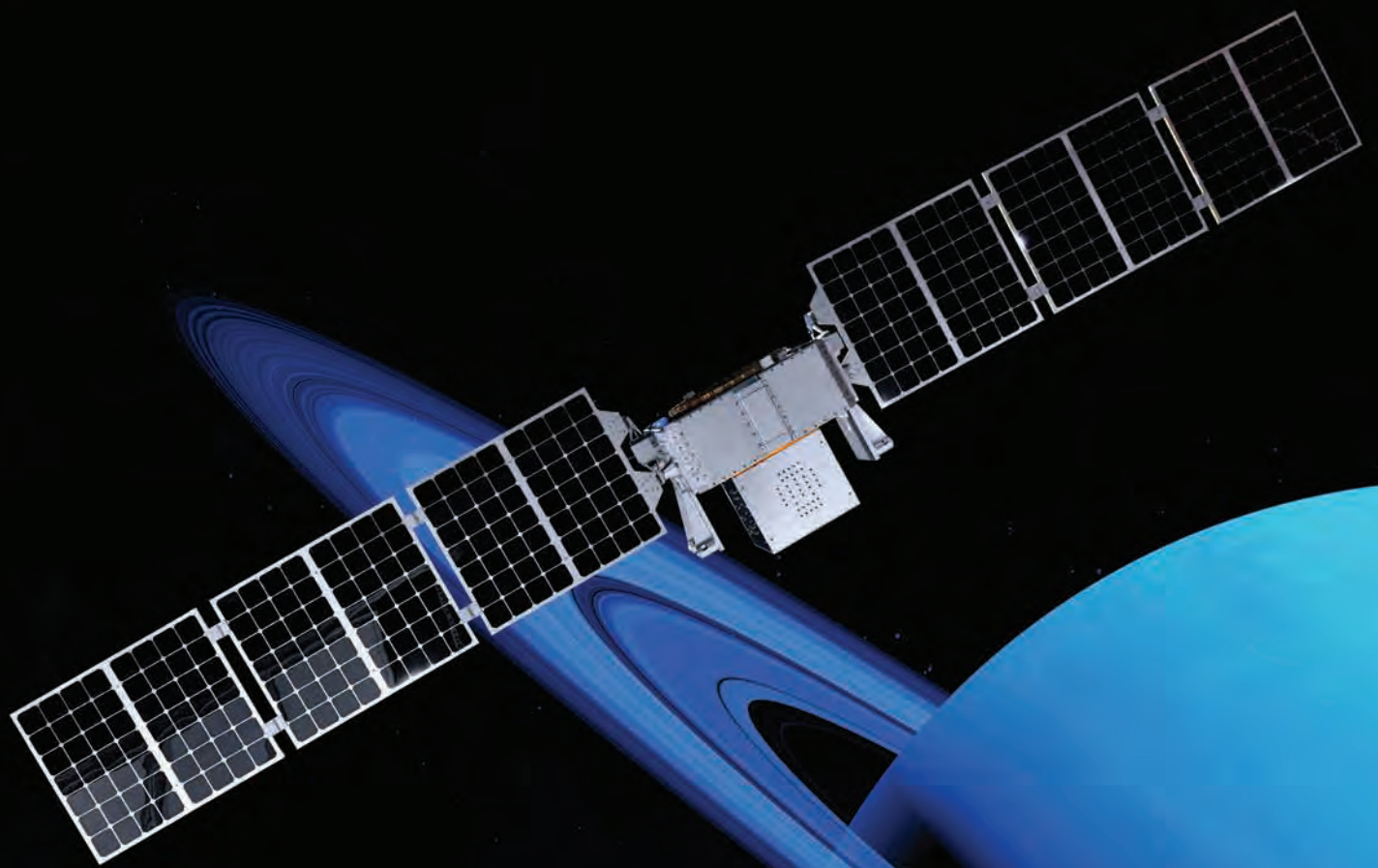
"So, it was significant for us to see how a proliferated LEO constellation could bring communications back," said Godfrey. "One of the more interesting things here, and it's well documented on Twitter by Elon himself, is the cyber-jamming attacks

against Starlink throughout this and how resilient they have been as well. That is really something that we're looking at and trying to understand."

The U.S. Space Force, meanwhile, is focused on the cybersecurity of its own networks as well as working "with our allies and partners to defend our shared networks as we go forward in a coalition engagement," said Lt. Gen. DeAnna Burt, Space Force deputy chief of space operations for operations, cyber and nuclear.

For example, the Space Force is considering "how are we sharing cyber threat information across the coalition and the >

SEE LESSONS, PAGE 4



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Blue Canyon Technologies' heritage of innovation is what keeps our fleet of spacecraft and components so revolutionary. By using sophisticated manufacturing to produce higher volumes of hardware on faster timelines, we successfully launch more spacecraft into orbit—bringing the vastness of space a little more down to earth.

