

The evolution of space as a contested domain

From the dawn of the first space age, Americans understood the many benefits that could come from the peaceful uses of space and the great harm that could result from hostile uses of space.

The launch of Sputnik 1 on Oct. 4, 1957 ignited a frenetic competition for superiority in space. Both the United States and Soviet Union made rapid technological advances in rockets, satellites, and human spaceflight, and because of these advances, the United States and Soviet Union quickly became the dominant powers in space. From 1957 through 1990, the United States and Soviet Union were responsible for 93 percent of all satellites launched into space. Moreover, the U.S. and Soviet space programs were directly linked to military power, and about 70 percent of satellites launched from 1957 to 1990 were military satellites.

Space also became a contested domain from the outset. Both the United States and the Soviet Union developed and tested a variety of counterspace weapons, beginning with the United States' launch of the Bold Orion missile from a B-47 aircraft in 1959. The missile flew within a few miles of the Explorer 6 satellite that was used as a target for the test. It was not equipped with a nuclear warhead, but it proved that, had it been armed, the target satellite would have likely been destroyed. In 1962, the United States conducted the Starfish Prime nuclear test, which detonated a 1.4 megaton nuclear weapon at an altitude of approximately 400 km. Although it was not primarily intended to be an anti-satellite (ASAT) test, the experiment proved that nuclear weapons could be used to destroy satellites. And in 1963, the Soviets began developing a co-orbital ASAT system capable of destroying satellites in LEO. The system had to be launched into the same orbital plane as the target satellite before gradually maneuvering close to its target and detonating a conventional warhead—a process that could take hours.

The development and testing of ASAT weapons continued into the 1980s, with the United

States' development of the Strategic Defense Initiative (SDI) and the Air-Launched Miniature Vehicle (ALMV). While SDI was primarily intended as a missile defense system, it would have had a latent capability to destroy satellites in LEO. ALMV was a direct ascent ASAT weapon launched from an airborne platform (an F-15 fighter jet), which gave it much greater flexibility for launch and a shorter response time than the Soviet co-orbital ASAT weapon. ALMV was tested only once against an actual satellite in 1985. Following this tests, the Soviets agreed to an informal moratorium, and no other debris-producing tests were conducted by any country until the Chinese ASAT test in 2007.

As the Cold War came to an end in 1991, the space domain began to transition into what has been called the "second space age." This transition was the result of nearly simultaneous shifts in the commercial uses of space, the geopolitical environment on Earth, and the military balance of power. The fall of the Soviet Union meant that there were no longer two superpowers locked in a stable, long-term competition in space. Operation Desert Storm, also in 1991, proved to be a key turning point in the military use of space because it was the first time space-based capabilities played a major role in conventional military operations—what Air Force Gen. Merrill McPeak called "the first space war." Furthermore, beginning in the 1990s space capabilities began to spread to other countries and commercial firms, bringing more of the benefits of space to people around the globe.

The defining characteristics of the second space age are that it is more diverse, disruptive, disordered, and dangerous than the first space age. It is more diverse because space capabilities have proliferated to many other nations, despite several attempts by the United States at limiting the spread of space technology.

From 1991 through 2016, 43 percent of new satellites and 39 percent of launches have been from nations other than the United States and Russia. Moreover, since 2014, a majority of satellites and a majority of launches have been from nations other than the United States and Russia—primarily China, Japan, Europe, and India. A greater number and variety of commercial firms have also emerged since the end of the Cold War and the easing of government restrictions on space technologies. In the first space age (1957 to 1990) just 4 percent of satellites launched were commercial, while in the second space age (1991 to present) more than 36 percent of satellites launched have been commercial.

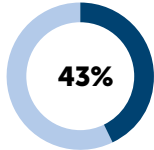
The accelerating pace of innovation in commercial space is also leading to disruptive changes in the way space is used. A notable example is the space launch industry where a handful of billionaire-backed startups, such as Elon Musk's SpaceX, Jeff Bezos's Blue Origin, Richard Branson's Virgin Galactic, and Paul Allen's Stratolaunch, are competing to lower the cost of access to space and to create a space tourism industry. SpaceX and Blue Origin in particular have disrupted the launch industry by developing first stages that can land vertically and be reused for multiple launches. Several commercial space firms are planning to launch constellations with hundreds—and in some cases thousands—of satellites for missions that include communications, imagery, and signals intelligence. Since the total number of satellites in orbit today is roughly 1,459, these massive constellations could dramatically increase the number of objects that need to be tracked—and associated space traffic management issues—by an order of magnitude over the coming decade. Private companies are also planning space missions in new areas that go beyond what current laws and regulations were designed to accommodate, such as on-orbit servicing of satellites, asteroid mining, and on-orbit manufacturing.

