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Space Security: The Next Decade

Private-sector initiatives have created considerable momentum in the space industry. The importance of space systems as critical infrastructures will continue to increase in the coming years. At the same time, it is increasingly likely that weapons will be deployed in space. For Switzerland, the trajectories of this trend bring economic opportunities, but also increased security risks.

By Michael Haas

A prototype of SpaceX's Starship spacecraft in Boca Chica, Texas U.S. September 28, 2019.
Callaghan O'Hare / Reuters

While we may increasingly take for granted the maintenance of our global high-tech civilization, it is in fact based on a broad range of challenging requirements. Since the late 20th century, one of these in particular has been access to outer space. Complex space systems are not only required for obvious applications such as satellite navigation and weather forecasting. Today, global financial transactions, electronic payment systems, mobile telecommunications networks, and elements of civilian air traffic control all depend on space-based infrastructures. It is thus quite appropriate that the Federal Council in its "National Strategy for Critical Infrastructure Protection 2018–2022" refers to Switzerland's very considerable dependence on space-based services.

The existing parameters that have governed the provision of such services to date are likely to change very significantly in the 2020s. Developments in the past decade have ushered in a new era in the use of space. Two major trends are particularly significant. First, it should be noted that, for the first time, the key impetus for the further development of the space industry is provided not by the governments of technologically advanced nations, but instead by a new breed of private technology corporations. Despite a trend towards renewed state investment, especially in the US and China, these players have managed to position themselves as key drivers of technological advancement while laying the groundwork for the even more intense use of space in the near future.

On the other hand, space has once again become a key battleground in the global competition among great powers. The situation at the beginning of the 2020s is difficult to compare to the "space race" of the Cold War. It is marked by a multitude of actors, a complex mix of cooperative and confrontational behavior, as well as by interests that are often ambiguous. However, a number of decisions made by great and medium-sized powers suggest that in the coming decade, geostrategic rivalries will extend into space to an even greater extent. As a result, many experts now fear that the military use of this domain will expand in line with this intensifying competition, and might even include the stationing of weap-

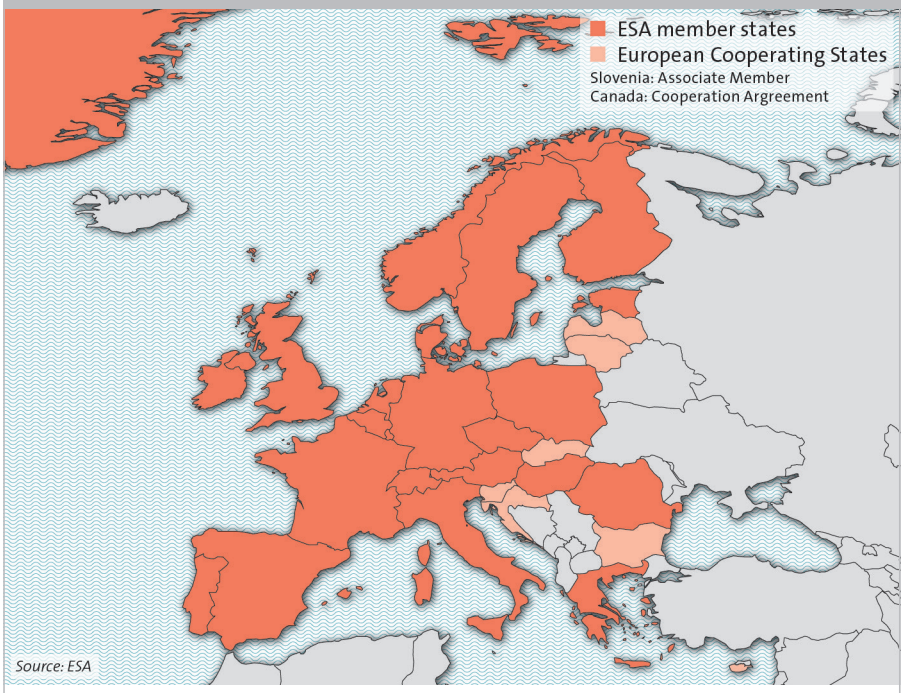
ons systems in orbit, which would likely increase the probability of military conflicts with knock-on effects for critical infrastructures in space.

Corporations as Technology Drivers

For decades, space technology has been highly dependent on, and largely supported by, state investment. The requirements of military users have been a particularly important driving force. The truism that space technologies tend to have dual-use components – i.e., that they can be used both for military and for civilian purposes – will continue to apply in the future. However, the environment in which cutting-edge space technologies are being developed has changed considerably over the past decade. For the first time, privately financed initiatives are about to become decisive drivers in advancing the use of space, albeit with substantial government support.

