NASA’s Next GIANT LEAPS

The U.S. puts its faith in Blue Origin, SpaceX and Dynetics to deliver lunar landers on the double

CREW DRAGON ON DECK
NASA and SpaceX enter the homestretch for crucial commercial crew test flight

Flying cubesats from home
The pandemic is accelerating the trend toward remote operations

INSIDE
- Space Mission: Improbable
- A cruel month for space conferences
- The FCC’s outsized impact on space policy
Cobham Advanced Electronic Solutions Appreciates Our Heroes

A salute to all who keep us soldiering on during the global fight against COVID-19. To healthcare workers, police officers and first responders, armed services, grocery workers, truck drivers, educators, government personnel, essential workers and everyone assisting in COVID-19 efforts, thank you! Cobham Advanced Electronic Solutions would like to also acknowledge the efforts of our entire workforce, suppliers and customers that have enabled us to continue operating remotely. We especially recognize and appreciate our frontline workers who have kept our factories open to produce essential technologies and equipment.

We hope that, through our space technology now being utilized to combat the virus, donations and the work from our team, we will continue to help those who need it most. We wish you and your family good health.

We Are All In This Together!

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ABOVE: A team at the Jet Propulsion Laboratory developed the Ventilator Intervention Technology Accessible Locally (VITAL), a ventilator specially designed for treating COVID-19 patients but that is simpler and faster to build than conventional ventilators. Credit: NASA/JPL-Caltech

COVER: NASA illustration

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$14M
How much Chinese space propulsion startup SpacePioneer raised in a pre-Series A round. The company, established in 2015, will use the funds to complete work on a 30-ton-thrust liquid-propellant engine named Tianhuo-5.

$7.5M
The value of a contract the University of California Berkeley received to build a sensor for a NOAA space weather mission. The university will build the Supra Thermal Ion Sensor intended to fly on NOAA’s Space Weather Follow-On Lagrange-1 mission in 2024.

$3.5M
What Japanese ground station startup Infostellar raised in convertible bonds. The company said it is looking to raise $1.2 million more by June to shore up against a coronavirus-induced recession.

422
The number of Starlink satellites SpaceX has in orbit following a successful launch April 22. SpaceX CEO Elon Musk, in a tweet after the launch, said a “private beta” of Starlink services will start in about three months, with a more public beta test in six months.

SIGNSIFICANT DIGITS

SPEEDCAST FILES FOR CHAPTER 11
The Australian satellite services company, which ended 2019 with $669 million in debt, said April 23 that customer struggles, amplified by the coronavirus pandemic’s impact on the cruise sector, made it “impossible” to raise much-needed equity. The company has arranged for up to $90 million in debtor-in-possession financing to maintain operations during its restructuring. Speedcast leases capacity on more than 80 satellites to provide communications services for a variety of markets, some of which, like oil and cruise lines, have been hard-hit by the pandemic.

ROCKET LAB NABS ARIANESPACE CUSTOMER
A Japanese synthetic aperture radar (SAR) startup will launch its first satellite with Rocket Lab rather than Arianespace. Rocket Lab announced April 14 it signed a contract to launch the first Synspective SAR satellite on an Electron rocket late this year. Synspective, which has raised $100 million for a constellation of about 25 such satellites, originally planned to launch that first satellite on a Vega rideshare mission. Synspective said that it switched to rocket lab “as a result of adjusting the launch timing and the orbit of the satellite,” and would fly a future satellite on Vega instead.

LONG MARCH 5B TAKES FLIGHT
China launched the first Long March 5B rocket May 5, a major milestone in its plans to develop a space station. The Long March 5B rocket, a version of the Long March 5 intended for missions to low Earth orbit, lifted off from the Wenchang Satellite Launch Center and placed into orbit a prototype of a next-generation crewed spacecraft. The prototype landed successfully May 8 after successfully maneuvering in space. The successful launch allows China to proceed with development of a space station, whose modules will be launched on the Long March 5B. The station’s core module, Tianhe, is expected to launch in early 2021.
QUICK TAKES

SATELLITE SERVICER PUTS INTELSAT-901 BACK TO WORK

Intelsat-901 has resumed operations after a servicing spacecraft moved it to its new orbital slot. Intelsat transferred 30 commercial and government communications customers to the Intelsat-901 satellite, which now uses Northrop Grumman’s Mission Extension Vehicle (MEV) 1 for propulsion. MEV-1 docked with Intelsat-901 in February and moved it to its new orbital location in geostationary orbit, replacing the Intelsat-907 satellite. Intelsat is also the customer for Northrop Grumman’s second MEV, scheduled for launch this summer to extend the life of the Intelsat-1002 satellite.

FAA SPACE OFFICE READY TO ROLL

The Federal Aviation Administration’s commercial space office has completed a reorganization announced nearly a year ago. In an April memo, the FAA Office of Commercial Space Transportation said it had finalized a reorganization that is intended to make the office more efficient. The new structure creates two main offices, one that handles licensing and safety issues and the other that handles office management and regulatory topics. That reorganization is part of a broader effort, including regulatory streamlining, to enable the office to keep up with growing commercial spaceflight activity.

SPACE FORCE GETS AN AD

The Space Force released its first recruitment ad May 6. The video shows a montage of launches, spacecraft, and control rooms, and includes the line, “Maybe your purpose on this planet isn’t on this planet.” The Space Force has not yet started openly recruiting new members. For now it is asking selected airmen in space jobs to voluntarily transfer to the new branch, followed by members of other branches.

AMERGINT TECHNOLOGY BUYS TETHERS UNLIMITED

Amergint Technology has acquired space technology company Tethers Unlimited for an undisclosed sum. Tethers Unlimited has developed a variety of technologies, including water-powered propulsion systems, reprogrammable smallsat radios and robotic spacecraft arms. Amergint said that it will combine its expertise in ground systems with Tethers Unlimited’s spacecraft expertise to create end-to-end solutions for the satellite communications and in-space services markets. Amergint acquired Raytheon Technologies’ space-based precision optics business in April.

NANOAVIONICS BAGS CUBESAT ORDER

NanoAvionics has won a contract to build a pair of cubesats for two European nations. Norway and the Netherlands plan to use the satellites, called BROS (binational radiofrequency observing satellites) to demonstrate space-based signal mapping for military applications. NanoAvionics said the 10-kilogram cubesats will be based on its M6P platform, equipped with deployable solar panels, propulsion and a high-precision attitude determination and control system.
GUIANA SPACE CENTRE BEGINS SLOW RETURN TO OPERATIONS

The European spaceport in French Guiana suspended launch activities in mid-March as part of the French government response to the coronavirus pandemic. Arianespace said that launch preparations will resume once the government eases a nationwide lockdown May 11. The spaceport's first missions will be a mid-June Vega launch previously scheduled for March, followed by an Ariane 5 launch in late July. While two Soyuz launches for OneWeb originally scheduled for this year from the spaceport are unlikely to take place now because of the company's bankruptcy, the French space agency CNES, which operates the spaceport, expects to be able to carry out the rest of the launches projected for this year.

STARLINK GETTING ACCESSORY TO BLOCK SUN’S GLARE

SpaceX plans to test a “sun visor” to reduce the brightness of its Starlink satellites on its next launch. At an April 27 meeting of a committee working on the next astrophysics decadal survey, Elon Musk said the “VisorSat” concept would install a visor intended to block sunlight from hitting reflective surfaces, like antennas, on its Starlink satellites. That is intended to significantly reduce the brightness of the satellites as seen from the ground, a concern for many astronomers who worry the Starlink constellation could interfere with their observations. Musk said the goal is to fly a VisorSat spacecraft on the next Starlink launch. SpaceX is also testing reorienting the satellites as they raise their orbits as another means of reducing their brightness.

VIASAT MEO CONSTELLATION GETS FCC APPROVAL

The 20-satellite system would operate at 8,200 kilometers using Ka-band and higher frequency V-band spectrum for uplinks and downlinks. Viasat has focused mainly on building a trio of large geostationary satellites that, with at least one terabit of throughput each, stand to be the highest capacity satellites in the world. The company, though, has shown interest in other orbits. Viasat hasn’t given a schedule for developing the constellation, but the FCC approval requires the company to launch half the system in six years and the full constellation in nine years.

A NEW CUSTOMER FOR FIREFLY

Firefly Aerospace has signed a launch agreement with Spaceflight for a rideshare mission next year. Spaceflight will provide payloads for the majority of the capacity of a Firefly Alpha launch in mid-2021, and will also contribute rideshare payloads for other Alpha missions. Firefly executives said they plan to perform tests on the two stages of the first flight version of Alpha in May and June, and then ship it to the launch site at Vandenberg Air Force Base in California for a launch later this year. Alpha will be able to place up to 630 kilograms into sun-synchronous orbits launching from Vandenberg. Firefly has used staggered shifts and telework to maintain progress during the pandemic.
Accelerate your space mission

Regardless of what science fiction you’ve encountered, a common thread runs through every space-based story—you’ve got to get from point A to point B. Whether it’s wormholes, light speed, warp drives, transporters, or conventional rockets, every science fiction protagonist needs to traverse space. We may not be able to bend physics to move ships across light-years instantaneously, but there is a discipline that holds the key to operating within the complexities of space to move at the speed of relevance. Digital engineering transforms science fiction into reality, accelerating capability and adapting to evolving circumstances.

