NEW SPACE, NEW OPPORTUNITIES

The entrepreneurial space age — New Space — is expanding more rapidly than ever, with opportunities for companies to mature their ideas and recoup their return on investment more quickly.

A BOLD NEW ERA

A new generation of entrepreneurs have long promised a bold new era of space development, marked by falling costs, reusable launch vehicles, innovative launch methods and new technologies, with the commercial world leading the charge.

That era is now in full bloom, and there's no better example than the recent launch of a Space Exploration Technologies Falcon rocket that transported two NASA astronauts into orbit for a rendezvous with the International Space Station. Not only did SpaceX became the first private company to achieve such a feat, but the successful launch heralded a historic milestone in the ongoing emergence of New Space.

The dawn of the entrepreneurial space age — New Space — has been in the making for some years. Now it's expanding more rapidly than ever, no longer the purview of governments. In the near future, it will deliver better communications networks for all, as well as the ultimate in adventure travel, space tourism. In the longer run, it will lead to a permanent, habitable moon base; possibly some mineral exploitation; and almost certainly a scientific colony on Mars — and that's only a partial list. More importantly, it's commercial enterprises that will be in the vanguard. As well as capital and ideas, the private sector provides much greater efficiency. For instance, the development of SpaceX's Falcon launch vehicles would have cost NASA about US$4 billion; it cost SpaceX approximately one-tenth that amount.

Between 1958 and 2010, government agencies by far were the biggest investors in space. In the past decade, private investment has surged to an annual average of 15 percent of the total. In 2019, a record US$5.7 billion was invested in space ventures, a 73 percent increase from 2018, according to Space Angels, a New York City-based angel investment and venture capital firm focused on early-stage investments in the space economy. Bank of America Merrill Lynch strategists forecast the space industry to grow from US$350 billion currently to US$2.7 trillion within 30 years.

> "In the short term, the novel coronavirus pandemic may slow some commercial space ventures, such as the inauguration of space tourism, but broader economic forces ultimately will drive New Space," said Carissa Christensen, CEO of Bryce Space and Technology, an analytics and engineering services firm.

> "In the long run, space will remain an attractive investment."

ROCKETS' EMERGING GOLDEN AGE

Some industry veterans are adamant that the growing demand for launch services for broadcast, mobile communications, imaging, Global Positioning System, remote sensing and navigation satellites will require not just reliable rockets, but also reusable launch vehicles (RLV).