Saltzman: 'We must pivot' to new ways of doing business



Chief of space operations of the U.S. Space Force Gen. B. Chance Saltzman speaks April 19 at Space Symposium

The chief of space operations of the U.S. Space Force Gen. B. Chance Saltzman called on the service to embrace challenges and opportunities created by the rapid commercialization and militarization of the space domain.

"I fundamentally believe we are now at the precipice of a new era in space," Saltzman said April 19 at the Space Symposium.

Saltzman assumed command of the Space Force in November. Since taking office, he has championed cultural changes in the service, including new ways to recruit talent and work with the private sector.

"The Space Force, our industry partners, our allies, our interagency teammates must collectively pivot to new ways of doing business to keep up with the new operating environment," he said.

Although the Space Force is only three years old, it was carved out of the former Air Force

Space Command and inherited the culture and ways of doing business from the first space age that started in the late 1950s and was shaped by the geopolitical tension between the United States and the Soviet Union. "I'm convinced that old methods, old mindsets are not going to be effective in addressing these new challenges," said Saltzman.

Now the Space Force has to quickly adapt to new realities, notably the threats posed by technologies that China and Russia have developed to target U.S. satellites. Over many years, the Chinese and the Russians have watched how dependent the U.S. military has become on satellites for every aspect of operations and would likely try to disrupt U.S. space systems during a conflict.

THREATS TO SATELLITES

In the last 15 years, Saltzman said, "we are seeing an incredibly sophisticated array of threats, including traditional satcom jammers

and GPS jammers to even more destabilizing direct ascent anti-satellite weapons across multiple orbital regimes."

"We're seeing on-orbit grapplers, pursuit satellites, nesting dolls, directed energy weapons, cyber attacks," he added. "And it's not just threats against our on-orbit systems. It's the use of systems by our competitors creating threats to the joint force and other domains."

The United States and allied forces must "contend with space-enabled attacks on our forces in air, land and sea," said Saltzman. In this new era, he said, "space is far more contested; U.S. access to space capabilities is not a given. This new era of space is far more congested and will challenge our ability to maintain situational awareness and operate safely in the domain."

The rapid commercialization of space, access to satellite and launch services from the open market means U.S. adversaries can innovate relatively quickly and compete with the United States.

That democratization of space is a reality that the U.S. military has yet to adjust to, Saltzman noted. "We're now seeing investments in space mobility and logistics, refueling, life extension programs, proliferated low Earth orbit, internet satellites and more," he said. "As this all unfolds, it is imperative that we understand that our traditional ways of addressing challenges must be evaluated."

EMPOWERING YOUNG LEADERS

Saltzman said it's important for current leaders to empower younger officers and allow them to innovate. "A contested, congested domain is their normal, and they wonder why the institutions are holding on to old methods and mindsets," he said, referring to junior leaders.

He encouraged young officers and enlisted personnel in the audience to "question existing ways of doing business."

"We must pivot," Saltzman said. "This is an imperative for the collective national security space enterprise, our industry partners and our allies. The old ways of doing business are too slow, too late to need, and too behind the times to meet the challenges we face."

He said some changes already are underway, including funding in the 2024 budget for proliferated LEO constellations and next-generation satellite communications systems. "We are building assets that are more survivable for this new era." **SN**

SANDRA ERWIN



NRO seeks innovative electro-optics

The National Reconnaissance Office is casting a wide net in its latest bid for commercial Earth observation. Innovative electro-optical capabilities will be the subject of the fourth focus area of the Strategic Commercial Enhancements Broad Agency Announcement. In a request for proposals scheduled to be released in the fall, NRO will invite U.S. companies and foreign-owned companies with U.S. subsidiaries to share information on new sensors, innovative ways of processing data and constellations.

DEBRA WERNER

“There are not specific things that we’re looking for,” NRO Director Christopher Scolese said April 18 at the Space Symposium here. Instead, NRO wants “to see what’s out there for people or organizations that are interested in working with us and to give them the opportunity to see what we do in more detail. Then, we can determine collectively if we see a mutual benefit and how to make that happen in the future,” he added.

PREVIOUS BROAD AGENCY ANNOUNCEMENTS

The NRO began issuing Broad Agency Announcements in 2021 for Earth-observation

Above: NRO Director Christopher Scolese spoke April 18 at the Space Symposium.

products and services. Previous BAA’s focused on synthetic aperture radar, hyperspectral and radio-frequency data.

The NRO also acquires electro-optical imagery for U.S. intelligence, defense and federal civil agencies through contracts awarded in 2022 to BlackSky, Maxar Technologies and Planet.

“We do have electro-optical systems out there today,” Scolese said. “They’re doing very well, and we’re going to continue to go off and use those. We’re looking for the next step.” **SN**

LESSONS FROM PAGE 1

< > partnership so that we’re all looking at ways to creatively exploit the capabilities that we have to defend against cyber,” Burt said. Potential solutions include jointly buying or building unique cyber-defense systems,” she added.

CLOSE RELATIONSHIPS

Panelists cited specific civil and commercial space systems that have proven valuable in supporting Ukraine.