Digital engineering ensures you are building something that resembles what you want and remains relevant as mission needs evolve or new threats emerge. It enables the optimal design of complex system-of-systems interactions for mission threads, allowing new ways to design space systems, cyber and communications networks, battle management, and command and control. It can seamlessly redesign and optimize life-cycle management, logistics, acquisition, and even inform R&D.
At SAIC, we’ve invested in the processes, methods, capabilities, and workforce development needed to truly master the systems of today and tomorrow. Our federal space customers are tackling engineering challenges like space domain awareness, space traffic management, human spaceflight, proximity operations, and more. The space domain is unforgiving of mistakes. Common issues include:

- Exponential growth of interfaces creates transmission errors and delay.
- Without clear objectives, keeping pace with technological innovation can devolve into a pursuit of the shiniest new toy.
- One person can’t process exabytes of data. Clear organization and data analysis are needed.
- Unexpected behaviors emerge as thousands of components interact with one another.

Digital engineering isn’t a magic wand. It is a logical and effective approach to a chaotic and complex environment. It keeps systems on pace and agile.

- Your current infrastructure may need to transform to achieve your missions. If so, digital engineering takes advantage of new technologies and leverages legacy elements.
- If the fidelity of your ecosystem is creating errors and vulnerabilities, digital engineering enables the seamless sharing of models and customization.
- Executing on a design requires the proper tools, partners, experts, and decision aids to navigate complex and malleable requirements.
- Digital engineering mitigates silos of expertise and creates structured knowledge sharing that facilitates innovation and collaboration.

Digital engineering assists the journey from concept to system. Lots of people offer digital engineering, but SAIC does digital engineering right.

Learn more at saic.com/digital-engineering
NASA and SpaceX are in the final phases of preparations for a commercial crew test flight that will carry two NASA astronauts to the International Space Station for an extended stay.

During a series of briefings May 1, NASA officials and SpaceX executives expressed excitement about the upcoming Demo-2 mission, scheduled for launch from the Kennedy Space Center May 27, despite some outstanding reviews and tests remaining before launch.

“I can’t tell you how exciting of a day this is for us. Gwynne and I have been waiting for this for a while,” said Kathy Lueders, manager of NASA’s commercial crew program, who participated in one briefing with SpaceX President Gwynne Shotwell.

On the Demo-2 mission, a Crew Dragon spacecraft will launch on a Falcon 9 rocket from KSC with NASA astronauts Bob Behnken and Doug Hurley on board. The spacecraft will dock with the station less than 24 hours later.

What’s not yet clear is how long the spacecraft, and Behnken and Hurley, will remain on the ISS. In a blog post posted shortly before the briefings, NASA Administrator Jim Bridenstine confirmed the mission will be extended because the station currently has on board just one NASA astronaut, Chris Cassidy, and two Russian cosmonauts. “We have extended the planned length of the Demo-2 mission from a standard test flight to ensure Behnken and Hurley can participate as Expedition 63 crew members to safely maintain and operate the station,” he wrote.

The exact length of that mission has yet to be determined. “It is a trade-off,” said Kirk Shireman, NASA ISS program manager, between getting the spacecraft back quickly to complete its certification and providing additional crew time on the station for maintenance and research.

The length of the mission will be

NASA astronauts Bob Behnken and Doug Hurley are scheduled to launch May 27 on SpaceX’s Demo-2 mission to the ISS.
linked to when the next Crew Dragon mission, called Crew-1, will be ready to fly.

“What we would like to do, from a station perspective, is to keep them on orbit as long as we can until that Crew-1 vehicle is just about ready to go,” he said.

Behnken and Hurley, who originally planned to fly a much shorter test flight, did augment their preparations with re-fresher training for ISS systems that, for Behnken, included training for a space-walk, if needed. The top priority for the mission is to check out Crew Dragon, but “our next step to try to offload Chris Cassidy,” Behnken said. “There’s a lot of work and activity that can be done in the U.S. segment, certainly more than one person can accomplish on their own.”

NASA and SpaceX are also wrapping up final checks of the spacecraft and reviews. Shotwell said one final test of the Mark 3 parachute system for Crew Dragon was slated for later in the day. “We’re looking forward to finishing that test and getting that item closed out,” she said. SpaceX, in a tweet later in the day, confirmed the test had been carried out, apparently successfully.

Lueders said that NASA had completed its review of an engine anomaly during a Falcon 9 launch of Starlink satellites in March, where one of the nine Merlin engines in the rocket’s first stage shut down prematurely. “We have reviewed the
anomaly resolution of the Starlink launch, and actually have cleared the engines on our vehicle,” she said. “That is behind us right now.”

There are still a series of reviews in the weeks ahead, as well as addressing issues that come up during launch vehicle and spacecraft processing. There will be a flight test readiness review at SpaceX May 8 and at NASA May 11, she said. A NASA flight readiness review is scheduled for May 20.

While the commercial crew program is designed to end NASA’s reliance on Russia for getting astronauts to and from the station, delays have forced NASA to purchase additional seats. Bridenstine said at a briefing that the agency was in final negotiations with Roscosmos for a seat on a Soyuz flight in October as a backup for any additional delays.

“We’re getting close to finalizing that deal, and I think it’s within days of being signed,” he said, with price currently the key issue being negotiated. He said NASA will wait to evaluate the performance of the Demo-2 spacecraft before deciding if the agency needs to also buy a Soyuz seat for a flight in the spring of 2021.

Bridenstine also reiterated a plea he made during a briefing a week earlier for the public to watch the launch from home, even as the state of Florida starts to ease restrictions imposed to slow the spread of COVID-19.

“The challenge we’re up against right now is we want to keep everybody safe. That’s the No. 1 highest priority of NASA,” he said. “So we’re asking people not to travel to the Kennedy Space Center. That makes me sad to even say it.”

“Having large crowds of hundreds of thousands of people at the Kennedy Space Center, now is not the time for that,” he continued. “We don’t want an outbreak.”

The Demo-2 astronauts, who will go into quarantine about two weeks before launch, won’t have friends or family present for the launch. “It certainly is a disappointing aspect of the pandemic,” said Hurley. “It’s obviously the right thing to do in the current environment.”

NASA Administrator Jim Bridenstine, asking the public to watch the Demo-2 launch from home rather than flock to Florida for the first crewed launch from U.S. soil since the space shuttle’s 2011 retirement.

“We’re asking people not to travel to the Kennedy Space Center. That makes me sad to even say it.”
In early April as the COVID-19 pandemic prompted the cancellation or postponement of one space conference after another, the Catalyst Accelerator made a surprising announcement.

The startup accelerator backed by the Air Force Research Laboratory’s Space Vehicles Directorate invited representatives of small businesses, government agencies and large corporations to Colorado Springs for a three-day event in July called Tech Collisions.

“Although virtual engagements are very effective for those separated by distance or pandemics, there are aspects of in-person gatherings that cannot be duplicated on virtual formats,” said KiMar Gartman, Catalyst Accelerator program director.

If the danger of contracting the novel coronavirus hasn’t subsided by July, the Catalyst Accelerator’s Tech Collisions conference will move online. “Our hope, though, is that the pandemic will be past us and we will be in the early stages of rebuilding our communities and reestablishing those connections that are so vital for our growth and development,” Gartman said by email.

That sentiment was widespread among space industry executives working from home in April instead of traveling as they normally would to high-profile conferences.
like the Space Foundation’s Space Symposium, Navy League’s Sea Air Space Exposition and U.S. Geospatial Intelligence Foundation’s GEOINT Symposium.

“When the shows resume, we’re looking forward to participating in whatever manner is practical and safe,” said Paul Welsh, Analytical Graphics Inc. vice president business development.

Lockheed Martin also plans to continue playing an active role in space conferences around the world as conditions permit, said Robert Lightfoot, Lockheed Martin Space vice president of strategy and business.

No one knows when local, state and federal agencies will lift travel restrictions and declare large gatherings safe to resume. That will depend largely on the spread of the COVID-19 virus and progress in the medical community identifying promising treatments and developing vaccines.

In the meantime, companies are relying heavily on video conferencing for everything from staff meetings to customer outreach and hiring.

Lockheed Martin Space is staying in touch with government and industry partners through video and teleconferences.

“Our primary way of meeting customers remains direct meetings, either in person or virtually, and those continue in earnest,” Lightfoot said. “Without the ability to attend conferences in person, we have to work harder to reach out to the space community.”

Although companies have embraced videoconferencing as a stopgap measure, conferences are “a very efficient way to connect face-to-face and foster relationships,” Lightfoot said by email. “Conferences give us the ability to meet with many of our government, international and industry mission partners in a short span of time (two to three days).”

During the 2019 Space Symposium, for example, 15,000 people working in civil, commercial and military space traveled from dozens of countries to the Broadmoor hotel in Colorado Springs for four days of classified and unclassified briefings and events.

The 36th annual Space Symposium, originally scheduled to begin March 30, was postponed until Oct. 31.

“This is the window we were able to find with the Broadmoor,” said Rich Cooper, Space Foundation vice president for strategic communications and outreach. “And yes, we know Oct. 31 is Halloween. No one has better costumes than the space community.”

It’s too soon to say how the pandemic will change the Space Symposium and other conferences. That will depend on guidance from the Centers for Disease Control and Prevention, any travel restrictions as well as local, state and federal guidance on large gatherings.

Before the Space Symposium was postponed, representatives of 40 countries were registered to attend. For now, many nations are restricting foreign travel in effort to limit the spread of the coronavirus. Will those restrictions remain in the fall?

“We don’t know where we will be at that particular point as to what travel restrictions may or may not be in place,” Cooper said. “We will look at all those pieces. We’ve also got to make sure it’s a safe environment that will make people feel comfortable in coming.”

Not all companies anticipate sending executives to conferences this fall, even if widespread bans on mass gatherings are lifted by then. “We’re going to minimize travel and attendance through the end of the year,” said a representative of a company that asked not to be identified. Instead, the company plans to focus its resources on virtual gatherings.

Even executives planning to attend conferences this fall, circumstances permitting, expect the pandemic to leave its mark.