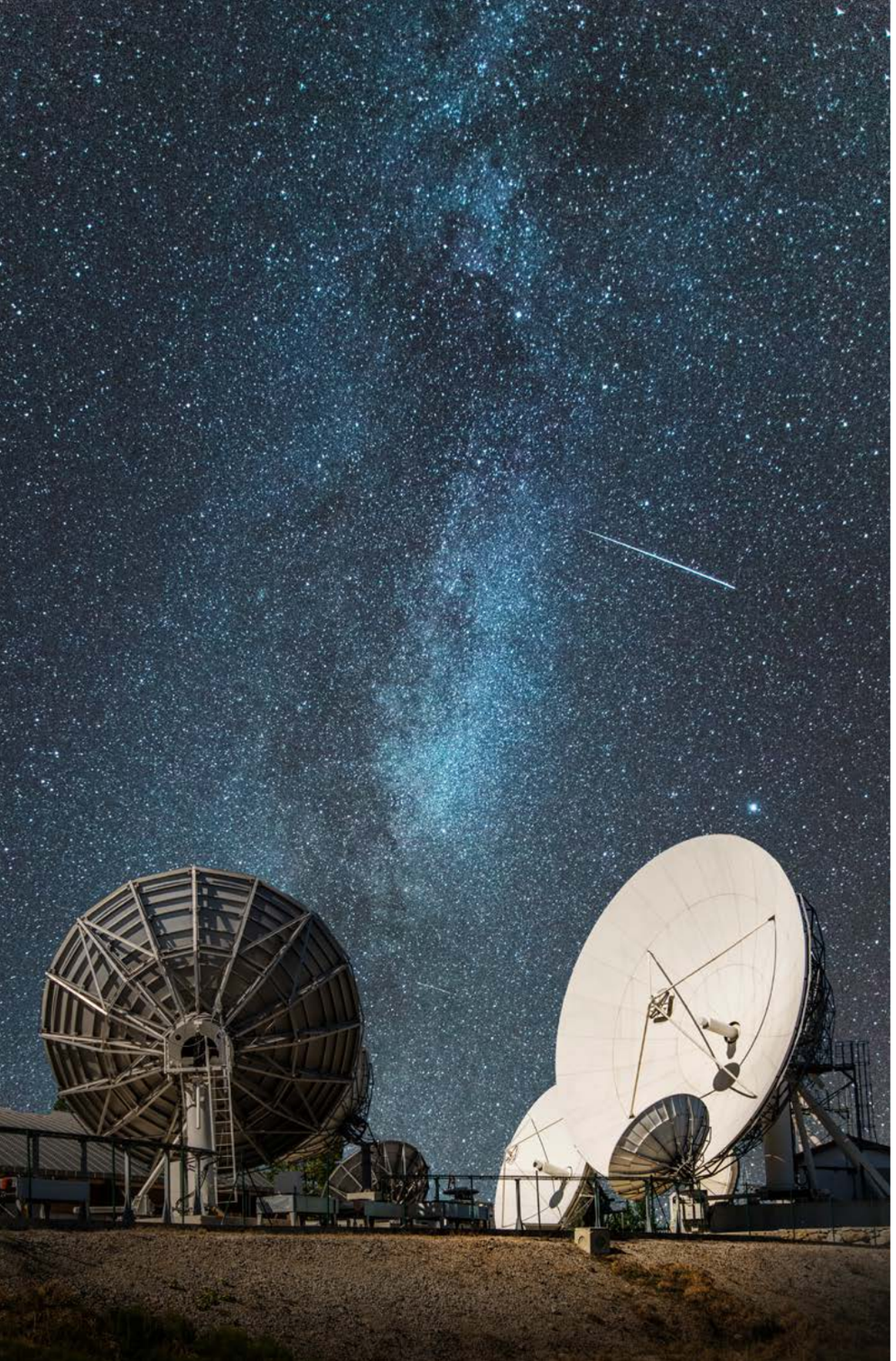
However, Tory Bruno, President and CEO of United Launch Alliance, believes the question of reuseability depends on the space mission. What the space community generally can agree upon is this: Reusable launch systems, which only recently demonstrated their potential to change the space-launch paradigm, will slash launch costs by reusing the rocket's most expensive components rather than discarding them — historically the biggest barrier to expanding commercial access to space.

Elon Musk's SpaceX wants rocket launches to be almost as commonplace and efficient as airliner operations. The goal is to cut the cost of launching a payload into orbit by at least a factor of 100.

> "Nobody was paying us for reusability; it had to be on our own dime," according to Musk. "It's probably at least US$1 billion we've spent developing this."

Other ambitious enterprises are pursuing the same quest. For example, Blue Origin, the brainchild of Amazon founder and CEO Jeff Bezos, has also demonstrated reusable suborbital flight and plans to begin flying its New Glenn orbital launch vehicle next year — with an emphasis on reusability.

Blue Origin's 100-mission BE-4 rocket engine and innovative operational reusability will "dramatically lower launch costs" and change the way money is made in space, Bezos declared.



SATELLITES: A WORLD APART

Satellites are the main component in the space economy engine, and account for about three-quarters of the US$348 billion in revenues generated from space activities, according to Bryce Space and Technology, a research and consulting firm focused mainly on New Space. They have played an enormous role in improving the state of the world, and will do even more as an explosion of technology innovation over time enables constellations of small satellites to be deployed with radical new capabilities.

More than 850 satellites were launched from 2014 to 2018, an increase of 243 percent over the prior four years. Small satellites or smallsats — those under 1,320 lb (600 kg) — comprise an ever-increasing share.

> “Once launch costs are much lower, satellites can come down in cost,” Bezos said. “They will be less precious, so you’ll be able to take more technology risks.”

