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As clock ticks, space station replacements raise profiles

Commercial projects in development as NASA looks at money and time required to avoid a service gap

In an image from December 1998, the robot arm of space shuttle Endeavour moves away from the docked Unity and Zarya modules during the assembly of the International Space Station.

BY CHRISTIAN DAVENPORT

It has good bones, as the real estate agents would say. Sleeps six, or more. Upgraded bathroom. Gym. Indoor garden. Parking for as many as eight visitor vehicles. And you can't beat the location — 240 miles high with superb views of Earth: Truly all the best low Earth orbit has to offer!

But after hosting a rotating cast of astronauts for more than 20 years straight, the International Space Station is showing its age — it recently sprang another tiny leak — and NASA is already shopping for a new spread for its astronauts.

The space agency is confident that its international partners and Congress will agree to extend the station's life beyond 2024, its expiration date. The Senate recently passed a NASA authorization bill that would extend that to 2030. But space is harsh, the station is aging and at some point it will have to come down.

What comes next, though, isn't certain.

Under President Trump, NASA has been working to return astronauts to the moon under an accelerated timeline. But the first big test the incoming Biden administration will face in space could well be the future of the space station. If it's retired without a backup, NASA would face an "existential challenge," as one top space agency official put it, with no place for its astronauts to go.

There are several companies working to develop a commercial space station and looking at various options: a modern version of what is there now, a station with modules that inflate like balloons and one that would refurbish discarded rocket stages that are floating around in orbit.

Those options show promise, but they are unproven and years from hitting the market.

As a result, NASA has been increasingly concerned that it could have a gap in low Earth orbit that would be even more consequential than the ignominious period after the space shuttle fleet was retired that left the space agency with no way to get astronauts to space from U.S. soil. Instead, NASA was forced to rely on Russia for rides, at a price that grew to as much as $90 million a seat, before Elon Musk's SpaceX in 2020 restored human spaceflight for NASA.

Even if the station is extended, NASA needs to be working on its replacement, officials said. It took years to get the existing station up and running. The concept was born in 1984, when President Ronald Reagan announced that the United States would put a station, eventually dubbed Freedom, into orbit. But after different administrations and design changes, the first segments weren't launched until 1998. Since then, NASA has invested more than $100 billion in the facility, which receives more than $3 billion annually from NASA.

Privately run stations would also need time to build their business cases, signing foreign governments as tenants, working with companies and universities that want to do research in space, and tourists who would pay millions of dollars to visit.

While NASA and the private sector work toward developing commercial habitats, China is building its own space station that it hopes to launch within a couple of years and is recruiting countries around the world as partners. The United States would not be one of them, however, since NASA is effectively barred by law from partnering with China in space.

"I think it would be a tragedy if, after all of this time and all of this effort, we were to abandon low Earth orbit and cede that territory," NASA Administrator Jim Bridenstine told a Senate panel in 2020.

The space station has some good years left, officials said. "We're good from an engineering standpoint," Joel Montalbano, NASA's space station program manager, said in an interview. "We're cleared through 2028."

Boeing, which is paid $225 million per year as the prime contractor supporting space station operations, said the station could stay in orbit for even longer.

"The ISS is incredibly healthy, with life capability well beyond 2030," said John Mulholland, Boeing's space station program manager. He said the United States and Russia recently completed a life extension study "and all the hardware has been cleared to a minimum of 2030. That's a real testament to the design and the maintenance that's been done on it."

Recently, the station got new

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lithium-ion batteries that are "less than half the size of the original batteries and produce twice the power," Mulholland said. The power upgrade also doubled the speed at which the station's crew can send data from science experiments back to Earth.

Over the years, the station's water recovery system has improved to the point where today, 95 percent of the water used for drinking and cooking is recycled, Montalbano said. The communications systems have also been upgraded, as have life support systems including carbon dioxide removal.

