What will space exploration look like in the future?

Russia has proposed to extend the life of the International Space Station to 2028. Image: REUTERS/Shamil Zhumatov

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The process of assembling the International Space Station (ISS) started in 1998 and was completed in 2011, with five partners involved: Canada, Europe, Japan, Russia and the United States.

It was initially planned to operate only until the year 2020, but in 2014 the US decided to extend its life until 2024. Since then Russia has proposed to extend further the life of the ISS to 2028, and the US space agency NASA seemed ready to accept this new extension.

However, major space policy changes happened in the US in 2017, with the revival of a high-level White House body, the National Space Council (NSpC), chaired by the Vice President. The new priority of the White House is a return to the Moon in the 2020s, as a step towards Mars in the 2030s.

In order to free funds for this new strategy, the NSpC favours an end-of-life of the ISS in 2025. A compromise with Congress will likely lead to the decision for an orderly transition of the ISS after

2025, from its current configuration to a public-private partnership (PPP) model, reusing the existing elements totally or partially.

At the end of this transition process, there may be one or many public-private stations, operating more or less commercially in low-Earth orbit (LEO). Such a scheme would also mean that the space agencies owning and operating the ISS today would be customers buying services on a public-private basis from private space stations.

If this scheme was not viable economically, the ISS may be finally decommissioned. Its structure would be guided in a controlled manner into the Earth's atmosphere, so that it burns up over large sections of ocean. In any case the ISS will leave an impressive legacy for research and international cooperation.

At the beginning of 2018, the ongoing mission is Expedition 54, which constitutes the 54th rotation of the permanent ISS crew of six astronauts. NASA has an extensive list of experiments, which will benefit from extension of the life of the ISS for a few more years. For example, the Alpha Magnetic Spectrometer, NASA's particle physics detector, is researching dark matter in a setting that would not be possible on Earth.

What happens after the ISS?

At the two-day International Symposium for Personal and Commercial spaceflight in October 2016, the decommissioning of the ISS was one of the major talking points. Charles Bolden, then head of NASA, announced that private companies would soon have the possibility of docking modules at the ISS, confirming an expectation that there will be a shift towards privately-funded ISS crews and missions, with the possible development of commercial space stations after decommissioning.

In fact, the foundations for private actor involvement in space are quite established. Bigelow Aerospace, an American space technology company, has already developed habitat modules, or expandable habitats (the Bigelow Expandable Activity Module, or BEAM), which are able to provide radiation and thermal protection and serve as a facility in which astronauts can operate in space.