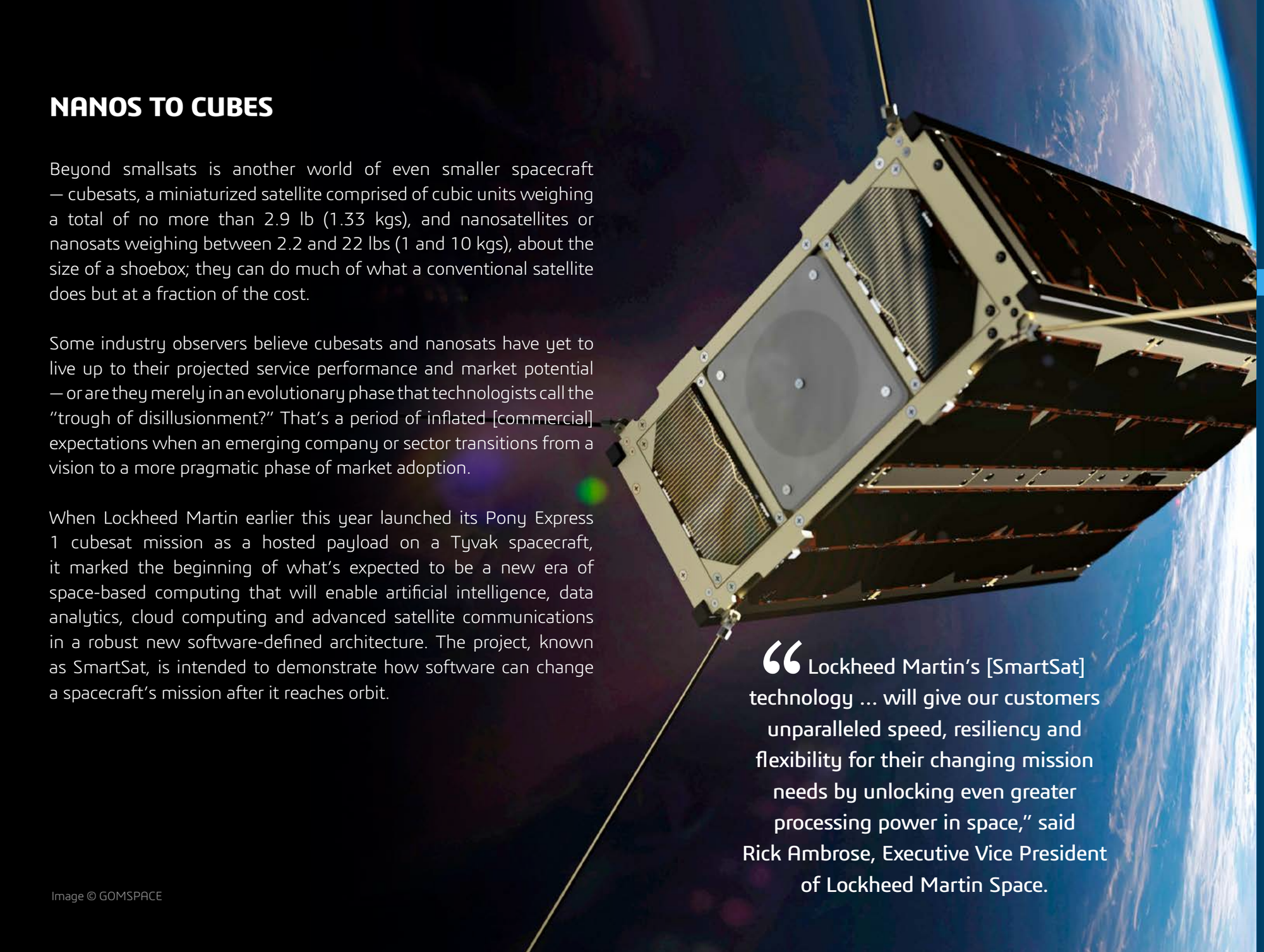
Upcoming constellations of small satellites in low Earth orbit (LEO) — such as those planned by Amazon, SpaceX and other companies — are expected to add some 26,000 new satellites in Earth orbit within a decade, according to Analytical Graphics systems engineer Ryan Lynch. In 2019, no fewer than 71 organizations were manufacturing smallsats for the first time.

NANOS TO CUBES

Beyond smallsats is another world of even smaller spacecraft — cubesats, a miniaturized satellite comprised of cubic units weighing a total of no more than 2.9 lb (1.33 kgs), and nanosatellites or nanosats weighing between 2.2 and 22 lbs (1 and 10 kgs), about the size of a shoebox; they can do much of what a conventional satellite does but at a fraction of the cost.

Some industry observers believe cubesats and nanosats have yet to live up to their projected service performance and market potential — or are they merely in an evolutionary phase that technologists call the "trough of disillusionment?" That's a period of inflated [commercial] expectations when an emerging company or sector transitions from a vision to a more pragmatic phase of market adoption.

When Lockheed Martin earlier this year launched its Pony Express 1 cubesat mission as a hosted payload on a Tyvak spacecraft, it marked the beginning of what's expected to be a new era of space-based computing that will enable artificial intelligence, data analytics, cloud computing and advanced satellite communications in a robust new software-defined architecture. The project, known as SmartSat, is intended to demonstrate how software can change a spacecraft's mission after it reaches orbit.

