A US space strategy for 2050: shaping a domain on the cusp

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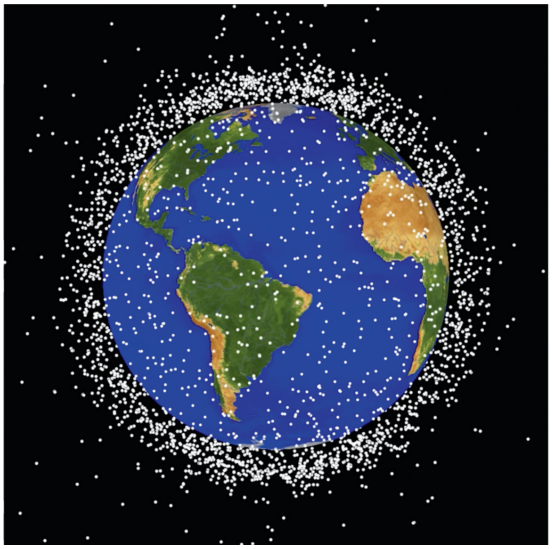
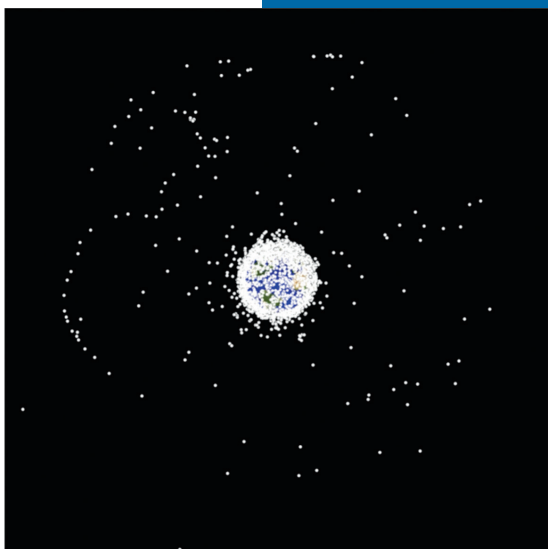
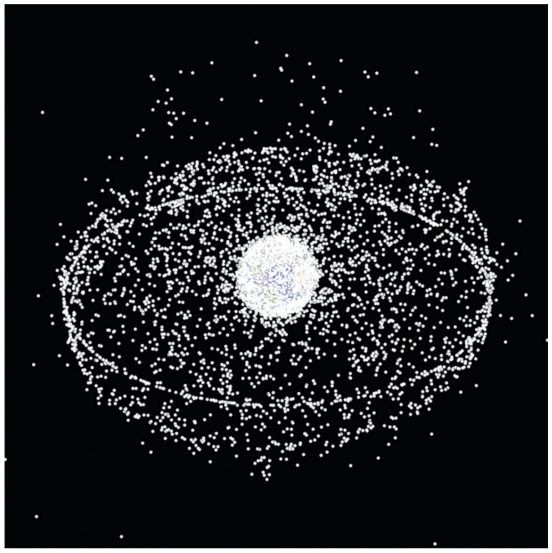
Outer space has rapidly evolved from being dominated by two primary actors in the 1950s to its current state where multiple actors, both private and government, are competing to seek commercial opportunities and establish themselves in the ultimate 'high ground' for security and defence. The authors assert that, given these developments, the United States and like-minded nations are in desperate need of a long-term, thirty-year 'strategy for space' to take advantage of space's transformative period as it evolves from a domain of primarily discovery and exploration to one largely defined by vast commercial resources and security implications.

Christa McAuliffe, the American teacher aboard the Space Shuttle Challenger when it was lost in January 1986, poignantly said: "Space is for everybody. It's not just for a few people in science or math, or for a select group of astronauts. That's our new frontier out there, and it's everybody's business to know about space." Her statement foreshadowed the major transition evident in space today and the need for long-term US space leadership.