Handshakes may be replaced by elbow bumps as they were at the Satellite 2020 conference in Washington in March. That conference shut down a day early when the District of Columbia banned large gatherings.

At Satellite 2020, AGI, a firm well known for serving ice cream at conferences, gave out hand sanitizer with the company logo. The hand sanitizer was so popular AGI might keep distributing it, Welsh said.

Future conferences also may offer remote access for people who can’t attend.

“Now that we’re all Ninjas in Microsoft Teams, maybe there’s a way to allow people to participate virtually,” Welsh said. “I think we’ll be able to do things even more effectively because we’re skilled in a lot of different areas.”
<table>
<thead>
<tr>
<th>CONFERENCE</th>
<th>LOCATION</th>
<th>ORIGINAL DATE</th>
<th>STATUS</th>
<th>NEW DATE</th>
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<td>Lunar and Planetary Science Conference</td>
<td>The Woodlands, Texas</td>
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<td>Advisory Committee for Commercial Remote Sensing meeting</td>
<td>Washington, D.C.</td>
<td>March 18</td>
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<td>IAF Spring Meeting</td>
<td>Paris, France</td>
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<td>SEA AIR SPACE</td>
<td>Washington, D.C.</td>
<td>April 6-8</td>
<td>CANCELED</td>
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<td>Space Power Workshop</td>
<td>Redondo Beach, Calif.</td>
<td>April 20-23</td>
<td>CANCELED</td>
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<td>GEOINT 2020 Symposium</td>
<td>Tampa, Fla.</td>
<td>April 26-29</td>
<td>CANCELED</td>
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<td>IFA Berlin (Berlin Air Show)</td>
<td>Berlin, Germany</td>
<td>May 13-17</td>
<td>CANCELED</td>
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<tr>
<td>International Space Development Conference</td>
<td>Frisco, Texas</td>
<td>May 28-31</td>
<td>CANCELED</td>
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<td>Farnborough International Airshow</td>
<td>Farnborough, U.K.</td>
<td>July 20-24</td>
<td>CANCELED</td>
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<td>ISS R&amp;D Conference</td>
<td>Seattle, Wash.</td>
<td>Aug. 6</td>
<td>CANCELED</td>
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<td>Goddard Memorial Symposium</td>
<td>Silver Spring, Md.</td>
<td>March 20</td>
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<td>NASA Space Awards Gala</td>
<td>San Luis Obispo, Calif.</td>
<td>April 17</td>
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<td>2020 CubeSat Developers Workshop</td>
<td>Paris, France</td>
<td>May 4-6</td>
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<td>Space Power Workshop</td>
<td>London, UK</td>
<td>May 20-21</td>
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<td>Global Space Exploration Conference (GLEX 2020)</td>
<td>St. Petersburg, Russia</td>
<td>June 9-11</td>
<td>POSTPONED</td>
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<td>63rd COPUOS Session</td>
<td>Vienna, Austria</td>
<td>June 17-23</td>
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<td>Goddard Memorial Dinner</td>
<td>Washington, D.C.</td>
<td>March 20</td>
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<td>36th Space Symposium</td>
<td>Colorado Springs, Colo.</td>
<td>March 30-April 2</td>
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<td>Oct. 31-Nov. 3</td>
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<td>SMI Small Satellites Conference</td>
<td>London, UK</td>
<td>April 28</td>
<td>RESCHEDULED</td>
<td>Sept. 1</td>
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<td>Space Tourism Conference</td>
<td>Los Angeles, Calif.</td>
<td>May 12-14</td>
<td>RESCHEDULED</td>
<td>June 25</td>
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<td>Military Space Situational Awareness Conference</td>
<td>Long Beach, Calif.</td>
<td>May 18-20</td>
<td>RESCHEDULED</td>
<td>Sept. 3-4</td>
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<td>Humans to Mars Summit</td>
<td>Cape Town, South Africa</td>
<td>May 18-22</td>
<td>RESCHEDULED</td>
<td>Aug. 31-Sept. 1</td>
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<td>Space Tech Expo</td>
<td>Vilamoura, Portugal</td>
<td>May 24-29</td>
<td>RESCHEDULED</td>
<td>Aug. 10-12</td>
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<td>16th International Conference on Space Operations (SpaceOps)</td>
<td>Montreal, Canada</td>
<td>June 1</td>
<td>RESCHEDULED</td>
<td>May 5-7, 2021</td>
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<td>AiaSpace</td>
<td>Singapore</td>
<td>June 9-11</td>
<td>RESCHEDULED</td>
<td>Sept. 20-29, Oct. 1</td>
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<td>Summit for Space Sustainability</td>
<td>Los Angeles, Calif.</td>
<td>June 9-10</td>
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<td>CommunicaAsia</td>
<td>Glasgow, Scotland</td>
<td>June 23-24</td>
<td>RESCHEDULED</td>
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<td>DataSpace</td>
<td>Los Angeles, Calif.</td>
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<td>Safeguarding Earth’s Space Environment</td>
<td>Paris, France</td>
<td>Sept. 14-18</td>
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<td>COSPAR 2020</td>
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<td>World Satellite Business Week</td>
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<td>AFA Air, Space &amp; Cyber Conference</td>
<td>National Harbor, Md.</td>
<td>Sept. 14-16</td>
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<td>Satellite Innovation</td>
<td>Mountain View, Calif.</td>
<td>Oct. 6-8</td>
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<td>APSCC 2020</td>
<td>Manila, Philippines</td>
<td>Nov. 17-19</td>
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<td>American Physical Society April Meeting</td>
<td>Washington, D.C.</td>
<td>April 18-21</td>
<td>NOW VIRTUAL</td>
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<td>236th Meeting of the American Astronomical Society</td>
<td>Madison, Wis.</td>
<td>May 31-June 4</td>
<td>NOW VIRTUAL</td>
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<td>2020 Exploration Science Forum</td>
<td>Boulder, Colo.</td>
<td>July 8-10</td>
<td>NOW VIRTUAL</td>
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<td>34th Annual Small Satellite Conference</td>
<td>Logan, Utah</td>
<td>Aug. 1-6</td>
<td>NOW VIRTUAL</td>
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<td>71st International Astronautical Congress</td>
<td>Dubai, UAE</td>
<td>Oct. 12-16</td>
<td>NOW VIRTUAL</td>
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<td>23rd Annual International Mars Society Convention</td>
<td>Los Angeles, Calif.</td>
<td>Oct. 15-18</td>
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In about four and a half years, NASA envisions a lunar lander touching down near the south pole of the moon. Two astronauts will exit the lander’s crew module and go down a few steps to be the first humans on the lunar surface since 1972. Or, they’ll make their way down a much longer ladder to the surface. Or maybe just take an elevator.

JEFF FOUST

NASA looked to tap into the creativity of the private sector with its Human Landing System (HLS) program to develop the landers needed for the Artemis program. Rather than use a conventional contracting approach and pick a single company to develop a lander under a cost-plus contract, it offered multiple fixed-price awards to companies that would develop landers through public-private partnerships, with NASA eventually being one of potentially several customers for them.

“Today, we’re going under contract with three companies that are going to take us all the way to the moon.”

Despite his confidence, though, there remain many questions about whether any of those companies will be able to have a lander ready in time to meet the Trump administration’s goal of a 2024 landing, or if NASA will have the budget to afford them.

THREE DIFFERENT LANDERS

When NASA released the final version of its HLS call for proposals last September,
the agency outlined a two-phase approach for developing lunar landers. NASA would first pick as many as four proposals for an initial round of studies, advancing designs to the equivalent of a preliminary design review over about 10 months. NASA would then select one or two companies for full-scale lander development, with one being ready to support a 2024 landing, while the other would take a slower development track for a mission in 2025 or later.

NASA selected three of the five proposals it received for those initial studies. The largest single award, $579 million, was also perhaps the least surprising. Blue Origin announced its intent to compete for the HLS program in October, with company founder Jeff Bezos announcing at the International Astronautical Congress in Washington a "national team" that features Draper, Lockheed Martin and Northrop Grumman.

The lander design NASA selected for further development closely follows what Blue Origin described last fall. Blue Origin will provide the descent stage, based on its Blue Moon cargo lunar lander concept and powered by the BE-7 engine it is developing. Lockheed Martin will build the ascent module that includes the crew cabin, leveraging systems it created for the Orion spacecraft. Northrop Grumman will build a transfer module, based on its Cygnus spacecraft, that will move the lander from the Gateway and Orion’s elliptical halo orbit around the moon to low lunar orbit. Draper will develop the lander’s avionics and software.

Dynetics, which received a $253 million award, took a lower profile in more ways than one. The company didn’t acknowledge that it bid on HLS until January, after Sierra Nevada Corporation executives said in a media call it had collaborated with Dynetics on a proposal. The company said little more at the time beyond that it had assembled “a very impressive team of experienced small and mid-sized companies” for its bid. That turned out to be a group of 25 companies that included Maxar, Thales Alenia Space, L3Harris and even one of Blue Origin’s teammates, Draper.

Dynetics offered a distinctive lander concept that won praise from NASA reviewers for its “crew-centric” design. Rather than have the ascent module, with its crew cabin, stacked on top of the descent module, like Blue Origin’s design as well as the Apollo lunar lander, the Dynetics lander consists of a single module ringed by propellant tanks, using the same engines both for landing and takeoff. That allows the module to be low to the ground, requiring just a few steps to get from the lander to the surface.

The third winner, SpaceX, never announced that it was bidding on the HLS program, although most in the industry were not surprised they competed. As many surmised, SpaceX offered a version of its Starship vehicle as a human lunar lander that NASA selected for a $135 million award. SpaceX had already offered Starship to NASA’s Commercial Lunar Payload Services (CLPS) program for landing robotic payloads, although the company has yet to win a CLPS task order for a lander mission.