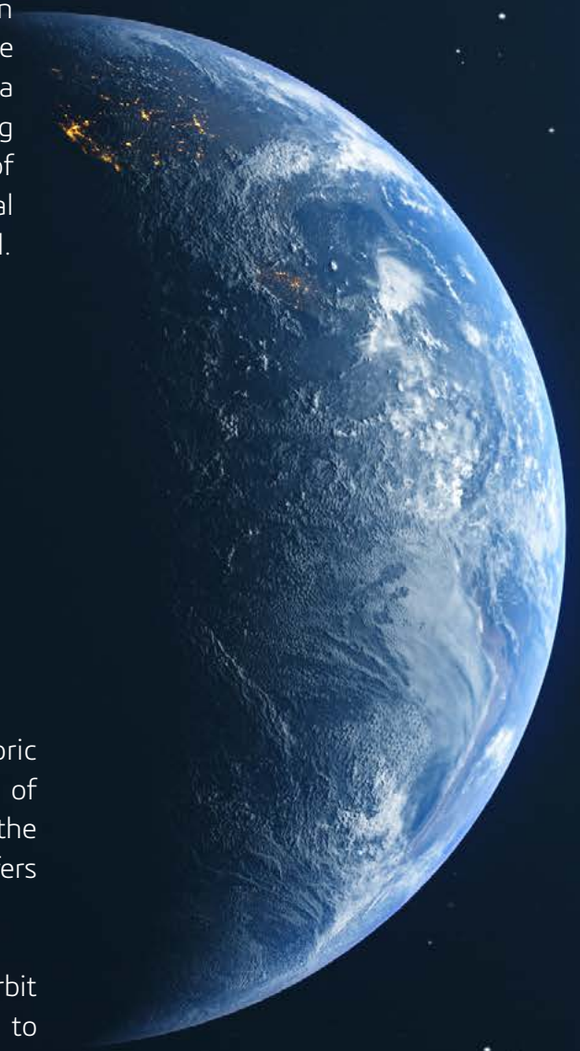


"Lockheed Martin's [SmartSat] technology ... will give our customers unparalleled speed, resiliency and flexibility for their changing mission needs by unlocking even greater processing power in space," said Rick Ambrose, Executive Vice President of Lockheed Martin Space.

Image © GOMSPACE

HIGH-ALTITUDE "ROADSIDE" ASSISTANCE

About a year ago, Northrop Grumman launched its Mission Extension Vehicle (MEV-1), the world's first commercial, in-space satellite-servicing mission. The New Space milestone could help seed a market for on-orbit service and serve as the first step toward unlocking manufacturing in space. Intelsat recently was able to extend the life of its Intelsat 901 and return the communications satellite to operational service for at least another five years; it had been running out of fuel.



> "We would not have been able to replace that satellite because the business case wouldn't have worked," said Ken Lee, Intelsat's Senior Vice President of Space Systems. "This allowed us to continue to provide service to our customers."

Northrop Grumman offered its own perspective: "This historic event, highlighted by the first in-orbit rendezvous and docking of two commercial satellites and the subsequent repositioning of the two-spacecraft stack, demonstrates the business value that MEV offers to customers."

Northrop Grumman plans to continue pioneering the future of on-orbit servicing through its multi-year technology roadmap leading to additional services, such as inspection, assembly and repair, according to Tom Wilson, Vice President of Northrop Grumman Space Systems and President of SpaceLogistics, LLC.