Today space is essential for winning wars, generating revenue and pushing the frontiers of scientific exploration and discovery - roles which will only increase in importance in the coming decades. Indeed, space holds great potential for humanity at large, as researchers, academics and entrepreneurs consider applications of space for addressing global issues like water scarcity, climate change and poverty, to name just three. At the same time, the renewal of great-power competition has expanded military competition







▶ Space congestion in 1975 (top) and today. During the cold war, regulation of satellites was relatively straightforward. Today, there are approximately three thousand operational satellites in orbit and some predict that there could be one hundred thousand of them in orbit within the next 30 years.

within space, as US competitors China and Russia develop sophisticated anti-satellite weapons while cyber and electronic counterspace tools become accessible to rogue states.

Goals

It is imperative to get out ahead and shape the future of outer space in ways that are favourable to order, security and prosperity. Short-term strategies and policies are insufficient to deal with the long-term trends. A long-term strategy, however, should reap the benefits of space, including virtually unlimited sources of energy, vast amounts of useful materials, new levels of connectivity and new innovations from space-inspired technology. This radical abundance from space has the potential to increase electricity and food access, reduce poverty, and elevate educational levels of those in the most remote areas on Earth. As such, the United States, in concert with its allies and partners, should set out an ambitious thirty-year strategy for space encompassing four major elements and corresponding short, medium and long-term recommendations.

Outer space is transitioning from primarily a discovery and exploration phase to a security and commerce phase

Space Governance

The US Chief of Space Operations, General John Raymond, routinely refers to outer space as the "Wild, Wild, West". Technology has advanced to a point where the foundational 1967 Outer Space Treaty has become obsolete. The treaty bans weapons of mass destruction, prevents military activity on celestial bodies, and charts peaceful

▲ Russia conducting a test of its direct-ascent anti-satellite (DA-ASAT) missile system on 15 December 2020.

uses for space. However, the language is overly ambiguous, stale, and naively assumes that activity in space will remain peaceful.

During the Cold War, the vastness of space and dominance of the United States and the Soviet Union made the regulation of satellites in orbit somewhat straightforward. However, today, there are approximately three thousand operational satellites in orbit and another 25,000 pieces of debris that governments track. This growth is driven by space entrepreneurs racing to launch thousands of satellites into low Earth orbit (LEO) to deliver Internet connectivity to the four billion people who still lack access. Some predict that there could be one hundred thousand satellites in orbit over the next thirty years. While there are clear benefits to the services these satellites could offer, the crowding of LEO without clear 'rules of the road' could lead to disaster.

Resource extraction is another challenge that needs to be addressed to mitigate concerns that are bound to develop as space-based solar power matures into reality, asteroids are mined for rare metals, and fuel is produced in space for new space-based commercial and security purposes.

The space treaties, when signed and ratified, did not adequately account for the future space reality – Moon colonisation, space tourism, asteroid mining, Mars inhabitance and other space-based activity. A significant portion of this new activity will take place in cislunar space, the sphere around the Moon. The United States and its allies and partners need to address how cislunar space will be governed and organised as this area becomes further developed in the years to come.

The United States, with like-minded spacefaring nations, should rejuvenate space governance and create rules of the road for the next thirty-years and beyond. Because prospects for revisiting the 1967 treaty in the short term are dim, US policymakers and diplomats should focus on strong national legislation on space resource issues, synchronisation of laws and standards with like-minded nations, close coordination with foreign partners on space situational awareness (SSA) and space traffic management (STM), and multilateral agreements like the Artemis Accords. Further, US diplomats should work to evolve these policies into norms, with the hope of shaping international customary law. In that vein, the United States should also be prepared to challenge, through diplomacy or show of force, actions which it considers destructive of space norms, lest those undesirable actions become accepted state practice.

A reasonable mid-term recommendation is to evaluate whether the United Nations (UN) should create a specialised organisation to promote regulations and standards for commercial uses of space; for instance, the International Civil Aviation Organization's sphere of influence should extend into space to coordination international SSA and STM. Toward the end of the long-term space strategy, and once the previous recommendations or similar actions have taken place, a new comprehensive treaty that includes updated language will be ripe for signature.