The Canadian government worked with MDA to supply data from the Canadian Space Agency’s three-satellite Radarsat Constellation Mission “to show the Ukrainians where the Russians were advancing and to help with their targeting,” Kenny said. Another

Canadian company, Telesat, provided critical communications, he added. “It shows the close relationship we need to have with industry as we move forward,” Kenny said.

Gen. Hiroaki Uchikura, Japan Air Self-Defense Force chief of staff, said one of Japan’s takeaways from the war is the need to “promote the utilization of private and commercial satellites by strengthening government-private cooperation.” **SN**

Kendall to seek new congressional authorities to speed up acquisitions



“We’re waiting for Congress to authorize new starts and appropriate funding,” U.S. Secretary of the Air Force Frank Kendall said during an April 19 keynote at the 38th Space Symposium in Colorado Springs.

U.S. Secretary of the Air Force Frank Kendall has submitted to congressional committees a proposal to allow selected programs in the Pentagon’s budget to get started before Congress passes the final appropriations bill.

Speaking April 19 at the Space Symposium, Kendall said it is “troubling” that the U.S. Air Force and Space Force have not been able to start critical programs to compete with China because of the lagging budget process.

“Our posture now is that we’re waiting for the Congress,” Kendall said.

‘OPERATIONAL IMPERATIVES’

Since taking office two years ago, Kendall has warned about China’s advances in military and space technologies and the possibility that they could surpass the United States. In a list of “operational imperatives” for the 2024 budget Kendall called for investments

in areas like hypersonic weapons, autonomous aircraft, cybersecurity and resilient satellite constellations.

Kendall said the Department of the Air Force nearly two years ago completed the analysis to justify funding in the 2024 defense budget for at least 20 new programs. But none of those projects can start until Congress passes a spending bill, which is not likely to happen for several months.

In the meantime, “We’re in waiting mode,” he said. “We’re waiting for Congress to authorize new starts and appropriate funding.”

The priority programs Kendall wants to start or accelerate — including new missile-warning satellites, remote sensing satellites to track moving targets and hypersonic vehicles — are on hold for several months or even a full year if there’s gridlock and the government is funded by temporary measures. Under continuing resolution funding, new programs can’t be started.

Kendall’s new legislative proposal would

allow these programs to start before funding is fully appropriated. “This would not be very expensive,” he said. It would allow the Air Force and Space Force to get a head start.

“Hopefully, Congress will approve this,” Kendall said.

The legislative proposal “gives the department some authority to initiate a program, if we are surprised technologically, without waiting for congressional approval,” he said. “This is a limited authority that would allow us to go through the preliminary design review phase to design, do performance trade-offs, systems engineering, maybe do some risk reduction.”

This will require some flexibility on the part of Congress, he noted. “I’ve tried to bring a great sense of urgency to the department. I think I’ve succeeded in that. I think we’ve got people mobilized, if you will, to respond to the challenges that we face. Now we need to move forward as quickly as possible.”

“It’s a minimum amount of authority Congress has to give up for a big return,” Kendall said.

WAR WITH CHINA A RISK

Shaping these discussions is the possibility of a military conflict with China, which Kendall said is not “inevitable” and would likely not start intentionally. “But it’s not impossible,” he said. “The danger is increasing over time.”

A “miscalculation” in space could escalate to a broader conflict, he said.

“China views space as an operational domain where it wants to dominate,” said Kendall. It is developing terrestrial and orbital anti-satellite weapons and is not concerned about creating debris or whether they lead to strategic instability, he added.

“China’s lack of concern about space norms is worrisome and creates a risk of miscalculation,” Kendall said.

This is a troubling scenario because a war that extends into space is uncharted territory, said Kendall. “If deterrence fails, we will all have a lot to learn.” **SN**

SANDRA ERWIN



The United Launch Alliance Vulcan Certification-1 (Cert-1) rocket on March 9, 2023, rolled to Space Launch Complex-41 at Cape Canaveral Space Force Station for the next phase of qualification testing in preparation for the inaugural flight.

Vulcan keeps Space Force in wait-and-see mode

The head of the U.S. Space Force launch program office, Maj. Gen. Stephen Purdy, said United Launch Alliance had briefed him on an anomaly experienced last month during testing of the Centaur upper stage of ULA's new rocket Vulcan Centaur. But he said it's too early to predict what long-term impacts further delays of Vulcan's debut launch might have on the national security launch program.

"Yes, we're tracking the ULA Centaur upper-stage issue. It's still under investigation. Obviously, we're closely following that," Purdy told reporters April 18 at the Space Symposium.

Purdy is the commander of Space Launch Delta 45 at Cape Canaveral, Florida, and program executive officer for assured access to space.

Before the March 29 incident, first reported by Ars Technica, ULA had announced a May 4 target date for Vulcan's first launch, known as Cert-1.