Still, just like a house, things break. Since a leaky roof could have dire consequences in space, and no plumbers or electricians are going to make a house call, astronauts are trained to repair the toilet or plug leaks. But even a tiny leak hissing air into the vacuum of space is a threat, and astronauts spent weeks recently searching for one in the Russian segment of the station before patching it. It was tiny: "Think of the size of two grains of salt is what we had to find," Montalbano said.

The recent Senate vote gave a significant boost toward extending the station, though not as of yet the money required to do so. Many in the space industry think the extension would be supported by the Biden administration and the House, where a bill that would extend it to 2028 has been introduced. It's unclear, though, whether Russia would want to continue, and getting the station's other partners on board would take time.

After the Commerce Department targeted Russian firms because of ties with the country's military, the head of the Russian space agency lashed out and said the move would threaten relations between the United States and Russia in space: "These sanctions are harmful, because they will create additional obstacles and irritations in such an important cooperation between Russians and Americans in space, in particular, on the ISS," Dmitry Rogozin wrote on Twitter.

Wary of a gap, Bridenstine has increasingly been sounding the alarm, urging Congress to fully fund the requests to build a commercial presence in Earth orbit that would include private stations.

Last year, NASA requested $150 million as part of its plan, but Congress granted just a tenth of that. For the fiscal 2021 budget, NASA requested the same amount but will receive just $17 million, sparking a new round of warnings: "ISS won't last forever & incentivizing the private sector to begin follow-on capabilities are needed now," said Lori Garver, who served as NASA deputy administrator in the Obama administration. "This concept isn't hard, have we learned nothing in the last 10 years?"

"It's critically important for the United States to have access to low Earth orbit with humans so they can live and work and do science and discovery in the microgravity of space," Bridenstine said in an interview. "That should be a national priority. There is a reality that we all have to accept, which is at some point in the future we have to focus on what comes after the ISS."

Some have been critical of the Trump administration for not doing more to prevent a gap. While the White House has been focused on returning astronauts to the moon, the future of the space station has received relatively little attention, said Jeffrey Manber, the CEO of NanoRacks, which is seeking to build small space stations.

"What troubles me is this administration is walking out the door having done very little to prevent a space station gap," he said.

After the space shuttle, NASA decided it did not need to own and operate its own rockets and spacecraft but could instead rely on the private sector to ferry its astronauts to space. In 2014, NASA awarded contracts to SpaceX and Boeing to develop spacecraft to fly astronauts. It took six years for SpaceX to have its first flight with humans. Boeing has yet to fly its first crewed mission.

Developing a private space station could take just as long, industry officials said, which is why NASA and the private sector need to get moving.

"It's very apparent to everybody that when the ISS comes to the end of its life, we're not going to replace it with another $100 billion station," Bridenstine said. "The transition needs to be to commercial space stations. Not just one, but multiple."

There are several companies NASA is hoping will help it continue the American presence in low Earth orbit.

Axiom Space, a Houston-based company, is working toward building a commercial space station that would be a modern version of the one in use now, with some key upgrades.

"When you look at the shell you go, 'Wow, that looks just like the same old space station.' But after that, pretty much everything will be dramatically different," said Mike Suffredini, Axiom's president and CEO.

The space station has some key components on the outside, meaning astronauts have to perform risky spacewalks to, say, swap out batteries. On the Axiom station, those would all be inside. It would also have "the largest window observatory ever constructed for space," and an interior designed by French architect Philippe Starck.

The company has a contract with NASA to attach at least one privately developed module to the space station by 2024, which could potentially allow crew capacity on the station to grow.

Suffredini, who previously served as the space station program manager for NASA, said he is not concerned about a gap. Rather, he said, he's more concerned about ensuring a transition from a government station to a commercial one that gives his potential customers confidence.

"I'm more concerned that we drive ourselves to keep ISS on orbit too long," he said. "The negative impact is investors start to worry about is ISS ever going to leave?"

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Sierra Nevada Corp. also is working to build a commercial station. But instead of a station with metal structures, it would be made of a Kevlar-like material that would inflate, making it easier to get more space station volume into orbit with fewer rocket launches.