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Defend space access

Diplomacy should be the tool of first resort in managing space issues; however, space is essential to national security applications, and military competition indelibly extends to space. As space becomes even more essential for military uses, there are many more (and more diverse) weapons pointed at space than at any time before. However, given the reliance of the global civilian economy on space services, any conflict in space could have widespread economic and humanitarian consequences. As such, the United States and its allies and partners should take steps to reduce the likelihood and consequences of conflict in space through deterrence, resilience, and (in the long term) a new space alliance. While existing successful alliances like NATO have nascent space

policies, the membership of NATO is not large enough to encompass the array of space actors that will need to be involved in securing this domain and theatre in the future.

The world is quite different from when the Outer Sace Treaty was signed in 1967. The Hubble Space telescope and initial cohort of astronauts discovered an entirely new universe that, prior to 1957, humans could only imagine. Now, as the space domain transitions from an exploration and discovery phase to a commerce and security phase, it will be ever more important to ensure that the interests of the US, its allies and partners are protected through deterrence and defence against aggression in space and against space assets.

Since the end of the Cold War, US competitors have accelerated their efforts to hold at risk US assets in space. The Soviet Union once fielded an impressive array of counterspace weapons, and Russia has steadily reconstituted this arsenal. Of worry are Russia's potential co-orbital anti-satellite weapons (ASATs), capable of rendezvous and proximity operations (RPOs) and space-to-space attack. China entered the counterspace competition in 2007, with its dramatic test of a direct-ascent ASAT, a test which attracted broad international condemnation for its production of debris. Both Russia and China reorganised and elevated their space forces in 2015, clearly signalling their intent to use space as a warfighting domain in potential conflict.

These actions have not gone unanswered. The US military re-established United States Space Command, and the United States Space Force became the first new US military service since 1947. US allies and partners also stood up new military space organisations, such as the French Space Command and United Kingdom Space Command. NATO preceded both by announcing in 2019 that space is an operational domain and stood up the NATO Space Centre; the Alliance will eventually establish a space centre of excellence in Toulouse, France. In 2021, NATO extended its mutual defence clause to include an attack in space, acknowledging the criticality of space to broader security.

It is imperative to keep on this track and go further. To properly secure the space domain from rogue activity, in the short and medium term, the United States and its allies and partners must develop a common understanding of space security, share intelligence, and coordinate new and existing activities in space. New consensus should be built on the protection of space-related assets and the coordinated development of space-adjacent capabilities (such as SSA) to enhance credibility on space security. In the long term, a space security alliance should be formed allowing for accountability and enforcement of space behaviour. A future space security alliance should be adaptable to the ever-changing geopolitical and technological environment. NATO is a logical place to start conversations that could lead to developing a formal space security alliance.

A future space security alliance should be adaptable to the ever-changing geopolitical and technological environment

Accelerate Space Commerce

As near-Earth space transitions to a commerce-centric domain that could radically benefit humans on Earth, it is vital for both governments and private companies to aggressively innovate new technologies and new policies that can foster a robust commercial environment. Consider the analogue of air transportation. In 1911, the first piece of mail was delivered by air. Since then, air-commerce-fuelled economic activity has ballooned into a multi-trillion-dollar market that includes cargo transportation, passenger travel and defence uses. Over the last one hundred plus years, regulations and government organisations like the US Federal Aviation Administration and UN International Civil Aviation Organization have played significant roles in promoting and formalising norms of behaviour in the air domain that have fostered and accelerated air commerce.