SpaceX’s approach would involve several different Starships, including one that would be a propellant depot in low Earth orbit, fueled by tanker Starships. The lunar lander Starship would launch to Earth orbit and fill its tanks at the depot before departing for the moon. The Starship lunar lander is far larger than the alternative concepts, and its crew cabin is so high that astronauts will need to use an elevator to get to the surface.

Notably absent from the winners was Boeing, which announced in November it proposed a lander that could launch as a single, integrated vehicle on a Space Launch System rocket. It argued that its “Fewest Steps to the Moon” concept minimized complexity over concepts that required aggregating two or three lander elements, launched individually, at the lunar Gateway.

NASA’s source selection statement for the HLS program did not explain why...
Boeing failed to win an award, only that it was removed “from further consideration for award earlier in the source selection process.” (That document also disclosed NASA received a bid from a fifth company, Vivace, best known as a manufacturer of tanks and structures; it, too, was excluded from consideration without explanation.)

“Boeing does not discuss its technical proposals or evaluations,” Boeing spokesman Jerry Drelling said.

INNOVATION VS. SPEED

NASA went to great lengths to emphasize the innovation the three companies, with their very different concepts, offered to the agency. “One thing that we were striving for,” said Lisa Watson-Morgan, NASA HLS program manager, “is to see what U.S. industry could bring us with respect to innovation. And boy, did they deliver.”

“In summary, all three offerors proposed audacious and innovative HLS designs and capabilities, each with unique technical merit,” NASA Associate Administrator Steve Jurczyk wrote in the source selection statement. “Many of the technologies upon which these capabilities rely have yet to be developed, tested, or demonstrated; the challenge that lies ahead is formidable.”

Those comments, though, highlight the tension in the HLS program between that desire for innovation versus the schedule challenge of getting humans back to the moon by 2024. Development of new technologies is subject to delays and setbacks, not the mention the risk of just not working at all.

That schedule risk emerged as a major issue in the evaluation of the proposals. NASA cited as weaknesses in SpaceX’s bid the complicated architecture involving many Starships and a “notably complex” propulsion that has little schedule margin to accommodate delays. “These development and operational risks, in the aggregate, threaten the schedule viability of a successful 2024 demonstration mission,” NASA noted in the source selection statement.

The reviewers also warned about SpaceX’s past performance, such as multiyear delays in development of Crew Dragon and Falcon Heavy, that reduced their confidence “in SpaceX’s ability to successfully execute on its proposed HLS development schedule.”

NASA raised similar issues about the other two winners. Blue Origin’s power and propulsion system is technically immature, the statement concluded, and requires “a very significant amount of development work that must proceed precisely according to Blue Origin’s plan, including occurring on what appears to be an aggressive timeline.”

The same system on Dynetics’ lander “introduces appreciable risk of unsuccessful contract performance from both a technical and development schedule standpoint,” the statement argues, in part because it relied on unproven technologies that “would need to be developed at an unprecedented pace.”

NASA was asked at the announcement how it could make that 2024 deadline since it has less time than in the 1960s with the Apollo lunar lander, which took about six and a half years from contract award to the Apollo 11 mission.

“We have technologies that exist today that had to be invented back in the ’60s. We don’t have to invent technologies today to make this work,” said Doug Loverro, NASA associate administrator for human exploration and operations, contradicting the assessment NASA made in its review of the proposals.

He said a bigger factor was getting the requirements right. A change in
requirements created a two-year delay between the preliminary and critical design reviews of the Apollo lander, he argued. Getting those requirements right will be a primary focus of the first few months of each HLS contract. “An extra month that we take in the very beginning to make sure that we have the requirements right will save us a year on the back end.”

AN EXTRA PUZZLE PIECE?

Loverro, like Bridenstine, saw the HLS awards as finalizing its plans for returning humans to the moon. “We are now on our way,” he said. “There are no hurdles left. There are no more puzzle pieces to add.” The Artemis program, he said, had everything it needed to land humans on the moon. For the 2024 landing, though, NASA may instead have an extra piece. Its original plans called for using the lunar Gateway as a base camp for those lunar landing missions, a facility where both the lunar lander and Orion would dock.

In March, though, Loverro told a NASA advisory committee that he was taking the Gateway off the critical path for a 2024 landing but preserving its development for later missions. Bridenstine confirmed that plan at the HLS announcement. “The Gateway is not required for that 2024 mission, and, in fact, I would go as far to say that it’s not likely that we will use the Gateway for the 2024 mission,” he said.

Gateway remains important for NASA’s long-term plans for sustainable lunar exploration, he emphasized. But, he added, “anything that is not necessary we need to move out of the way so that we can get to the surface of the moon” by 2024.

Loverro said that Gateway may yet serve a supporting role for the 2024 mission. “It’s still going to serve as a communications hub,” he said. “It’s going to be our high-bandwidth communication back from the surface of the moon for 2024.”

A GIANT FUNDING LEAP

The three HLS awards have a combined value of $967 million. However, the contracts are only a down payment for building one or more landers, which is likely to cost NASA several billion dollars plus whatever contributions the companies in the program make as part of the partnership.

NASA, anticipating that cost, requested a nearly 12% budget increase in its fiscal year 2021 budget proposal in February. However, the federal government’s response to the coronavirus pandemic, including more than $2 trillion in supplemental spending bills, has created doubts that Congress will be willing to support that increase.

Bridenstine was optimistic. “I don’t see our budget being cut because of this,” he said at the HLS announcement, discussing how he talked in the days leading up to the awards with members of the House and Senate of both parties.

“They have all been very supportive of the effort to get to the moon,” he said, “and I have not heard anybody suggest that, because of the coronavirus pandemic, we’re going to have to cut NASA.”

But not everyone in Congress backs NASA’s lunar lander plans. In a statement the day after the announcement, Reps. Eddie Bernice Johnson (D-Texas) and Kendra Horn (D-Okla.), chairs of the House Science Committee and its space subcommittee, respectively, criticized NASA’s approach to the Artemis program in general and lunar landers in particular. They introduced, with their Republican counterparts, a NASA authorization bill in January that called for a more traditional development approach for the lander.

“The multiyear delays and difficulties experienced by the companies of NASA’s taxpayer-funded commercial crew program — a program with the far less ambitious goal of just getting NASA astronauts back to low Earth orbit — make clear to me that we should not be trying to privatize America’s Moon-Mars program,” Johnson said.

Bridenstine was undeterred. “I don’t think we’re in any danger,” he said during a May 5 webinar hosted by the Center for Strategic and International Studies, making the case for including NASA in any infrastructure stimulus bill Congress may consider later this year. “There’s strong bipartisan support for the Artemis program.”

But the giant leap in funding needed for Artemis may yet turn out to be a bigger obstacle than the technology needed for lunar landers that will allow astronauts to make the next small steps on the moon in 2024. SN
Students operating the twin Electron Losses and Fields Investigation (ELFIN) cubesats were heading into finals at the University of California, Los Angeles, when they realized they needed to quickly transition to remote operations.

“As soon as all of us were done taking three-hour tests, we had three-hour meetings to figure out what we needed the satellites to do and how to make it as easy as possible from a software and technical perspective,” said Sharvani Jha, ELFIN software development lead.

The COVID-19 pandemic has prompted cubesat operators across the country to abandon mission operations centers in favor of living rooms and kitchen tables. The trend now extends to NASA-funded missions like ELFIN and two science satellites operated by the Utah State University Space Dynamics Laboratory (SDL): Hyper-Angular Rainbow Polarimeter and Compact Infrared Radiometer in Space.

Both UCLA and SDL were working to establish remote operations prior to the pandemic.

“We saw it as being very helpful to have added flexibility whether someone was on travel, supporting another program or supporting calls on weekends or during graveyard shifts,” said Tim Neilsen, SDL Commercial and Civil Space Division program manager.

Before the pandemic, SDL had secure communications links between its Logan, Utah, headquarters and ground stations at the NASA Wallops Flight Facility in Virginia to support missions like Hyper-Angular Rainbow Polarimeter, a three-unit SDL...
“Some of us are seeing speed impacts from the number of people working from home and kids going to school remotely.”

Tim Neilsen, SDL Commercial and Civil Space Division program manager, shown left operating NASA-funded cubesats from his living room.

In addition, ELFIN operators miss working together in the mission operations center. “You make a lot more mistakes when you are operating remotely without someone looking over your shoulder or another operator to riff off of,” Yap said.

To prevent mistakes, the ELFIN team is restructuring operations and rewriting software. Now, ELFIN’s most experienced operators plan spacecraft data collection activities while recruits determine whether the satellites performed as expected. If not, recruits reload commands directing the satellite to gather the data.

SDL satellite operators in Utah also see some of the drawbacks of working from home.

“Video conferencing is a wonderful technology,” Neilsen said. “But there are always communication challenges when the mission operations team is dispersed in multiple locations during an overpass, while planning for an overpass or analyzing data after an overpass. We need mature and well-designed tools to make up for the fact that we aren’t in a conference room working together on a whiteboard.” In addition, SDL satellite operators are sometimes frustrated by slow internet connections.

“Some of us are seeing speed impacts from the number of people working from home and kids going to school remotely,” Neilsen said. “We certainly have seen some minimal impacts in that category, but luckily they have been very minimal.”

Overall, SDL remote operations are having “negligible impacts” on satellite operations,” Neilsen said. “We’re getting the job done and the cost to the customers has not increased on these two missions due to COVID-19.”