The increased use of space by more nations and the development of new commercial space capabilities is making the space domain more

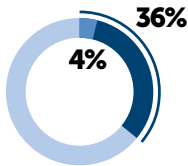
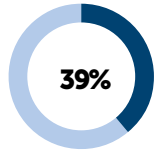


disordered. Policy makers are scrambling to understand the national security and foreign policy implications of this new environment, and some have argued that current laws and treaties are outdated and not designed to accommodate the way space is being used today. One of the policy implications of the second space age is that the availability of advanced space capabilities on the commercial market can potentially bring the advantages of space within the reach of rogue nations and non-state actors. As a result, it could make the world more transparent to the public and weaken the ability of state actors—including the U.S. government—to control the flow of information. >

The U.S. launched an anti-satellite, or ASAT, missile from a highly modified F-15A in 1985 hitting a DoD science satellite orbiting 555 kilometers overhead.



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< > While space has become more diverse, disruptive, and disordered, it is also more dangerous because the targets in space—particularly U.S. military satellites—are more attractive for adversaries to attack in a wide range of scenarios with a wide array of counterspace weapons. Other nations have taken note of the many advantages space provides to the U.S. military and its critical dependence on space-based capabilities. Some have attempted to replicate U.S. space capabilities to provide similar advantages for their own forces. Other nations have developed counterspace capabilities to reduce or eliminate the advantages space provides for the United States. China and Russia appear to be pursuing both strategies. These developments indicate that space is a more strategically important domain in modern warfare, not just for the U.S. military but for others as well, which increases the potential for conflict in space.

Senior leaders in the U.S. military are quick to point out that conflict in space is not something that occurs in isolation. Instead of talking about a war in space, military leaders routinely refer to a war that “extends into space.” One could argue, though, that war already extends into space every time space-based capabilities are used in combat, from GPS-guided weapons to unmanned aircraft controlled through satellite data links. The U.S. military uses its space systems across the full spectrum of conflict, from gray zone conflicts to high-end major theater war. It is only natural to expect that adversaries will attempt to disrupt, degrade, or destroy these systems. What is different in the second space age is not that war could extend into space, but rather that a wider array of adversaries can begin to fight back against U.S. space capabilities—both from the ground and from space.

Further complicating matters, military satellite constellations that were once intended primarily for nuclear missions, and were thus protected by the cloak of nuclear deterrence, are now being used routinely for conventional warfighting at lower ends of the conflict spectrum. This calls into question whether a nuclear

or non-nuclear adversary would be deterred from attacking these systems in a conventional conflict—especially if these systems are actively providing the U.S. military with a substantial advantage in that conflict. The second space age is more dangerous because old notions of deterrence and controlling escalation in space may no longer be valid.

From the dawn of the first space age, Americans understood the many benefits that could come from the peaceful uses of space and the great harm that could result from hostile uses of space. In what has become known as his moon speech at Rice University in 1962, President Kennedy addressed the dilemma of how to reap the benefits of space without conflict:

“[O]nly if the United States occupies a position of pre-eminence can we help decide whether this new ocean will be a sea of peace or a new terrifying theater of war. I do not say we should or will go unprotected against the hostile misuse of space any more than we go unprotected against the hostile use of land or sea, but I do say that space can be explored and mastered without feeding the fires of war, without repeating the mistakes that man has made in extending his writ around this globe of ours.”

For 60 years, space has been the exception—the one domain that has remained free from the scars of war. But the fractured balance of power and lack of norms in the second space age are leading perilously close to the “new terrifying theater of war” of which President Kennedy warned. The hope is that by better understanding the dynamics of the current situation, a more stable equilibrium can be found to usher in a third space age—one that is defined by stability and widely accepted norms of behavior. The norms that govern the next space age could shape the balance of power in space—and on Earth—for a generation or more. **SN**

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