To accelerate space commerce in the short term, the US government should increase targeted research and development for

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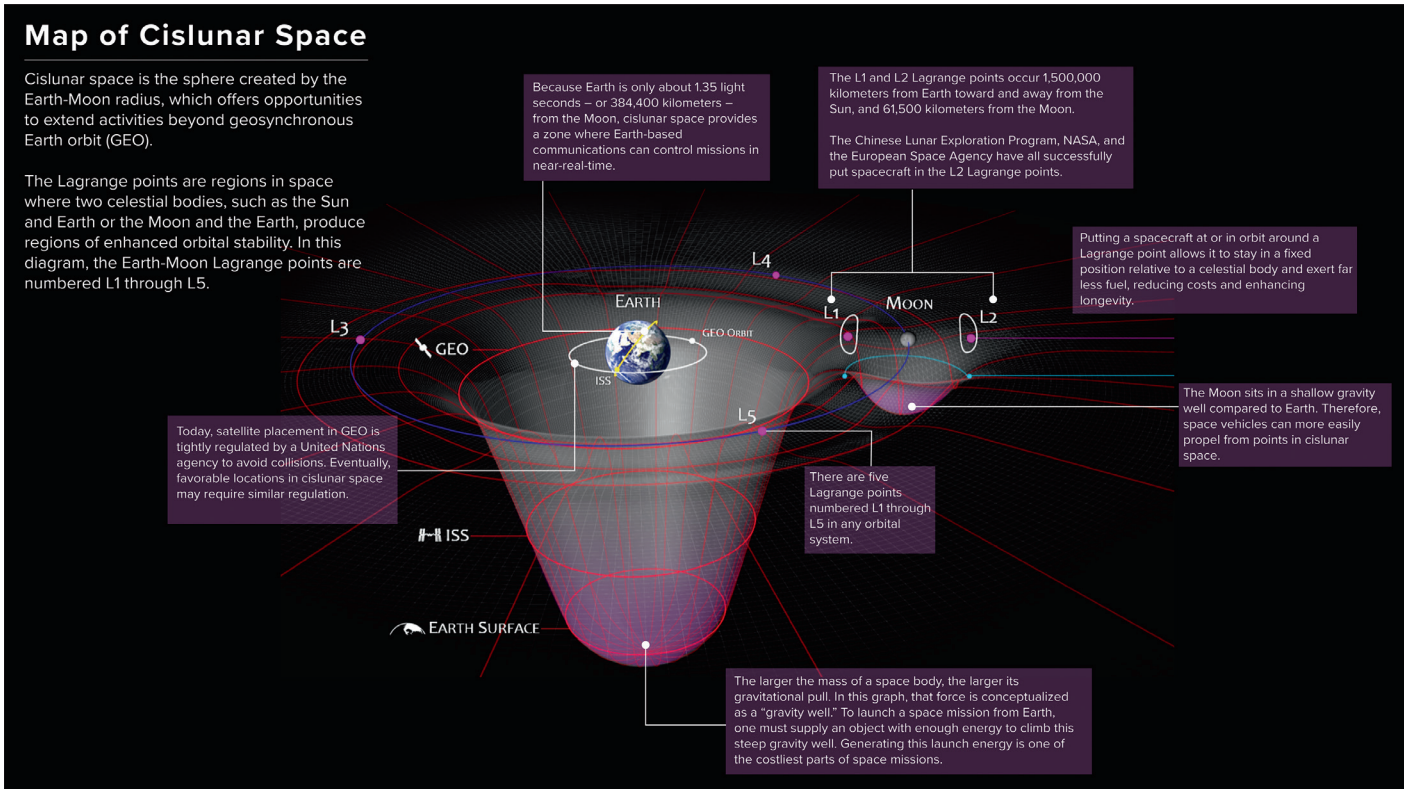

▲ Potential uses for cislunar space include lunar resource extraction, communication relays, intelligence and national security purposes, and the ability to use shallower gravity wells as launch points for missions to places like Mars or other celestial bodies.

specific space advancements that have positive externalities that can be leveraged across the US and allied space-industrial base. The National Space Council, in coordination with its Users' Advisory Group, should advocate for space equities and work with relevant agencies and Congress to routinely re-evaluate existing regulations on space commerce, with special focus on those which prevent robust public-private partnerships from flourishing. Those regulations that are dated and hinder new space developments should be modified or rescinded by the applicable organisation.