Meanwhile, UCLA’s ELFIN operators are nearly finished writing new software to make it easier to command the satellites remotely. SN

THE U.S. NAVAL RESEARCH LABORATORY (NRL) HAS MADE FEW CHANGES IN SATELLITE OPERATIONS DUE TO THE COVID-19 PANDEMIC. Missions flown out of NRL’s Blossom Point Tracking Facility in Maryland were designed to operate in a “lights out environment,” Tim Kennedy, NRL branch head for mission operations, told SpaceNews. “Our mission planning, command and control and ground resource management software are able to perform all of the functions required to plan, set up and execute satellite ground contacts.”

If the software detects an anomaly, it pages mission operations personnel, who still have access to the mission operations center. “The policies and procedures for COVID-19 have not affected our existing on-call approach to mission operations, since only one or two engineers are required to come on-site,” Kennedy said. “However, distancing and cleaning protocols were put in place to address site access for these personnel.”

cubesat with an instrument from the University of Maryland, Baltimore County, to detect aerosol and cloud properties, and Compact Infrared Radiometer in Space, a six-unit cubesat built by Ball Aerospace to collect Earth imagery for scientific studies.

“What is new and what did require some serious thought and design work was that last leg from our headquarters into our individual homes using appropriate encryption and virtual private networking technologies,” Neilsen said. Now, seven SDL satellite operators can connect from their home workstations to the mission operations center central computers and servers in Logan, and from there to Wallops, he added.

Similarly, UCLA students began establishing remote access soon after ELFIN launched in 2018 alongside NASA’s Ice, Cloud and land Elevation Satellite-2.

“We have winter break and summer break where we would not be in Los Angeles physically,” said Rebecca Yap, ELFIN mission operations manager. “Being able to set up a flexible operations workflow was important.”

During the school holidays, though, at least one ELFIN satellite operator remained on campus with access to the mission operations center and satellite communications antenna on the roof of a nearby building.

Since UCLA moved instruction online in March, that’s no longer possible.

ELFIN, a three-unit cubesat that detects energetic electrons traveling from the Van Allen radiation belts toward Earth, is continuing to perform its science mission. Remote operations, though, are making it hard to train new satellite operators.

“We can’t hold in-person training sessions for recruits,” Yap said. “And we are not physically present in the mission operations center to help them.”
Venture capital is pulling back, but Voyager is ‘in for the long run’

**SPACE FINANCE**

Space startups have been hit hard during the coronavirus pandemic as venture capital has retreated. Matthew Kuta, president and chief operating officer of Voyager Space Holdings, says the crisis has laid bare a fundamental mismatch between venture investors focused on making quick profits and what space companies need to be successful, which is a long-term commitment.

Denver-based Voyager Space Holdings, backed by angel investor Dylan Taylor, was founded in October. Kuta told SpaceNews that the company is poised to increase investments in the space sector. So far it has acquired the space robotics company Altius Space Machines, and there are multiple deals in the works.

Kuta is a U.S. Air Force Academy graduate and former F-15 fighter pilot who spent time on Wall Street in private equity investment at Goldman Sachs. Having been in that part of the investment world, Kuta believes that the traditional private capital models are ill-suited for space businesses that have long research-and-development time horizons and high capital expenditures. Voyager provides what he calls “permanent capital.”

What is happening with venture investment in space?

VC money has dried up. The recession is driving investors from space to other sectors where they can make profits faster. Venture investment is incentivized by what is known as the “internal rate of return” where the incentive is to put money into a company and sell it after a few years at a profit. This has worked well for venture space in recent years but now VCs are looking at industries that have lower capital expenditures like software. It’s tricky for space. There are large capital expenditures, there’s R&D delays, there are launch delays. That’s why space startups are struggling. Investors don’t see them as places where they earn that internal rate of return within a short time window.

**Any predictions on what’s next for the startup community?**

It’s going to be a very difficult road for many startups. If they’re lucky, their venture investors will give them some more capital to prop them up and take more ownership of the company. Some will ride out the storm by making drastic cuts so investors can salvage whatever assets they can or sell the company. Because there’s so much uncertainty, it will be tough to raise money. VCs were very late to enter the NewSpace sector. They’re going to be the first ones to retreat because they never really completely understood it. It was just one component of their portfolio.

**Can the Pentagon influence VC behavior?**

I hear defense officials talk about this all the time. The narrative out there is that U.S. investors are walking away from space and DoD is concerned that foreign buyers will buy distressed companies. There are some things DoD can do, like extending contracts or funding Small Business Innovation Research projects. But the most important issue for DoD to understand is the incentive structure of venture capital, and I don’t think they do. VC investors will focus on propping up their portfolio companies to salvage existing investments, or they’re going to retreat to known business models that are light on capital expenditures. What I would tell DoD is that venture capital is a fundamental mismatch for the space sector.

**DoD worries about “adversarial capital.” Is the fear justified?**

Absolutely. I know for a fact there are U.S.-owned space companies that were being heavily courted by the Pentagon before coronavirus hit. But since VC money started drying up, these companies are burning through cash. They face a choice. They can keep listening to DoD policymakers telling them to not take foreign capital. But ultimately, they’ve got to put food on the table. They don’t want to go out of business. As a result, they’re starting to entertain conversations from foreign investors ready to invest. They’ll worry about CFIUS reviews later. Maybe they get boxed out of potential DoD programs in the future if the Committee on Foreign Investment in the United States determines the foreign investment impacts national security. That’s a problem they’ll figure out in two or three years, but they have to pay their mortgage now.

**Is China stepping up investments in U.S. companies?**

China is not the only one, but they’re obviously there. China is looking to make investments in U.S. companies, and they’re...
Is the current climate creating opportunities for Voyager?
We’re still investing while venture has slowed or stopped. We’re not a venture capital fund. We’re not a private equity fund. We are a holding company. We provide long-term, permanent investments, and we do that before, during and after a recession. We focus on long-term value creation versus the short-term internal rate of return. The mechanics of what we do look and smell very much like venture capital and private equity: we find companies, we invest, we own some percentage of a company. But there’s a difference. Voyager is purpose built to service the NewSpace sector. We have shareholders, we have capital. When we make an investment, it’s permanent. We never have to sell the company; we can just focus on growing it for two, five or 20 years.

Altius is the only company in your portfolio. Are you looking at more acquisitions?
Yes. We actually have a few companies under exclusivity right now. I can’t disclose the names because we’re under NDA. But there is a company we plan to publicly announce in the coming weeks our intent to acquire. Generally, we don’t do early stage investments. We’re interested in companies that have a more established stream of revenue, maybe $5 million to $15 million. They produce cash flow. And right now the companies that we really like, and the ones that are kind of in our pipeline, have a substantial amount of revenue coming from the government. That provides a lot of risk mitigation. Of course, there’s risks that government budget priorities can change. The Trump administration’s support of space provides downside protection, particularly to purely commercial streams of revenue that might have dried up because of COVID-19.

Do you expect the small-launch bubble will burst soon?
Venture capital is not a good fit for the launch business because of the high rate of failure, very thin operating margins and massive capital expenditures. The last I heard, there are over 140 small-launch companies out there. As a recent RAND study noted, the U.S. can probably support two large launch companies at a time. Who knows how many smaller ones? Maybe a couple, but not 140. There’s a place for small reusable launch, but no one’s smart enough to pick the two or three out of the 140. As a result, I think there’s going to be a large shakeout.

How should the government think about space investment?
It’s more than just developing a new hypersonic missile or launching a new satellite. DoD, and the government more broadly, should focus on large infrastructure-type investments like what the United States did with the Apollo program in the 1960s. That is how we get significant long-term capital into NewSpace companies. Infrastructure investments can be really transformative for our country and get people energized about space. GPS is an example. It’s the backbone of the infrastructure for a lot of commercial space. And when the government invests in these assets, we have to protect those assets, which means more DoD and national security investment. The space sector, like the internet in the 1990s, is transformative. The national security component provides downside protection, so there’s a lot of opportunity.

When do you see the space sector recovering from this crisis?
We view this in phases. For Voyager, there’s now less competition because venture capital money has moved elsewhere. So there are a lot of fantastic space companies out there — with visibility for a year or two into streams of cash flow — that are perfect fits for us. We see a one- to two-year slowdown. Post pandemic, we see a great opportunity of long tail winds with this industry. Geopolitical tension with China is an issue. The creation of the Space Force was part of the outcome. That is significant for space and national security, making the space budget a recession resistant stream of revenue that we see as kind of acyclical, if you will. We see a $400 billion space economy grow into a multi-trillion dollar space economy over the next 20 or 30 years. SN
OAKMAN AEROSPACE HASN’T FURLoughed anyone. In fact, the Colorado company is training two recent hires thanks in part to the Paycheck Protection Program (PPP), a U.S. Small Business Administration initiative designed to limit the economic impact of the COVID-19 pandemic.

“We likened it to winning the Powerball,” said Oakman Aerospace CEO Maureen O’Brien.

That’s because Oakman Aerospace, one of the thousands of small businesses sharing more than half a trillion dollars in relief loans underwritten by the SBA, won’t have to repay the money if they meet the terms for loan forgiveness — namely, maintaining a steady payroll for the next two months.

Much of the news about PPP has focused on awards to the Los Angeles Lakers, Shake Shack and Ruth’s Chris Steakhouse, companies that have pledged to return the money.

Space industry small businesses including ExoTerra Resources, Oakman Aerospace, Space Micro and Stellar Exploration also received PPP loans, as did SpaceNews.

The PPP is a $669 billion federal loan program established by the Coronavirus Aid, Relief, and Economic Security (CARES) Act in late March and expanded by a follow-on relief bill Congress passed in late April.

“We encourage all eligible lenders to participate and all eligible borrowers that need this assistance to work with an approved lender to apply,” Treasury Secretary Steven Mnuchin said May 3 in a joint statement to work with an approved lender to apply, “Treasury and all eligible borrowers that need this assistance to work with an approved lender to apply.