The company says it could get its first modules into space within five or six years and is confident that there will be enough demand to make it feasible financially.

"We're looking forward at the projected market out there, and it just looks incredibly bright," said Janet Kavandi, a former astronaut who serves as the company's senior vice president for space systems. "There's so much interest in space right now, in the commercialization of space and the potential out there for everything from manufacturing to tourism to research laboratories to observatories."

NanoRacks is also interested in developing commercial stations. But instead of launching them from Earth, the company wants to take discarded rocket stages that are already in orbit and transform them into stations designed for research.

"We need to make the investment now to understand how we can develop cost-efficient free fliers and, just as important, to continue to grow the market for customers," Manber said.

Blue Origin, Jeff Bezos's space company, is also interested in building habitats, and recently posted a job opening for an "Orbital Habitat Formulation Lead." (Bezos owns The Washington Post.)

"To develop Blue Origin's vision of millions of people living and working in space, humanity will require places for them to live and work: space destination systems in which value-creating economic activity can occur," the posting read. The space station in low Earth orbit (LEO) would go beyond the International Space Station to support "a robust LEO economy" and be "fundamentally different from the 'exploration' habitats designed for small, professional trained crews in deep space."

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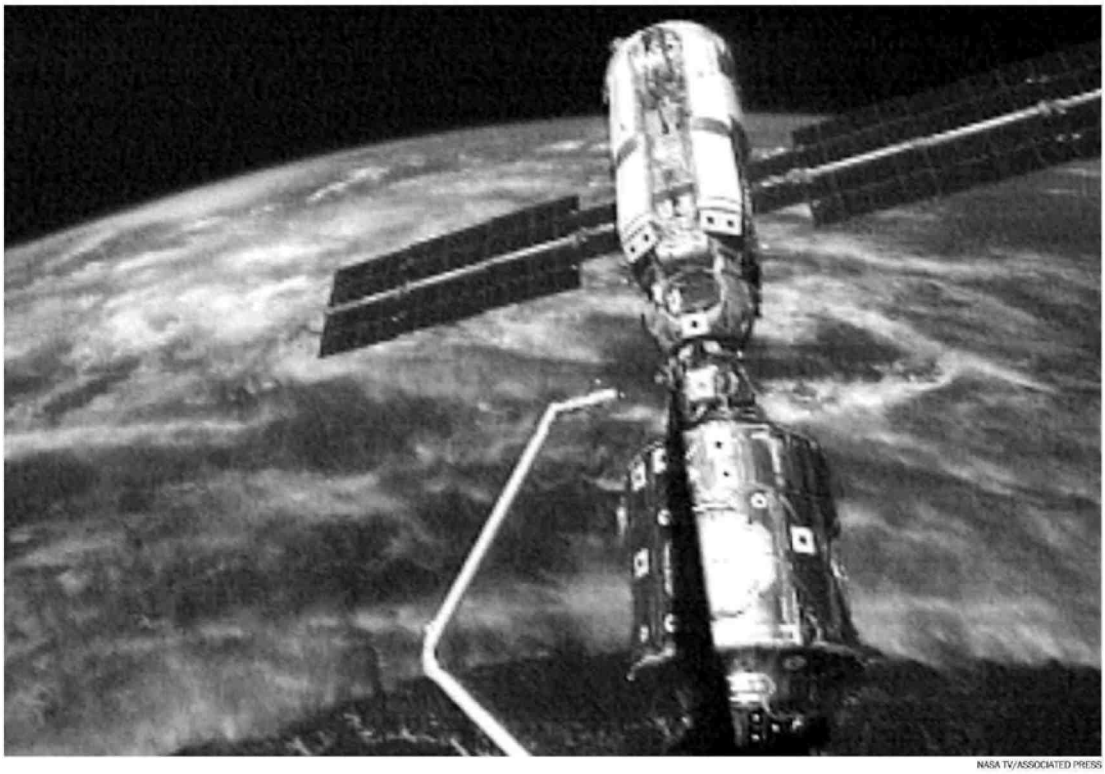

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