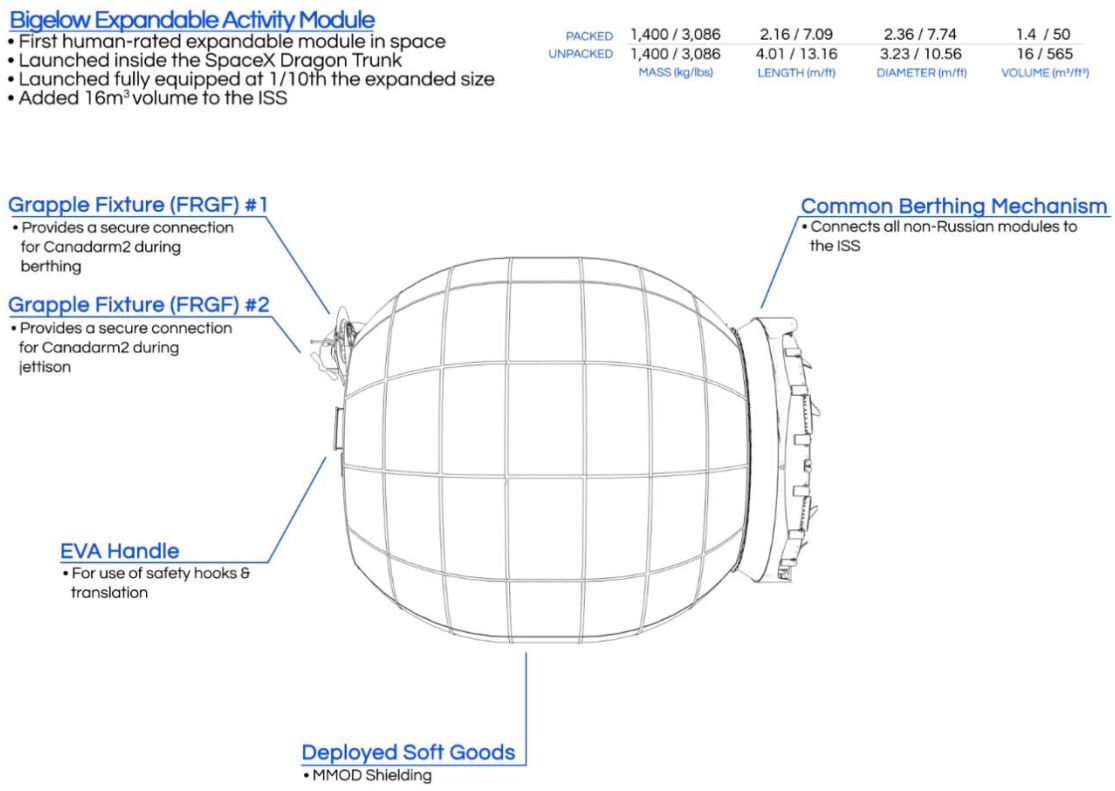

Image: Bigelow Aerospace

The first launch was in April 2016, from SpaceX's Dragon spacecraft CRS-8 on a resupply mission to the ISS, which represented the first step private actors have made towards a replacement 'station' located in space.

Other private corporations such as Orbital Sciences, Lockheed Martin and Sierra Nevada Corp are all developing new technologies to be used on future missions, and Axiom Space is seeking to establish the world's first private, international, commercial space station by 2020 – the Axiom International Commercial Space Station.

Supporters of commercial space stations point to significant cost reductions for state space agencies. Space agencies would rather be able to lease an expandable orbiting habitat at a relatively affordable price – perhaps at $1 million for a one to two month visit. While the ISS has cost over $100 billion to develop, BEAM was constructed for $17.8 million.

Such cost reductions could increase the accessibility of space exploration for countries with less experience and financial resources. Private space stations could not only serve as a base for scientific research, but also a hub for those travelling to the moon or to Mars, or to support the activities of emerging space actors, such as asteroid mining companies. Public-private partnerships for space station cooperation are also likely to gain traction, due to the cost reduction benefits.

Such concepts fit well within the new space policy framework setup by the US Federal Administration in 2017.

But states are also preparing for life after the ISS. For example, Russia apparently considers the creation of its own space station, and after 2024 it may detach its ISS modules with the aim of constructing of a new Russian habitable space station – dubbed the Russian Orbital Station (ROS). Roscomos sees the creation of an autonomous space station as a necessary prerequisite for fulfilling itsambitions in space, including the establishment of a Moon base.

In addition, China is planning its own permanent space station – the Tiangong Space Station. In October 2016, the Chinese space agency successfully launched two taikonauts (a term for Chinese astronauts) to board the experimental space laboratory (Tiangong 2). These developments constitute integral steps in achieving China's plans to complete the space station by 2022. China was unable to cooperate on the ISS due to refusal by the US. Currently,China's space station plans are among the most comprehensive of any nation and with a successful completion of the Tiangong Space Station, China could potentially challenge US dominance.

The possible fragmentation of outer space research activities in the post-ISS period would constitute a break-up of an international alliance that has fostered unprecedented cooperation between engineers and scientists from rival geopolitical powers – aside from China. The ISS represents perhaps the pinnacle of post-Cold War cooperation and has allowed for the sharing and streamlining of work methods and differing norms. In a current period of tense relations, it is worrying that the US and Russia may be ending an important phase of cooperation.

Nevertheless, Russia indicated its willingness to extend the life of the ISS beyond 2024, or possibly to become a partner in a follow-on project of NASA, called theDeep Space Gateway (a small ISS-like station in cislunar space) – fueling hopes of further outer space research. The International Spacecraft Working Group (ISCWG), made up of ISS colleagues from the US, Russia, Japan, Europe and Canada, is tasked with mapping ideas and technical details for launching a new deep-space exploration program, expected in the 2020s.

The European Space Agency (ESA) has expressed an interest in extending international cooperation, whatever the fate of the ISS. ESA envisages the construction of a moon base, comprising a collaborative community of both public and private organisations from around the world (the "Moon Village"). A lunar base – just four days from Earth – would allow scientists to research and test technologies which could facilitate explorations to farther destinations, such as Mars.

As the ISS as we know it will likely no longer exist in a decade from now, the cooperation it initiated will hopefully persist and even attract other private and state players. In the future, it is likely that private actors will increasingly fill the void left behind by the ISS and that certain states will seek to establish their own space stations. However, there still appears to be a number of initiatives which can promote international cooperation in space, which is one of the main legacies of the ISS and perhaps its greatest achievement.

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