SANDRA ERWIN

PERHAPS A JUNE OR JULY LAUNCH

ULA's CEO Tory Bruno, said April 14 via Twitter that Vulcan likely won't be ready before June or July. Vulcan must complete two orbital missions successfully to get certified to launch U.S. military and intelligence satellites under the National Security Space Launch program.

"Our hope is that we can find the way to continue to pursue the Cert-1 launch, which would be great," Purdy said. "And then it just becomes a more of a long-term fleet kind of a discussion. That's our hope. The data will drive us into that decision or not."

In an April 13 tweet, Bruno shared a video of a fireball igniting during tests of a structural article of the Centaur upper stage of its Vulcan rocket at NASA's Marshall Space Flight Center in Huntsville, Alabama.

The Space Force was expecting Vulcan to launch its first national security mission in late 2023, but that now appears unlikely.

A leak caused hydrogen to accumulate inside the test rig, Bruno wrote. "H2 accumulated inside the rig. Found an ignition source. Burned fast. Over pressure caved in our forward dome and damaged the rig."

On March 29, he said a hardware anomaly occurred during qualification testing of a Centaur 5 structural article. "This is why we thoroughly & rigorously exercise every possible condition on the ground before flight. Investigation is underway. Vulcan will fly when complete," Bruno wrote.

He said the company has not yet determined if the problem was the test article or the ground system.

Vulcan is already years behind schedule due to delays in developing and testing the Blue Origin BE-4 engine that powers the vehicle's first stage.

VULCAN NEEDED TO LAUNCH NATIONAL SECURITY MISSIONS

The Space Force was expecting Vulcan to launch its first national security mission in late 2023, but that now appears unlikely. The vehicle was selected in 2020 to launch 60% of national security missions over five years. SpaceX won the other 40%.

Randy Kendall, vice president of launch and architecture operations at the Aerospace Corp., told *SpaceNews* that depending on the outcome of the investigation, the Space Force would chart several paths to deal with the potential delays.

Aerospace is a nonprofit that provides technical advice to the U.S. government, as well as engineering and support services for the national security space launch program.

Kendall said he could not comment on the specifics of the Centaur anomaly.

"The good news is that BE-4 testing and qualification has come along really well," he said. "I don't anticipate they're going to have any challenges getting off the launch pad this year."

Under the terms of the National Security Space Launch Phase 2 contract won by ULA and SpaceX, Kendall said, if one of the providers is unable to perform a mission, the Space Force could choose to delay the mission or ask the other provider to step in. **SN**



Early-stage space investor Mark Boggett (left) said there were a record 25 growth rounds in first three months of 2023, although the average amount raised in these deals has not yet reached heights seen in other quarters.

Space investors see industry growth capital returning after uncertain 2022

Investment activity is picking up again for young space companies as growth-stage capital returns following market uncertainty in 2022, according to investors on an April 18 Space Symposium panel.

The “space industry is thriving at the moment,” Seraphim Space CEO Mark Boggett said, pointing to the venture capital firm’s research showing a record 25 growth rounds in the three months to the end of March.

However, he said these growth rounds — Series B, Series C, Series D, and beyond — remain smaller in value than previously seen in the industry.

When excluding mega-deals, Seraphim data shows the average growth-stage round size was \$38 million in the first quarter of 2023, compared with north of \$60 million as recently as the second quarter of 2022.

While Boggett said the volume of new companies coming to the space industry is increasing quarter-on-quarter despite challenging macroeconomic conditions, “the one area where we have a weakness in this

market is around growth capital.”

It’s an area that suffered a “setback during the course of the last 12-18 months,” he said, as public investors that were becoming more interested in space as a growth market lost out amid the hype surrounding a spate of companies that went public via merging with a SPAC, or special purpose acquisition company.

The poor share performance of these high-profile space companies is also dragging on the valuations of other companies in the industry.

Space companies are not being treated differently than “deep tech” firms that also went public via a SPAC, Boggett said, but the sector has seen a “huge amount of interest that has now gone wrong to some extent.

“And what we now have to do is we’ve got to rebuild the confidence of these growth stage investors to bring them back into the market,” he added, “so that these companies that are being created, that provide all of these amazing capabilities, are going to be able to grow and scale and thrive.”

Boggett said he is confident the industry

will get there, not least because of the huge defense budgets across the world that he expects will drive significant revenues through many of these businesses.

“It’s the revenues and the growth in those revenues that are going to attract the growth investors,” he said, adding that sovereign investors and climate-focused funds are also becoming an increasingly important source of capital for space companies.

Pete Cannito, CEO of space infrastructure conglomerate Redwire, which has shares currently trading at around \$3 after going public via a SPAC merger in 2021 at \$10, stressed the need for investors to understand that investing in space “is a long game.”

“It’s been a very dynamic couple of years,” Cannito said, “but this is not a declining market. Space is more important than ever, in the civil domain, in the national security domain, and in a commercial domain.”