SPACE SWEEPERS

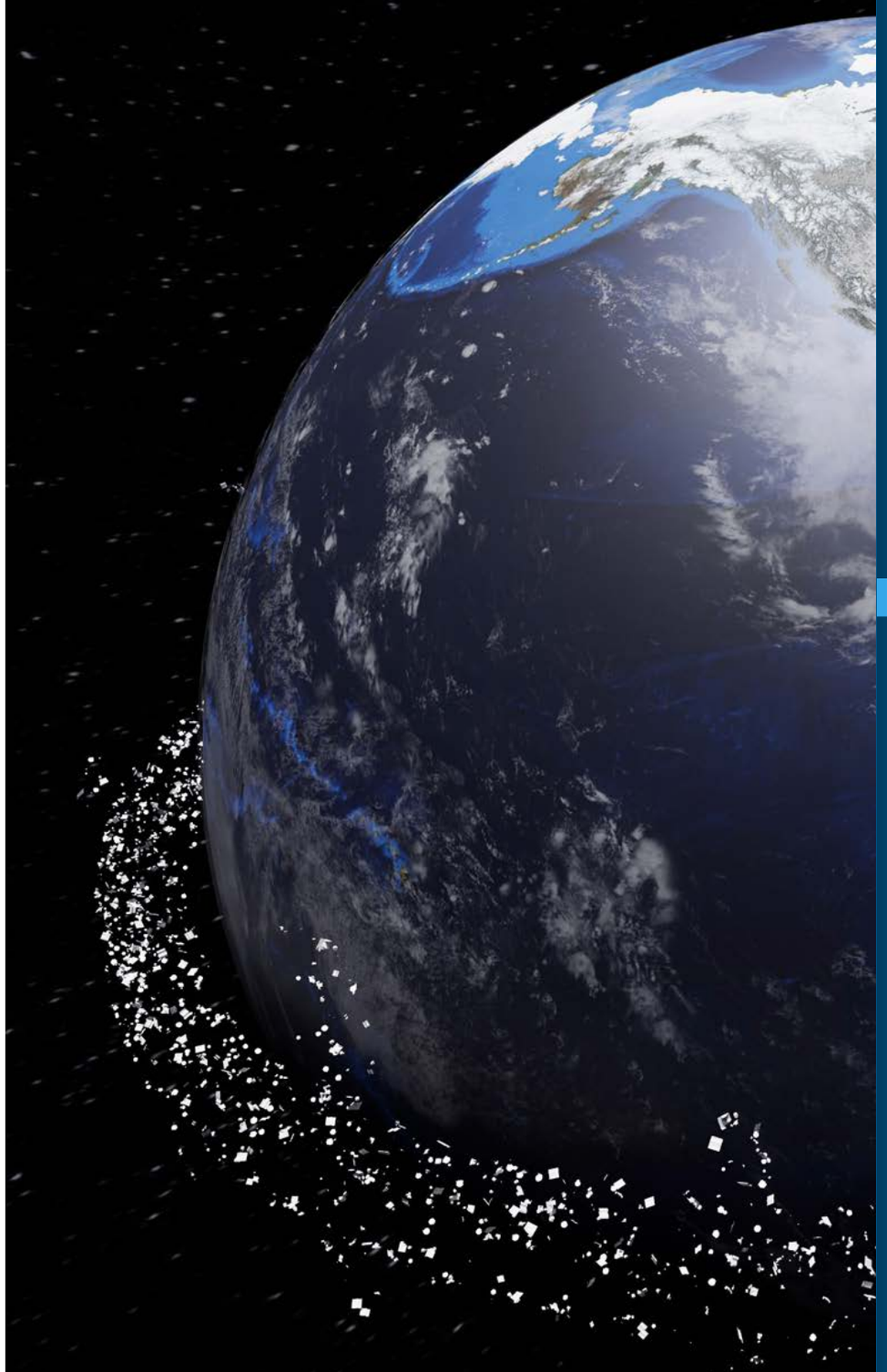
The development of technology for active space-debris removal (ADR) is gaining momentum. But can it be profitable? Tokyo-headquartered Astroscale Holdings believes so. Its goal is to provide a debris-removal solution at a competitive price, targeting mainly governments.

> “For satellites, the highways in space are getting more congested, so the idea is to make an [American Automobile Association] in space,” founder Nobu Okada said.

Nobu has been in discussions with about 10 countries. NorthStar Earth and Space, a Canadian company, expects to launch the first of its space-junk tracking satellites in 2021, and UK-based Effective Space Solutions’ business model includes ADR for objects weighing up to 10,000 kg (4,540 lb) in geostationary orbit.

There is no shortage of objects to be swept up. At this precise moment, more than 3,000 nonoperational satellites are orbiting Earth. In addition, some 34,000 pieces of debris larger than 4 in. (10 cm) long, according to the European Space Agency. An additional 900,000 objects between 1 and 10 cm also pose a significant risk.

Moreover, thousands of pieces of space junk are speeding around Earth, but current space-tracking tools aren’t yet able to pinpoint where most of the junk is at any given time, putting other satellites at risk — and fueling a nascent industry to track debris and satellites.