Secretary Steven Mnuchin said May 3 in a joint statement with Jovita Carranza, who leads the Small Business Administration.

Space companies needed no encouragement. Many began working with their banks to apply as soon as PPP was unveiled in March, but were frustrated when the initial tranche of $320 million was committed in less than two weeks.

“Almost everyone has complained about this process for good reason,” said Michael Torosian, who leads the emerging company and venture capital practice at international law firm Baker Botts. “It’s a new program that was launched very quickly.”

Industry groups representing space and technology companies complain many venture capital-backed startups are not eligible for PPP funding because of the Small Business Administration’s “affiliation rule.” PPP eligibility is limited to firms with fewer than 500 employees. Under the affiliation rule, “small venture-backed or investor-backed companies could fall outside of the PPP loan program if they’re controlled by an investor who controls other companies,” Torosian said. In certain cases, “you have to aggregate all those employees “ and still fall under the 500-employee cap, he added. The cap, however, didn’t apply to franchise businesses like some of the national restaurant chains subsequently shamed into returning the money.

In spite of those issues, PPP terms were so attractive companies raced to apply. PPP lets small businesses borrow an amount roughly equal to two and a half months of payroll to spend over eight weeks to cover wages, rent, interest and utilities. The loan is forgivable, meaning it does not have to be repaid, provided the company doesn’t layoff employees or cut wages.

Banks were overwhelmed by the demand. Umpqua Bank with 350 branches in Oregon, California, Washington, Idaho and Nevada, received roughly 6,500 PPP applications in the first 24 hours.

“The number of applications at the outset was so large that we paused submissions and carefully managed intake so that we could process the applications already in our system,” said Kurt Heath, spokesman for the Portland, Oregon-based bank. “We knew early on it was a race against the clock to get as many applications approved as possible.”

Since banks began accepting applications April 27 for the second tranche of PPP money, “we’re working around the clock,” Heath said by email.

PPP funding allowed ExoTerra and Stella Exploration to bring back employees furloughed when the pandemic halted work.

ExoTerra of Littleton, Colorado, has 29 employees. Stellar Exploration of San Luis Obispo, California, has 11 employees.

PPP funding means “we can continue working on projects for our customers, even with inevitable inefficiencies and productivity loss from the current conditions, and thus protect our current staff employment,” Stellar Exploration President Tomas Svitek, said by email.

Satellite component supplier Space Micro was surprised by the speed of its PPP loan. The San Diego company with 85 employees found the money in its bank account three days after learning its loan was approved.

“It shows the government can move fast when it wants to,” said Space Micro CEO David Strobel.

For Oakman Aerospace, a firm with 27 employees and two interns, PPP money provides some breathing room.

“It’s pennies from heaven as far as our business is concerned,” O’Brien said.

YOU DOWN WITH PPP? If your small business applied for a Paycheck Protection Program loan, please take our survey: https://www.surveymonkey.com/r/sn-ppp-survey
Understanding the FCC’s outsized impact on the space industry

The U.S. Federal Communications Commission is not a space agency, but many of its actions have shaping impacts on what happens in space.

Two of the commission’s recent actions — approving a spectrum license modification for Ligado despite concerns from GPS users, and proposing but later deferring on new orbital debris regulations that worried Congress and industry — showed just how big a role it plays in space.

Last month, the FCC unveiled a new seal that emphasizes its role in space, emblazoned with a satellite, cellular towers, and satellite dishes. The refresh was timely, as the FCC’s decisions are having an increasingly sizable impact on commercial space companies in the U.S. and abroad.

SpaceNews convened a panel of experts to weigh in on the FCC’s recent actions as they pertain to the space industry. Here are some key takeaways from our April 29 webinar.

**ON LIGADO**

The FCC on April 20 approved a license modification request from Ligado Networks, authorizing the company to deploy a network of ground-based signal transmitters in L-band spectrum. The U.S. Department of Defense says Ligado’s network could interfere with precision GPS signals, which use adjacent spectrum.

**Was the FCC the right agency to decide on Ligado?**

Carlos Nalda: Fundamentally, this order is about spectrum sharing and the interference impact of the Ligado system. The FCC is uniquely qualified, and is indeed the expert agency to address these issues, even to the extent there may be some disagreement among U.S. government agencies. This was an issue before the FCC for nearly two decades, and moving forward as the licensing agency does seem clearly to be within its jurisdiction and mandate.

Jennifer Manner: From a satellite industry perspective, or from any licensee perspective, we’re glad there was a decision, whatever the decision is. I don’t have a dog in this fight, but I think we’re happy to see companies getting certainty.

Carlos Nalda: Clearly there was interagency coordination and consultation over time. The changes to certain agency positions may have occurred as the proposal continued to evolve. Some questions were raised at the eleventh hour. The FCC attempted to address some of those concerns with additional conditions that will require Ligado to continue to assist and address any potential interference going forward.

**Was there sufficient coordination between the FCC and other agencies on Ligado?**

Manner: It is very hard to coordinate spectrum between agencies and the FCC. The memorandum of understanding [between the FCC and the National Telecommunications and Information Administration] provides the framework, but maybe this is an opportunity to go back and say ‘should there be something else being done?’

... From an industry perspective, we would like to see improved sharing and improved coordination between government users and the FCC, and that's for a wide variety of bands, not just the L-band.
ON ORBITAL DEBRIS

The FCC on April 23 adopted requirements that U.S. satellite operators seeking licenses and foreign operators seeking U.S. market access provide new details about collision and deorbit risks of their spacecraft, but stopped short of mandating stricter debris mitigation criteria. Facing congressional and industry objections, the FCC said it will engage in further study to create better debris mitigation regulations that will be voted on at a later time.

What should the FCC’s role be in shaping U.S. policy on space debris?

Nalda: The draft order proposed to adopt a few requirements that seemed to be at odds with U.S. orbital debris policy. The FCC has moved those particular elements of the draft order into the further [notice of proposed rule making]. The basis upon which the FCC is adopting and implementing orbital debris policies is its general public interest mandate to authorize launch and operation of satellite systems consistent with the public interest, convenience and necessity. That does encompass U.S. orbital debris policy. The question becomes is the FCC empowered to independently develop the orbital debris policy that is otherwise not part of U.S. coordinated policy?

Manner: Orbital debris regulations, to the extent they are being applied to the commercial community should be done through the FCC. That’s my view — that’s the commercial licensing body; it makes sense. It’s the development of the standards and what the policies are that needs to be done by an expert agency.

ON CONCERNS ABOUT FCC REGULATIONS THAT WERE WITHDRAWN FROM THE APRIL 23 VOTE:

Moriba Jah: I think moving forward, whatever the FCC does it has to hit on transparency, predictability and accountability, and it needs to make it very clear how a greater community can actually weigh in on this. Whatever data and whatever tools and assumptions are used, that has to be vetted by independent organizations, entities and individuals so that you can aggregate what’s important and compare notes. Because the domain belongs to all of us, not just a select few.

ON SATELLITE COLLISION PROBABILITIES:

Jah: Collision probability in and of itself is a completely nonsensical measure of coming up with collision risk. It’s one number that tries to encapsulate so many different things and assumptions.

You could take the same data, the same sensor measurements — absolutely identical — and give it to four different people and you’re going to come up with four different collision probabilities just because the physics properties they assume when they process the data are different, the assumptions on the shape and material properties of the object, and all these things. It’s very nuanced. Collision probability can be part of the answer, but it can’t be the thing that people hang their hat on because it’s a very subjectively computed sort of thing.

ON DISPOSAL BONDS

The FCC’s regulations were going to require operators pay bonds — $5 million to $100 million depending on the orbit and number of satellites — that would be forfeited for failing to properly dispose of spacecraft. The bond was pushed to a later vote, for which a date has not been set.

Manner: At least on the GEO side, which is where my company is mostly focused, there’s really been no issue that we could find where a geostationary operator didn’t dispose of a space object in accordance with the requirements. So it seemed like there wasn’t a real need for that, [or] at least as broad a need.

Nalda: Unlike large, established satellite operators who have extensive assets and credit histories, small startups and NewSpace companies are unable to get a bond or some kind of credit facility to support the bond … instead these small companies with no credit history have to take the amount of the bond in cash and deposit it in an account to support a letter of credit because it’s not possible for them to get a pay as you go bond. Tying up that amount of capital for a startup can really dampen space and satellite innovation.

ON OPERATORS INDEMNIFYING THE U.S. GOVERNMENT:

Manner: I don’t know how that is implementable. We’re very happy to see that move to the notice. I don’t think we’re against indemnifying the United States for damages if caused by an operator, but you want to know what that is, what that looks like, what you’re committing to.

WEBINAR REPLAY

To watch a video replay of our panel discussion on the FCC’s role in space policy, go to: bit.ly/FCC-webinar-replay
You are driving on the highway when, without warning, there is a bright flash that fills the sky. Thirty seconds later there is a thunderous explosion. Traffic on the highway quickly comes to a standstill. Radio broadcast and cellular communications cease. However, an app in your smartphone immediately informs you of a ground-level nuclear detonation in the city. A short time later, the same app is advising you to set out on foot to avoid radioactive fallout that will arrive at your location in about an hour. You and thousands of others receiving this information are spared radiation poisoning.

Unfortunately, if this scenario played out today, information to those in the path of the fallout would probably be delayed. The consequences of delayed public warnings would be devastating, just as it has been in the case of the coronavirus pandemic. COVID-19’s lesson for nuclear detonation warning is that satellite-based nuclear detonation detection broadcasts must be declassified now so that in the future they can be received directly by cellphones in time to save lives.