The space economy is also rapidly maturing, said Laurence Vigeant-Langlois, a managing director at private equity firm AE Industrial Partners, which she said will increasingly attract more institutional investors. **SN**

JASON RAINBOW



Left: Rocket Lab CEO Peter Beck in 2018. **Right:** A Rutherford engine recovered from the booster used on an Electron launch in May 2022 will be reflown on an Electron launching in the third quarter of 2023

Rocket Lab to reflly Electron engine

Rocket Lab will use a previously flown engine on an upcoming Electron launch as the company moves closer to reusing the rocket's entire first stage.

Rocket Lab announced April 19 that it will use a Rutherford engine originally flown on a May 2022 Electron launch, whose booster was recovered, on another Electron launch scheduled for the third quarter of 2023. The launch will mark the first time Rocket Lab has reflown an engine.

"We really wanted to get an engine back on the vehicle quickly," Peter Beck, chief executive of Rocket Lab, said in an interview during the 38th Space Symposium. "The engine is the hardest thing to recertify for flight." The third quarter launch is the earliest opportunity to do so since the vehicles planned for launch this quarter have already been assembled.

The company decided to integrate the engine after putting recovered engines through a "huge barrage" of testing to requalify them, he said. "We got to the point where that's done and we're very happy with it, so it's time to put one in production."

He said nearly every Electron booster now

being produced will have some components that have previously flown. That gets the company closer to the long-term goal of refurbishing and refling an entire booster. Beck, though, declined to estimate when he felt the company would reuse a booster.

Rocket Lab also confirmed that it will no longer attempt mid-air recoveries of the boosters as part of their reusability effort. The company made two such attempts last year but was unable to catch the booster. Instead, the company will recover the boosters from the ocean after splashdown, something Beck said in February the company was leaning towards doing.

"We were always afraid of getting it wet," he said, which led them to try the helicopter approach. "We were surprised when we pulled the first one out how good it was." The company has since made what he described as some tweaks to the booster design "to ensure the bits that we don't want to get wet don't get wet."

Beck said Rocket Lab is still planning as many as 15 Electron launches this year. The next two will carry NASA TROPICS cubesats on missions scheduled for the end of April and mid-May. The company recently moved those launches from Virginia to New Zealand.

SUBORBITAL ELECTRON

Rocket Lab is also offering a suborbital version of Electron for hypersonics research. The company announced the Hypersonic Accelerator Suborbital Test Electron (HASTE) vehicle April 17, which will make its first launch later this quarter from Wallops Island, Virginia, for an undisclosed customer.

HASTE is very similar to the Electrons used for orbital launches. The vehicle has some minor changes, such as a modified kick stage and strengthened structures, that allows it to fly suborbital payloads weighing up to 700 kilograms. "But apart from that, it's a standard Electron," Beck said.

Rocket Lab sees strong interest in HASTE for hypersonics testing and targets from Defense Department agencies. "We can get exact trajectories at a cost and frequency but also an accuracy that's never been available before," he said.

The company has not set a flight rate for HASTE yet. Beck said the company would likely fly a couple "to ease our way in" and then determine how to best meet demand.

"It's great for the orbital business as well," he added. "The more vehicles we put through the factory, the cheaper they get." **SN**

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“A lot of institutional investors have lost hundreds of millions of dollars, and that then trickles down to the folks that are looking to allocate private capital,” Matt Kuta, chief operating officer at industry consolidator Voyager Space, said April 17 during a Space Symposium panel discussing the outlook for deal-making in the space industry.

Lower space company price tags pave the way to more acquisitions

A drop in space company valuations could open the door to more transactions in the industry, according to an April 17 Space Symposium panel on the outlook for deals, as long as they can navigate increasing regulatory scrutiny.

“There were a lot of deals that we haven’t participated in over the last five years because the companies were overvalued,” said Megan Crawford, co-founder of venture capital firm SpaceFund.

“I like to refer to this as the magic space sprinkles,” she said, “you add space, or AI, or blockchain to the name of your company and all of a sudden the valuation goes up

JASON RAINBOW

by 100x.”

She said this issue was compounded by a spurt of early-stage space companies that went public in recent years by merging with a special purpose acquisition company (SPAC), often with lofty business projections despite a lack of current revenues.

Their high-profile valuations helped raise price tags across the rest of the industry. However, the vast majority of early-stage companies that merged with a SPAC have since significantly underperformed in the public market.

“On the public side, I think there’s a lot of blowback from public equity investors about the newspace sector,” said Matt Kuta, chief operating officer at industry consolidator Voyager Space.

I like to refer to this as the magic space sprinkles. You add space, or AI, or blockchain to the name of your company and ...the valuation goes up 100x.” — Megan Crawford,

SpaceFund co-founder

He said “a lot of institutional investors have lost hundreds and hundreds of millions of dollars, and that then trickles down to the folks that are looking to allocate private capital.”

The poor trading performance of space companies that went public via a SPAC, coupled with high inflation and other macroeconomic challenges, are weighing on valuations as investors become more conservative in general.

The hype that had been inflating space valuations is “starting to fade,” Crawford said, “and we’re starting to see deals that are a lot more in line with what we think are the real valuations of a lot of these ... companies that we think were highly over-valued over the last couple of years.”