DESTINATION: SPACE

Blue Origin and Virgin Galactic within the next 12 to 18 months almost certainly will transition from flight-test organizations to commercial space operators by transporting flying passengers on sub-orbital excursions that offer the thrill of weightlessness and a view of the curved edge of Earth against the blackness of space. By 2035, UBS financial services analysts expect space tourism to be a US$3-billion market.

About 800 intrepid customers have ponied up deposits on a flight on Virgin Galactic, now a publicly-traded company, and the number of people who have registered interest is approaching 4,000.

> “Even if we don’t get a 100 percent conversion rate, we should get a large number of them, and that’s good for the pipeline and for the path to drive this business toward greater scale and growth,” CEO George Whitesides said.

The inaugural revenue-generating spaceship, SS2-1, has an initial capacity for four passengers per flight, while SS2-3 and SS2-4 will carry five per flight.

“We believe a sequence of milestones involving sending [civilians] into space for more regular, more ambitious missions can be an important driver to increase public and investor awareness of the emergence of a US$1-trillion [space] economy,” according to Morgan Stanley analysts.

IMAGINING THE FUTURE

From landers ready to roam the Moon to companies that can downlink data in the blink of an eye, entrepreneurial start-ups are pioneering the commercialization of New Space — with Dassault Systèmes a critical enabler.

For example, Zero 2 Infinity, which is developing high-altitude balloons to provide access to near space and low Earth orbit, is partnered with Dassault Systèmes to access its engineering software on the **3DEXPERIENCE®** platform. Dassault Systèmes also provides technical skills and mentoring to the private Spanish company.

> “New Space is a huge and growing entity but is still in its infancy,” said Jeff Smith, Senior Director of Aerospace and Defense Industry Strategy & Innovation at Dassault Systèmes.

Jeff continued, “We are helping create an environment in which start-ups can mature their ideas faster and venture capitalists funding those ideas can recoup their return on investment quicker.”

One of the ways that Dassault Systèmes fulfills the strategic objective of accelerating innovations in satellite technology is by participating in the creation of Soundview Innovation Campus (SIC), a 500,000-sq-ft world-class center near Puget Sound designed to promote the cross-fertilization of new ideas and open innovation among different industries. Modeled after Dassault Systèmes' **3D**EXPERIENCE Center in partnership with Wichita State University's National Institute for Aviation Research, SIC will become a "center of gravity" for accelerating New Space R&D, according to Smith.

Two years ago, Dassault Systèmes launched **Reinvent The Sky** on the Cloud, an industry-solution for the aerospace and defense industry. Tailored for product innovation by start-ups and small original equipment manufacturers, **Reinvent The Sky** cuts the development time of a first prototype in half. Dassault Systèmes is using the initiative to attract start-ups and venture capital firms to New Space.

The future of space is only limited by our imagination to dream big together!

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A 24-year veteran of Aviation Week, Anthony Velocci is former Editor-In-Chief of Aviation Week & Space Technology magazine and Editorial Director of Aviation Week Group.

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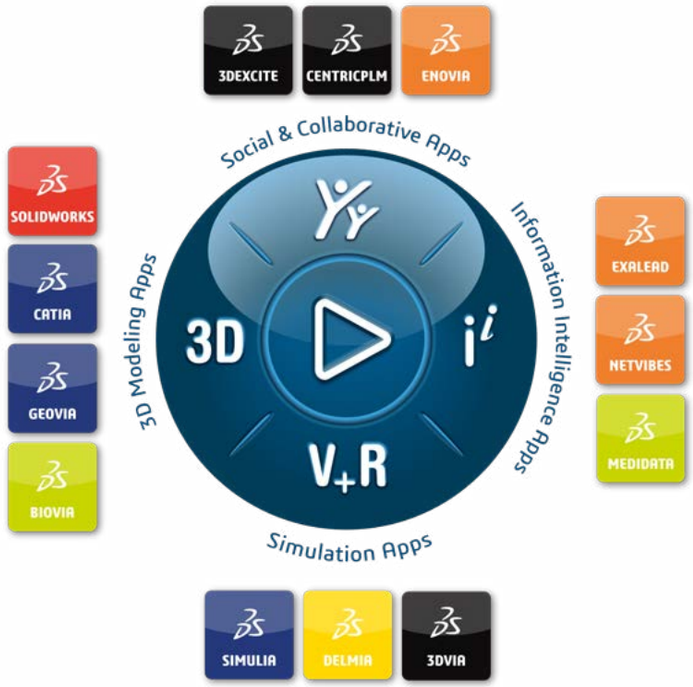

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