Three developments are particularly significant here: (1) the introduction of cost-saving, reusable launch systems, (2) the miniaturization of satellites and their payloads, and (3) increased competition among manufacturers. In the field of launch systems, competition has already become quite fierce. From 2021 onward, Elon Musk's company *SpaceX* will see competition from *Blue Origin*, which is financed by Amazon founder Jeff Bezos, and will also begin executing space flights with (partially) reusable launch vehicles. During the same period, more "traditional" providers of defense and space technology such as *Northrop Grumman and United Launch Alliance* are also expected to fly a new generation of launchers. While the US government is making targeted efforts to encourage shifts in the domestic market and will be pleased to see a decline in costs per kilogram of freight, the implications of this development for the states of the European Space Agency (ESA, see map) will be more negative, at least initially. The European Ariane 6 program, in particular, is at risk of becoming permanently unprofitable if prices continue to rapidly decline. Even leading ESA members have already succumbed to the siren song from across the Atlantic, as became apparent when the German *Bundeswehr* announced that it would commission *SpaceX* to deliver its *SARah* radar satellites into space. Moreover, the existing funding in the framework of ESA will likely be insufficient to offer a cost-effective alternative at relatively short notice. The pressure to act in this area is set to further increase in the coming years.

The ESA and Switzerland



The *European Space Agency* (ESA), founded in 1975, currently has 22 member states. ESA is not part of the EU's institutional structure. It does, however, maintain a framework agreement with the EU. Its programs are limited to promoting the peaceful use of space. ESA's core budget for programs and activities was 4.18 billion EUR in 2019. Switzerland's share was 158 million EUR (3.8 per cent), with this budget contribution being reinvested as far as possible in the Swiss space industry according to its "geographical return principle".

As an ESA member and an important high-tech location, Switzerland aims for a leading position in five areas of technology development:
– high-precision mechanisms and structures,
– atomic clocks,
– photonics (light-based digital sensor and transmission technologies),
– technologies for high-precision scientific measuring instruments,
– technologies for future small and flexible, user-funded systems and applications.

At the same time, the continuing miniaturization of satellite systems weighing less than 100 kilograms opens up the prospect of new suppliers entering the market with lighter and less complex launch systems. The significantly lower costs of development, manufacturing, and transport make miniature and micro-satellites highly attractive, particularly for those players who have thus far been unable to consider building space systems of their own. Cost-saving transport concepts in the lighter-weight brackets are being developed not only by Western companies, but also by Chinese suppliers such as *LandSpace*, *LinkSpace*, and *OneSpace*. Competition in this sector is therefore likely to further intensify and will continue to place downward pressure on transport costs in the medium term. As a result, access to space would become more and more attractive for smaller countries such as Switzerland, as well as for financially powerful private firms. Against this backdrop, a new "space boom" seems possible, if not likely – a reality that will further augment the role and importance of space systems as critical infrastructures.

Space has once again become a key battleground in the global competition among great powers.

States Remain Key Actors

As private technology companies gain importance, their political influence will also continue to increase. It is not yet clear whether this growing clout will manifest itself in demands for a more comprehensive role extending into the realm of governance and space security, or whether their

Limitations on the Military Use of Space

In the Outer Space Treaty of 1967, the currently 109 signatory states undertake "not to place objects carrying nuclear weapons or other weapons of mass destruction into orbit around the Earth, nor to equip celestial bodies with such weapons, nor to station such weapons in space".

Furthermore, "[t]he Moon and the other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden."

However, the treaty contains no stipulations regarding the arming of satellites with conventional weapon systems, the use of conventional weapons from satellites against the Earth's surface, and shooting down satellites using ground-, air-, or sea-based anti-satellite weapons. Further attempts since 1967 to establish binding norms and standards of behavior have been unsuccessful.

See: Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

influence will be limited primarily to established lobbying channels. In some areas at least – such as the avoidance or removal of space debris – a constructive contribution by tech companies is certainly both conceivable and desirable. Moreover, and at least in principle, it would be sensible to include these players in any norm-building processes and potential agreements in order to ensure that the booming use of outer space is sufficiently regulated.

However, on the level of security policy, the negotiation of any new treaties will in all likelihood continue to be shaped primarily by geostrategic considerations. There may be some scope for compromise where the regulation of commercial activities is concerned. Any such flexibility will quickly come to an end, however, where important geostrategic interests are affected. At the same time, companies such as *SpaceX* will continue to rely on public contracts and thus remain closely intertwined with the defense capabilities of their respective nations. Overall, states may have lost their technological monopoly, but their dominance of – and indeed monopoly over – the security and defense sectors will remain unchallenged for the foreseeable future.

The Path to Weaponization

Already in the preceding decade, displays of power in space reflecting the strategic competition between the great and medium sized powers were once again a defining element of international security policy. This pattern will undoubtedly continue into the 2020s – not only in the form of state-financed lunar and preparatory Mars missions, but also with a further expansion of military capability development. Against this background, it is increasingly likely that conventional weapons systems will be stationed on satellites for the first time, which would be tantamount to crossing one of the few remaining "red lines" in space security. It is true that space has been used intensively for military purposes since the late 1950s – from reconnaissance, early warning, communications to navigation, and targeting, to name a few. Moreover, there is little doubt that Russia has, in recent years, deployed unarmed "killer satellites" that can disable enemy systems through collision or by manipulation of important system functions. Anti-satellite weapons that are launched from the earth's surface or from aerial platforms have also been tested repeatedly since 2007, notably by China, the US, Russia, and most recently also by India in March 2019. However, to the best of our knowledge, none of these countries have thus far armed any of their satellites in the expectation of actual combat in space. It is here that we will likely witness the most change in the years to come.