However, the panel also pointed to an increasingly tough regulatory environment standing in the way of acquisitions in the space industry.

The Committee on Foreign Investment in the United States (CFIUS), which reviews certain foreign investments in American companies, “remains a huge concern, as well as anti-trust” obstacles, said Sameer Garg, managing director and head of space investment banking at New York-based Citi.

“We’re seeing that all across the board,” Garg said. Regulatory concerns are now “really front and center” of conversations Citi has with clients early on in a merger and acquisition (M&A) process, “as opposed to something that you typically pick up in the second round of diligence,” he said.

But while Garg expects increasing regulatory scrutiny will impact both private and public transactions, he said the underlying M&A environment continues to be constructive for deal-making. **SN**

Northrop Grumman clears design hurdle for milcom satellite

Northrop Grumman completed a critical design review of a Space Development Agency communications satellite in 13 months, a fraction of the time required for traditional space programs.

“It’s paradigm-changing for programs that have this type of capability,” Blake Bullock, vice president for Northrop Grumman’s Communication Systems business unit, told *SpaceNews*. “For a more standard military communications satellite program, you’re typically looking at multiple years to get to a critical design review.”

Northrop Grumman, L3Harris and York Space

DEBRA WERNER

Systems won SDA contracts in early 2022 to deliver 42 satellites apiece by 2024 for the Space Development Agency’s Transport Layer Tranche 1, a global communications network in low-Earth orbit. In addition, Northrop Grumman and L3Harris are supplying SDA with 14 missile-tracking satellites apiece. Northrop Grumman also is responsible for providing the ground system for the Tracking and Transport constellations.

To meet the challenge of building 58 satellites in less than three years, Northrop Grumman is relying on its own expertise and that of industry partners.

Airbus U.S. Space & Defense is supplying Northrop Grumman with 42 buses for the

Tranche 1 communications satellites. Mynaric is supplying optical terminals for the 14 Tranche 1 missile-tracking satellites.

“Partnerships are a key part of why we are able to move at a different pace,” Bullock said.

Louis Christen, Northrop Grumman Proliferated Space Operating Unit director, added, “We’ve done laser communications for decades and we’re extremely capable in it, but Mynaric has a niche in this high-production, lower-cost-target range.”

To produce satellites quickly for SDA, Northrop Grumman “streamline processes as well, finding the right balance of verification and the right level of design rigor to allow us to move forward,” Christen said. **SN**

Maxar secures Dish Network order in its first satellite contract of 2023

Dish Network said April 18 it has ordered a satellite from Maxar Technologies to expand high-definition broadcast services over North America.

The ES XXV satellite is expected to be ready for launch to geostationary orbit (GEO) “within the next few years,” Dish Network spokesperson Ted Wietecha said. A launch provider was not announced.

The satellite will be based on the Maxar 1300 series platform, the largest in the manufacturer’s product line with a mass of up to 6800 kilograms

Wietecha said ES XXV would also “provide greater flexibility” across its fleet of seven satellites. The company currently also leases capacity from four satellites for a broadcast service covering the United States and Puerto Rico.

The satellite comes amid a secular decline in the satellite TV industry amid a shift toward online streaming services, where Dish Network

JASON RAINBOW

Chris Johnson, Maxar’s senior vice president and general manager of space, says the manufacturer remains committed to the GEO market despite an ongoing slump in orders.

also provides services in a highly competitive market.

The company recorded 9.75 million net pay-TV subscribers at the end of 2022, comprising 7.42 million for its DISH TV satellite broadcast business and 2.33 million for its SLING TV streaming service, which was a 268,000 decline compared with the prior year.

ES XXV is also the first GEO contract Maxar has announced this year in a market that has declined amid the rise of constellations in low Earth orbit (LEO).

Maxar secured contracts for two GEO satellites in 2022 in a year that only saw 11 orders, according to Euroconsult research, a far cry from the 15-20 that used to be ordered annually.

Chris Johnson, Maxar’s senior vice president and general manager of space, said the “GEO market remains important” for the



company in a statement that accompanied its announcement.

Meanwhile, the company has been gaining traction for its LEO-focused Maxar 300 series, the manufacturer’s smallest and most modular bus.

In August, Maxar said it was selected by L3Harris to build 14 missile-detection satellites based on the platform for the U.S. Space Development Agency. **SN**



Orbital Debris: Dealing with the “Bad Neighborhood”



Top: An overly dramatic visualization of a massive cluster of abandoned space hardware. **Bottom:** Darren McKnight, LeoLabs senior technical fellow

Earth orbit has become a junkyard of dead or dying spacecraft, discarded booster stages, and countless pieces of human-made debris. Toss in, for good measure, harmful bits of human-made leftovers resulting from anti-satellite tests.

This heavenly mess has long-term consequences. One upshot has been the creation of the “bad neighborhood,” said Darren McKnight, a senior technical fellow for LeoLabs, which is generating unique measurements and data products intended to enhance space safety in low Earth orbit.