**The real-life nuclear threat**

The scenario above is based on a 2016 Department of Homeland Security planning guide, which describes a 10-kiloton improvised nuclear weapon being detonated by terrorists. It assumes that there will be limited operational federal response at the scene for the first 72 hours and that the blast and heat from the detonation will compromise much of the local response capability. But is a nuclear attack realistic?

Unfortunately, if this scenario played out today, information to those in the path of the fallout would probably be delayed. The consequences of delayed public warnings would be devastating, just as it has been in the case of the coronavirus pandemic. COVID-19’s lesson for nuclear detonation warning is that satellite-based nuclear detonation detection broadcasts must be declassified now so that in the future they can be received directly by cellphones in time to save lives.

**Don’t try to walk a line**

The coronavirus pandemic has amplified three important truths about global disasters. First, emergency response capabilities need to be ready when prevention fails. Second, early detection enables an effective response. During the pandemic, this is often referred to as “testing, testing, testing.” Third, and most important, governments must share detection information with the public. On April 15, The Associated Press reported that “China’s attempt to walk a line between alerting the public and avoiding panic set the stage for a pandemic that has infected more than 2 million people and taken more than 133,000 lives.”

The U.S. Nuclear Detonation (NU-DET) Detection System (USNDS) is a space-based system designed to provide unambiguous, timely, accurate, and continuous information of a nuclear attack and situational awareness of high-altitude nuclear explosion impacts to national, defense, civil, and commercial satellites. USNDS sensors onboard GPS satellites.
COMMENTARY Vaughn H. Standley

flood the Earth’s surface with detection data in the same frequency band as GPS navigation signals. Unlike GPS data, however, USNDS transmissions are encrypted because they are still treated as classified. For the public to receive alerts from USNDS today, they must first be decrypted by military systems and shared with civil warning systems through centralized operations centers.

Unhardened public broadcast systems, however, are likely to be damaged or too overwhelmed to effectively distribute alerts that originate from USNDS during an actual crisis. In 2017, the Federal Emergency Management Agency’s Integrated Public Alert and Warning System conducted the third in a series of nationwide Emergency Alert System Tests. Participants of the test reported overall that only 41.9% of the messages were received “due to the traffic load approaching or exceeding the maximum load capacity of one of the FEMA data centers.” If this is the result during an exercise, imagine how poorly the system might perform during an actual nuclear attack. It may be the intent to promptly share USNDS detection information with the public during an attack, but it seems likely that there will not actually be the means to do so. Gambling that the system will work, despite signs that it won’t, is also going to look like an attempt to walk a line if and when there is an actual nuclear detonation.

Half measures will not be enough
Because USNDS data is still classified, the telecommunications industry has not yet had an opportunity to miniaturize the components to fit within handheld devices like it has done for GPS. That process takes years. What should fit on a tiny chip inside a cellphone, USNDS receivers are tractor-trailer sized — so big they barely fit in the nation’s largest transport aircraft — cost millions of dollars each and are few in number. According to a USAF Acquisition Annual Report, the program only just delivered ground systems 2 through 4 in fiscal year 2018.

Slow delivery of expensive and outdated technology is a symptom of a much more serious problem. In response to a Freedom of Information Act request, the Defense Department released its 2018 Inspector General report about the USNDS space segment. The redacted report concludes that a “lack of an established and empowered governance body contribute to the risk of potential mission failure.” This finding parallels that of a redacted 2015 DoD IG report about the Integrated Tactical Warning and Attack Assessment’s mobile ground system, which includes the USNDS ground trailers. Lack of governance in these cases is not random. It is the systematic result of there being almost no incentive for the responsible agencies to work with each other to manage a system that is expensive, difficult to procure, classified, and does not actively do anything for anyone except create false alarms. Failures will continue unless this issue is addressed. The only way forward is to apply the GPS model.

Most people do not know that just like USNDS, GPS was originally a classified military system. It was not until the shooting down of Korean Air flight 007 in 1983, after it inadvertently strayed into Soviet airspace, that the Reagan administration first authorized limited public access to GPS telemetry. Later, the Clinton administration declassified all GPS navigation data. With open access to GPS telemetry, the telecommunications industry made possible everyday use of the system by reducing the cost, size, and power needs of receivers. Years later, virtually every cellphone is equipped with a GPS receiver. And because it now serves the public, the management of GPS is under greater scrutiny to assure that the capability is maintained and improved. While it was counterintuitive at the time, these decisions also led to GPS having a higher military utility.

Peacetime use of USNDS telemetry will also put pressure on the responsible agencies to manage it properly. If made public, USNDS could provide life-saving information during different types of emergencies, not just nuclear attack. The electromagnetic pulses emitted by certain types of lightning strikes can be detected by USNDS to determine the exact position and strength of a thunderstorm, supercell, or eye of a hurricane. We can track hurricanes today, but because direct transmissions from USNDS satellites are all-weather and globally available, anyone in the world would have immediate and unfettered access to this information even when public power and communications are out and in the most remote or impoverished locations. Another peacetime application of USNDS sensors is monitoring the space environment. These sensors can warn of conditions dangerous to commercial satellites or capable of bringing down parts of the electrical grid. Just as it happened for GPS, a new industry will be created from companies competing to make the best cellphone applications using these data.

Priorities for the new U.S. Space Force
Daniel Baker, the director of the Laboratory for Atmospheric and Space Physics at the University of Colorado, Boulder, reminded us recently of the devastating effects that a 1962 high-altitude nuclear tests had on satellites at the time and warned that the impact could be more severe today due to the greater number of satellites and their reliance on “soft” technology. What prompted his remarks were interagency disagreements amid reassessments of requirements that for the first time in 50 years might cause the U.S. to “not have the eyes in the sky to monitor such threatening nuclear events.” Preserving these capabilities is linked to White House and congressional priorities and ought to be priorities for the new U.S. Space Force.

One priority is described in an Executive Order about the nation’s resilience to
Electromagnetic Pulse. EMP accompanying a high-altitude nuclear strike will test the survivability of networked communications. The military may continue to operate with hardened systems, those built to withstand nuclear effects, but unhardened networks that are too congested or destroyed will maroon the public and private sectors. During peacetime, these capabilities can help discern manmade EMP from geomagnetic disturbances, which can also cause power and communications outages. Whether the source is natural or manmade, open access to USNDS can provide a high degree of resiliency to the effects of EMP that are not limited to military systems.

The other priority arises from the 2018 false alarm in Hawaii, which prompted concerns about how federal, state, and local authorities work together to inform the public about possible attack. Section 1756 of the 2020 National Defense Authorization Act affirms that “the authority to originate an alert warning the public of a missile launch directed against a State using the public alert and warning system shall reside primarily with the Federal Government” but asked the Department of Homeland Security to examine how to do this while concurrently alerting a state so that it may activate related protective action plans. One way to do this would be for the Space Force to deliver warnings directly to citizens and state officials simultaneously. After cellphones start incorporating USNDS data, Space Force could work with DHS to provide a smartphone application that minimize false alarms and that operates in concert with state and local systems.

The Space Force will need to be creative if it is to succeed in maintaining USNDS capabilities it inherited from Space Command and that it needs for its important mission. Improper classification of data that should otherwise be public is both a drain on the government and a loss of a potential resource. Space Force Vice Commander Lt. Gen. David Thompson put it this way: “Part of the culture that we grew up with that we need to change was that desire to deeply hold and deeply protect secrets related to space.” He said that a “new much more transparent era” and “need to move out in a coalition environment” are reasons to retool existing classification regimes for the force going forward. The COVID-19 crisis points to at least one other reason: saving lives.

**The bottom line**

What coronavirus is teaching us, more than anything, is that rapid public release of detection data is critical to mitigating a global disaster. Nuclear detonation detection information from the USNDS is continuously broadcast to the entire surface of the Earth from GPS satellites, just like navigation data that is received by your smartphone. However, USNDS data remains encrypted because the U.S. government still considers the information classified, which was the case for GPS navigation data before 1983. The U.S. government should do exactly what it did for GPS, declassify the information and stop encrypting broadcast telemetry so that cellphone makers can, in the service of their own interests and at virtually no cost to the government, begin to incorporate specialized electronics in cellphones to receive and process the data. Doing so will save lives, not just as a result of a nuclear attack, but also resulting from other natural disasters associated with a loss of power and communications or in places that are remote or impoverished.

Rocket science was the easy part

What can other domains teach us about space?

THE SPACE COMMUNITY KNOWS COMPLEXITY. We’ve been building, launching, and deorbiting complex systems in space for more than 60 years. We’ve gotten so good at it and done it so many times that the space operating environment is now becoming more challenging than engineering the systems themselves. Complex challenges are emerging that are (geo) political, policy, regulatory, standards-based, and organizational in nature.

Because we consider space unique, we often fail to look at other domains for inspiration and to avoid potential pitfalls. That’s a mistake. Following are some challenges the space community is facing right now, where we can learn from others:

PROLIFERATION OF NEW ACTORS

As the cost and barriers to entry have dropped, a proliferation of new actors is headed to low Earth orbit. The proliferation of space will undoubtedly drive innovation, bring new technologies to bear, and lead to other positive changes. But I expect the proliferation of satellite owner operators and launch providers will also erode norms. It’s not hard to foresee a situation where new satellites catch the community by surprise, when hackers take over underprotected satellites for fun, or dead satellites aren’t deorbited in a timely manner.

Similarly, many new actors entered the mobile phone industry as the barriers to entry dropped. We can learn from how the industry addressed tough cybersecurity challenges. Code reuse and cyber protection have been managed both through a central controller model such as is in the Apple iOS App Store — and through the Google Play Store, where a secure marketplace is offered, but not mandated.