Two types of options for weaponization appear particularly relevant for the near future. While the stationing of anti-missile weapons in space has been the subject of much debate in the past, the idea has received renewed attention in recent years, and was brought back into play as an option in the *Missile Defense Posture Review* conducted by the Trump administration. As of now, however, no concrete procurement programs to this end have been registered. The situation looks markedly different for the prospect of arming satellites for the purpose of defending against or attacking enemy space systems. This, it seems, is increasingly likely. In this regard, the US armed forces in particular have much to lose if an arms race in space were to ensue. Yet, with the founding of the US Space Force in December 2019, preparatory measures for warfighting in space are likely to gain traction. It is also noteworthy that the use of armed satellites is no longer only being considered by the major powers. The French Defense Ministry, for example, has announced its intention to equip selected satellites with energy or projectile weapons by 2030. It has also established a separate Space Command to integrate these new capabilities into the existing bureaucracy. NATO, too, has begun to take account of these developments and declared the space domain as an "operational domain" at the end of 2019.

In addition to the steps taken towards arming space systems, the proliferation of ground-based and possibly airborne anti-satellite weapons will also continue. Such capabilities are within the realm of possibility for a number of states that have experience in developing ballistic missiles or space systems, such as Iran, Israel, Japan, North Korea, Pakistan, and South Korea.

It is increasingly likely that conventional weapons systems will be stationed on satellites.

In addition to shooting down satellites, there are numerous other ways to disable space systems, at least temporarily, for example by disrupting communication links to or from the ground, by "blinding" sensors, or with cyberattacks against control stations. It is also relatively easy to jam or manipulate GPS signals.

In view of these observable trends, it is likely that the space environment will be affected by a more pronounced arms dynamic in the coming decade. Intensifying competition between the US and China, in particular, is likely to feature prominently in this context. Whether such an arms dynamic will in itself raise the likelihood of conflict is difficult to assess and answer based on existing research findings. However, we can surmise that any possible escalation flowing from an arms race – which is bound to result in high levels of military capability – would result in more severe damage to space-based infrastructure. Moreover, and in light of technological advances in the field of anti-satellite weapons, satellites in higher orbits that may once have been considered to be relatively immune are also likely to fall victim to targeted attacks.

Further Reading

Fernholz, Tim: **Rocket Billionaires: Elon Musk, Jeff Bezos, and the New Space Race,** New York: Mariner Books, 2018.

Defense Intelligence Agency: **Challenges to Security in Space,** Washington, D.C.: DIA, 2019.

Johnson-Freese, Joan: **Space Warfare in the 21st Century: Arming the Heavens,** London: Routledge, 2016.

Vulnerable Switzerland

Even today, Switzerland as a high-technology hub is exposed to considerable vulnerability in the event of failure or impairment of space systems, which will further increase in the coming decade, provided that the expectation of growth in space travel fueled by cost savings should prove accurate. For a small state with limited budgetary resources, a comprehensive effort to resolve or mitigate all the resulting risks is well-nigh impossible. Nevertheless, Switzerland should prepare for possible critical infrastructure failures as best it can in the context of its military and civil exercise activities, as well as crisis management planning within the framework of the Swiss Security Network. Insofar as they cannot be avoided at acceptable cost, Switzerland's own dependencies should be limited to the extent possible to the European environment, where the degree of compatibility of interests with regard to the protection of critical space-based infrastructures is relatively high.

The members of the ESA will, however, have to undertake ambitious steps if they want to be in a position to provide a cost-effective alternative to future initiatives launched by *SpaceX, Blue Origin,* and their competitors. One predictable precondition in this regard is an increased investment by member states. With its know-how and industrial capacities in the field of space technology, Switzerland can play an important role in this respect. Given the increasing proliferation of small satellites and micro-satellites, it is also conceivable that Switzerland might be able to build up limited capabilities of its own.

Switzerland is exposed to considerable vulnerability in the event of failure or impairment of space systems.

Whether more affordable space capabilities – for example in the area of intelligence, surveillance, and reconnaissance – are worth pursuing in the longer term should be a matter for consideration in the coming security and defense policy debates. It is difficult to imagine that any such option could be practically implemented within the coming decade. Nevertheless, both civil and military requirements should be continually monitored and, if necessary, reassessed in line with changing circumstances. The opportunities and risks associated with an intensifying and ever more dynamic use of outer space over the next decade should be reflected accordingly in the federal government's strategy toolbox.

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