SpaceNews asked McKnight about the state of affairs stemming from orbital litter.

What are the two most obvious precursors to space safety issues in Earth orbit?

They are a large breakup event or a cluster of massive, abandoned hardware. The fragment cloud would increase the probability of mission-terminating and debris-generating events, while the massive derelicts would provide the fuel for very consequential collision events creating

thousands more lethal fragments. But of course, we could not be so unlucky as to have these two deleterious catalysts at the same place, are we?

Define what you call the “bad neighborhood.”

The bad neighborhood in low Earth orbit is around 800 to 900 kilometers in altitude. It has the dubious honor of having the highest density of derelict mass in Earth orbit and the largest debris cloud in Earth orbit.

LEONARD DAVID

What caused this?

The Fengyun-1C fragment cloud, resulting from China's 2007 anti-satellite test, is centered around 860 kilometers. Nearly 2,800 fragments are whizzing through the 800 to 900-kilometer altitude region. This one cloud comprises 25 percent of all fragments in low Earth orbit, and all of the fragments from this cloud have either their perigee or apogee of around 860 kilometers. More than 10 percent of the over 500,000 high-probability of collision events over the last year involved a piece of debris from the Fengyun-1C debris cloud, and this cloud calls the “bad neighborhood” home.

What other aspects of this issue concern you?

The greatest concentration of scrap metal in LEO also peaks at 840 kilometers, driven largely by 36 massive Russian rocket bodies and non-operational payloads. The rocket body and payload for each launch were left in basically the same orbit. A collision between any of these 36 objects would produce on the order of 15,000 trackable fragments

which would double the fragment population in an instant.

You've flagged China and Russia as contributing to the bad neighborhood. What about the United States?

The United States has also contributed tens of derelict objects and hundreds of fragments from a series of breakup events. This makes the “bad neighborhood” a remnant of the government space race, which, if not remediated, may create powerful headwinds to the exciting commercial space race underway.

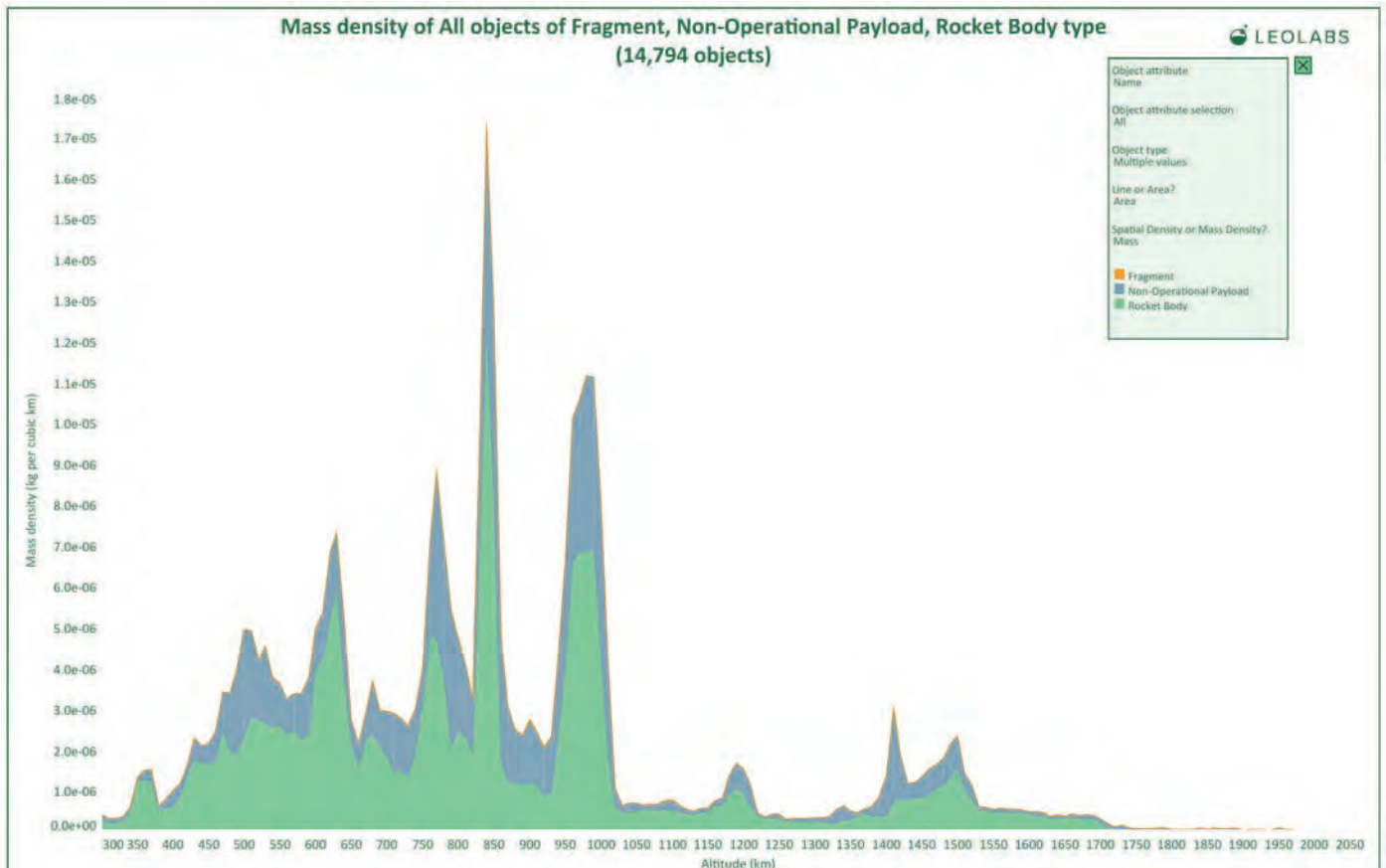
How severe is this issue at the moment?