SPACE IS NOW A WARFIGHTING DOMAIN

Consider info and cyber warfare

Space is now publicly acknowledged as a warfighting domain. This redefinition of the commons opens questions around rules of engagement, collateral damage, neutrality, and hostile intent. For example, are commercial satellites used by the military considered valid targets in time of war? How should governments, insurers, and industry manage risk of a third-party conflict that may reach far beyond the belligerents’ systems?

This is not the first time in history that traditionally peaceful domains have become battlefields. A very recent example of this is in information operations, where social media enables gray zones of conflict. We’ve also seen foreign governments target commercial companies such as the 2014 Sony Pictures hack. Conflict in these previously benign environments has forced a sea of both government and corporate policy changes, security enhancements, and commercial investments in self-protection to keep the bad actors from their systems.

COMPETITION FOR LIMITED RESOURCES

Learn from air traffic management

Low Earth orbit is growing more crowded, and that means a competition for limited resources. In the absence of worldwide norms for space operations like those for commercial flight, conflicts over available orbits and spectrum will increase. And less obviously, the availability of government resources impacts the ability to operate in space — such as the human capacity to license organizations and space traffic management. Competition for surveillance and conjunction coordination resources will increase the risk of collision.

Similarly, airlines are placing increasing demands across the electromagnetic spectrum, physical space, and air traffic...
control resources, especially in regions such as the Northeast Corridor. The Federal Aviation Administration (FAA) partnered with industry to develop technical solutions that straddle both the aircraft and the control infrastructure. Examples include information sharing approaches that benefit the industry’s safety posture, technical requirements for Reduced Vertical Separation Minimum, and increasing automation to reduce controller workload. In building these solutions, the FAA and industry have accounted for noncompliant aircraft, a pattern that may also be very useful in dealing with space resource contention.

MASSIVE CHANGES IN TRADITIONAL ORGANIZATIONS

Driven in part by the Space Policy Directives, new government organizations are emerging, and responsibilities are shifting, resulting in massive changes in traditional organizations. The Department of Defense stood up the U.S. Space Force. The Space Development Agency and the Space Rapid Capabilities Office are introducing new players on the acquisition field. And with Space and Missile Systems Command, the SMC 2.0 reorganization has realigned traditional programs across the entire command. The responsibility for maintaining the space object catalog will soon shift from the Department of Defense to the Department of Commerce.

Though driven by tragedy instead of progress, the space community can look back to the massive changes the U.S. government made in organizational responsibilities following the September 11th attacks. This included standing up the Department of Homeland Security, realigning current and new agencies underneath it, and establishing the Director of National Intelligence. Creating these new agencies and responsibilities meant many new opportunities for engaging with industry. But it also meant breaking some of the historic ties with industry that the Coast Guard and the Department of Defense had developed over many years. The successes and stumbles of this period can help us increase effectiveness through the current changes.

These cases highlight just a few potential sources for inspiration against the new challenges of space. Of course, the degree to which analogies are useful will vary. We must consider not just the similarity of the problem, but also the similarity of costs, time, and the consequences of mishaps.

As unique as we are in space, we can learn a lot by taking a fresh look at how innovators from other domains have solved similar challenges.

BEN POOLE IS THE TECHNICAL DIRECTOR OF SPACE PROGRAMS AT MITRE, A NOT-FOR-PROFIT COMPANY THAT OPERATES FEDERALLY FUNDED R&D CENTERS. THE OPINION EXPRESSED IS THE AUTHOR’S AND DOES NOT NECESSARILY REFLECT THE VIEWS OF MITRE.
U.S. space industry takes one-two punch from China and the virus

A COVID-19 RECESSION COULD LEAVE CASH-STRAPPED SPACE STARTUPS MORE SUSCEPTIBLE TO SO-CALLED ADVERSARIAL CAPITAL

In the May 2019 “State of the Space Industrial Base” report issued by the Defense Innovation Unit and the Air Force Research Laboratory, China was singled out as a perpetrator of intellectual property theft and predatory investments in American companies.

China’s behavior, experts said in the report, is driven by its ambitions to displace the United States as the dominant space power. They warned that China’s game plan “presents particular threats to the U.S. space industrial base.”

The same team of experts from government, industry and academia who wrote that report a year ago gathered again this month — in a Zoom workshop hosted by the nonprofit NewSpace New Mexico — to prepare the 2020 State of the Space Industrial Base report.

Two officials who participated in the workshop told SpaceNews that the same issues that were raised last year with regard to China are still major concerns. But the coronavirus has compounded the problem by slowing down dramatically the availability of venture capital for the U.S. space industry.

The economic downturn precipitated by the pandemic has opened a window of opportunity to what the Pentagon calls “adversarial capital.” Space startups that are part of the defense market make especially attractive targets because they are likely to give China access to valuable technology, at the same time making those startups ineligible to sell that technology to the Pentagon.

The final recommendations of the 2020 State of the Industrial Base workshop will be published in a few weeks. The group will propose “actions to preserve and expand the U.S. space industrial base in light of the disruption from the COVID 19 virus pandemic,” said one of the participants.

Last year’s report called for a national strategy that includes a space industrial base policy that maximizes innovation. It also recommended “reforms in government contracting and direct government investment as needed to compensate for U.S. adversaries’ anti-competitive behavior.” It also said the U.S. government should make steady investments in technological and logistical space infrastructure “needed to ensure long-term, U.S. dominance in space.”

In 2020, there is still no clearly defined space industrial policy. But the Pentagon has signaled that it might be taking the lead in driving future policies.

Deputy Defense Secretary David Norquist last month directed the stand up of a Space Advisory Committee under the Defense Innovation Board. The DIB is a panel of business leaders, scholars, entrepreneurs and technologists led by Eric Schmidt, former executive chairman of Alphabet. The chair of the space advisory committee is Mark Sirangelo, the former chief executive of Sierra Nevada Corporation’s Space Systems division.

Even though the United States has historically held a technological advantage in space, “potential adversaries are now advancing their space capabilities and actively developing ways to deny our use of space in a crisis or conflict,” Norquist wrote in a memo.

The Pentagon expects the space advisory committee to provide independent inputs on strategic, organizational and technological issues — including the value and implications of technologies being developed for space, and the role of commercial space innovation.

According to participants of the 2020 State of the Industrial Base workshop, the group’s recommendations could shape the agenda of Sirangelo’s space committee over the next several months. These officials said they are hopeful this could mark the beginning of a serious effort to develop a space industrial policy that drives future investments.

With the space industry hit hard by the pandemic and U.S. companies increasingly the target of predatory investment, experts believe the solution will require a whole-of-government collaboration and a close partnership with the private sector. SN
# ON THE HORIZON

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NASA Administrator Jim Bridenstine has frequently discussed how the agency could be a beacon of hope during the coronavirus pandemic. He argued that missions like the upcoming SpaceX Demo-2 commercial crew test flight and launch of the Mars 2020 rover could uplift the public’s spirits and show what the nation was capable of doing during an otherwise dark chapter.

But those missions might get upstaged by Tom Cruise. The entertainment publication Deadline first reported May 4 that the superstar was in talks with both NASA and SpaceX to film an action adventure movie on the International Space Station. The article suggested that Cruise, known for doing many of his own stunts, would go to the station. Bridenstine appeared to confirm that in a tweet the next day, writing that “NASA is excited to work with @TomCruise on a film aboard the @Space_Station!” The statement was a little ambiguous, though, leaving open the possibility that Cruise may stay on terra firma during the film’s production, just as he did when he narrated a 2002 IMAX documentary about the station.

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The idea of producing a feature film or television show in space has been around for decades. The cash-strapped Russian space program of the post-Soviet era was interested in any project that could generate hard currency, which led to filming of commercials on Mir and the ISS for companies ranging from Radio Shack to an Israeli milk producer.

More ambitious projects, though, foundered. A Russian director, Yuri Kara, sought to fly two actors to Mir for what was described as a “sci-fi romance” film in the 1990s but failed to secure the funding. At the peak of his fame from the Survivor reality TV show, Mark Burnett proposed Destination: Mir, a reality show where the winner went to Mir, but the station crashed to Earth before the show could launch. And director James Cameron lobbied for years to fly to the ISS for a documentary but has remained grounded.

From a technical and legal standpoint, filming a movie on the ISS is now more feasible than ever. Commercial crew vehicles like Crew Dragon and Starliner offer improved access to the station, while Axiom Space is planning a commercial module for the ISS that could offer additional volume to accommodate filmmaking. NASA now has a commercial use policy for the ISS along with a price list for the use of space station resources.

The real challenge is, like so many other space-related ventures, closing the business case. A seat on a commercial crew vehicle is likely to cost at least $50 million, with a movie requiring at least two or three seats (say, two actors and a director/camera operator.) That’s as much as $150 million before accounting for the other costs of filming in space, as well as salaries, marketing and other expenses. By comparison, Cruise’s latest Mission: Impossible film, Mission: Impossible – Fallout, cost $178 million.

Moreover, you don’t need to go to space to make a convincing space film. While Gravity’s depiction of an orbital debris cascade wiping out everything in low Earth orbit was hyperbolic, much of the rest of the movie looked quite realistic. You didn’t need much suspension of disbelief to think that Sandra Bullock really was floating inside the space station, rather than a soundstage. And it cost just $100 million.

With the movie industry struggling right now — productions halted, new releases postponed and theaters closed — its appetite for an extremely expensive new project, even with a star like Cruise attached and the unique aspect of filming in space, might be limited. The Deadline article noted no studio had yet signed onto the project.

If anyone can make this work, it’s Cruise. In a 2018 interview with the magazine Empire, Cameron said he and Cruise discussed back in 2000 flying together on a Soyuz mission to the ISS for a film project, although the idea never got far. But in the end, it may be a mission even Ethan Hunt can’t accept. SN
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