Just as the original biplane evolved from a rudimentary flying vehicle into today's sleek airliners, space rocket technology has advanced. It now costs roughly $1,500 dollars to send a kilogram into space, an order of magnitude less than just a decade ago, a development partially attributable to reusable rocket technology. With these lower costs, it may become feasible to use rockets for point-to-point cargo transportation around the Earth for time-sensitive material like medical transplants or mission-critical spare parts. In the next ten years, the United States and allies and partners should build out and encourage rocket infrastructure growth and applicable regulation to seize the commodity of time.

In the long term, the national security space and commercial communities should identify and invest in the keystone technologies that can ensure both the national security and commercial aspects of space grow into a vibrant space ecosystem – on-orbit servicing, nuclear power and propulsion, space debris removal, and in-situ resource utilisation (ISRU) are just a few examples.

Technology has advanced to a point where the foundational 1967 Outer Space Treaty has become obsolete

Embrace Cislunar Space

New opportunities are pushing companies and nations to look beyond geosynchronous orbit (GEO), the orbit traditionally used for weather mapping, intelligence purposes, certain communication requirements, and other national security uses. Now, there are emerging uses for cislunar space, the sphere formed by the Earth-Moon radius. Some potential uses include lunar resource extraction and harvesting, communication relays, intelligence and national security purposes, human tourism, and the ability to use shallower gravity wells as launch points for missions to places like Mars or other celestial bodies.

In the short term, NASA should work with Congress to communicate the required resources and support needed to meet the 2024 goal of returning humans to the Moon. In the medium term, the US Space Force should consider military applications of cislunar space, including expansion of space domain awareness and potential placement of national security payloads in cislunar orbits.

In any two-body system, there are five areas of gravitational stability known as Lagrange Points. The United States, in the long term, should develop infrastructure at the Earth-Moon Lagrange Points. The mind is the limiting factor in conceptualising future uses for these points, but, for now, the Earth-Moon Lagrange points are best suited to communications relay and SSA purposes. The Lagrange points are key to accessing cislunar space, deep space, and other yet-to-be-dreamed-of strategic uses.

Working together

John F Kennedy famously said: "The exploration of space will go ahead, whether we join in it or not, and it is one of the great adventures of all time, and no nation which expects to be the leader of other nations can expect to stay behind in the race for space." The world, especially the space domain has changed exponentially since President Kennedy made his space speech in 1962. Outer space is transitioning from primarily a discovery and exploration phase to a security and commerce phase. The new space rush requires a long-term strategy, led by the US and its allies and partners, to ensure that space remains a benefit for all humankind.

Young people are more impressed with today's space rush than their counterparts probably were with the first space race. The positive impacts space can have on humanity, in terms of economics and environmental sustainability, is sparking the new generation to get involved, something that President Kennedy also challenged Americans to do. To that end, young people are creative, ambitious advocates for a sustainable future. Policymakers should think outside the proverbial box and foster new ways of leveraging young people's skills and novel ways of thinking. One idea is to socialise a long-term strategy during a joint National Space Council with multi-generational participants, to include allies and partners, in an overseas location. This would bring other nations physically together, inspiring bold action and excitement that the space domain deserves.

Only through focused, methodical engagement by socialising norms of behaviour, deterring and defending space from nefarious activity, accelerating space commerce, and pushing the envelope on harnessing cislunar space, will true security and prosperity be achieved over the next thirty plus years. ■

Editor's note

This article draws from *The Future of Security in Space: A Thirty-Year US Strategy*, an Atlantic Council Strategy Paper by Clementine G Starling, Mark J Massa, Christopher P Mulder, and Julia T Siegel published in April 2021. Opinions, conclusions and recommendations expressed or implied within are solely those of the authors and do not necessarily represent the views of the Air University, the United States Air Force, the Department of Defense, or any other US government agency.

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▼ Separate images by NASA's Galileo spacecraft were combined to generate this view of the Earth and Moon.