On average, every two weeks, there is a close encounter in the “bad neighborhood” between two massive derelicts that would have necessitated a collision avoidance maneuver if either derelict could maneuver. In 2022 alone, there were 836 conjunctions in LEO with a miss distance of less than 100 meters. Nearly a third of these most dangerous conjunctions, 237 instances, occurred between 800 and 900 kilometers. There was

even one event in the “bad neighborhood” last year between a non-operational Chinese payload and an abandoned US rocket body with a miss distance of roughly 50 meters.

So what now? Can anything be done to deal with the bad neighborhood quandary?

The only way to deal with this simmering collision potential is to remove the fuel that will stoke the flames of debris generation in the bad neighborhood. Active debris removal of the massive derelicts in this region is paramount to managing future space safety. This case is amplified by noting that the Fengyun-1C debris cloud has only lost about 20% of its fragments over 15 years and will persist for decades to centuries, slowly filtering through the lower altitudes where many of the most ambitious constellations are being deployed. The massive derelicts in these altitudes will be even more persistent, likely orbiting and whizzing past each other for centuries. **SN**



LEOLABS



Leidos unveiled a prototype of the lunar rover it is developing in partnership with NASCAR during the 38th Space Symposium April 18.

Leidos working with NASCAR on Artemis lunar rover

Leidos is working with the racing company NASCAR to develop a lunar rover they will offer for an upcoming NASA competition.

Leidos unveiled its design April 18 for a Lunar Terrain Vehicle (LTV) that can accommodate two astronauts for excursions on the lunar surface, starting with the Artemis 5 mission in the late 2020s. The rover could be used autonomously when not needed by astronauts.

“We’re about to enter a new moon race, except we’re going to enter a moon race with a partner that is really good at going fast, NASCAR,” said Steve Cook, Leidos Dynetics Group president, during an event at the Leidos exhibit at 38th Space Symposium where the company revealed a full-scale prototype of the rover.

Leidos executives said they chose to partner with NASCAR on the LTV design for technical and business reasons. “Their deep experience and capability in developing high-performance vehicles in harsh environments is something that obviously can help us a great deal as we engineer this vehicle,” said Jonathan Pettus, senior vice president for aerospace, defense

and civil operations at Dynetics. He cited as one example NASCAR’s work on a new race car design with design principles, like fast and agile maintenance, that is also useful for a lunar rover.

Another reason for the partnership is commercialization. Industry expects NASA to follow a services model for the LTV project, procuring the rover as a service rather than a more conventional contract to acquire a rover. That could allow the company to offer the rover to other users or even seek sponsorships. “NASCAR is very good at connecting sponsors, and we are excited about what that may mean in terms of our commercial plans for the future and how we can leverage their expertise,” Pettus said. “We think there’s a lot of opportunity there.”

“The last couple of months we’ve [been] getting to know the Leidos Dynetics team really well,” said Pete Jung, NASCAR senior vice president and chief marketing officer, saying it helped the organization look ahead as it celebrates its 75th anniversary. “Another thing that gets us excited is how our organizations are aligned in terms of philosophies and commitments to sustainability and equality.”

The team working on the LTV design includes companies with both automotive and aerospace experience. They include Roush Industries, Collins Aerospace, Motiv Space Systems and Moog, among others.

Pettus said they are designing the rover to accommodate a wide range of payloads, providing them with power, communications and thermal control. “We’ve gotten feedback from a variety of potential commercial and academic partners around payload needs, so we’ve tried to address that as we’ve designed the vehicle.”

Leidos is one of several companies that have announced plans to propose LTV designs to NASA. Lockheed Martin announced plans in 2021 to work with General Motors on a rover, while Northrop Grumman is working with Intuitive Machines, Michelin and others to create a rover. Startup Astrolab plans to offer its Flexible Logistics and Exploration (FLEX) rover it is developing for robotic and human missions.

NASA, in procurement filings, says it expects to issue a final request for proposal for LTV no later than May 26, with a contract award anticipated in late November. **SN**

JEFF FOUST

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