Essay 3. The paradox of space weapons

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Introduction

The United States derives significant and growing benefits from its space programme. To provide these benefits it has been necessary to develop a support infrastructure both on earth and in space. Using its space programme the USA can collect information of value to the military and communicate, navigate and support military operations that permit precise attacks on targets.[1]

At the same time, space has become vital to the functioning of civil society. Allowing it to become a battlefield could ultimately cause serious harm to society. Moreover, the economic importance of the use of space is growing.[2] There are obviously significant opportunities for substitution, and many if not most space-related or space-enabled activities would continue even if space systems were to be substantially degraded. Nevertheless, the economic and social impact of a loss of space assets would be enormous—and would have an impact extending far beyond the direct loss of spacecraft or ground infrastructure. The USA would have the most to lose should space become an active battlefield, or be filled with large amounts of debris.

A key US objective is to prevent a pre-emptive attack that would disable its satellite systems to such a degree as to have a big effect on military and civilian systems. Such an attack would succeed in turning a significant advantage into a major weakness by exploiting the USA's operational dependence on satellite systems.[3] What is the true nature of this threat?

The lack of a close competitor to the USA

Under any conditions, the USA will enjoy unfettered superiority in space for at least the next decade and relatively few states could *ever* become an equal competitor of the USA on any level.[4] The vast majority of states would be unequal competitors, while a select number would be unequal adversaries able to develop some means to counter satellite threats—a group likely to reflect the US designation of 'states of concern'.

[1] Pike, J., 'The military uses of outer space', *SIPRI Yearbook 2002: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2002), pp. 613–64.

[2] A 2001 report by the Associate Administrator for Commercial Space Transportation (AST) stated that satellite industries contributed $61.3 billion to the US economy in 1999. US Department of Transportation, Federal Aviation Administration, AST, 'The economic impact of commercial space transportation on the US economy', Feb. 2001, available at URL <http://ast.faa.gov/files/pdf/econ_final.pdf>. A subsequent report put the figure at $80 billion for 2000. 'Report of the Commission to Assess United States National Security Space Management and Organization', 11 Jan. 2001, available at URL <http://www.dod.mil/pubs/space20010111.pdf>. According to the Satellite Industry Association, satellite systems enabled $1.7 trillion of business activity worldwide in 2000. Satellite Industry Association, 'Satellites, connecting the world', June 2001.

[3] The benefits and vulnerabilities of US dependence on satellite systems are elaborated in US Department of Defense, News Transcript, 'Secretary Rumsfeld outlines space initiatives', 8 May 2001, available at URL <http://www.defenselink.mil/news/May2001/t05082001_t0508spa.html>.

[4] Appendix 15B in this volume contains tables of military satellites that were operational in 2002.

Only three states have been actively involved in research to create and deploy space-based weapon systems: China, Russia and the USA. Russia was once in a position to compete with the USA in space but domestic concerns and budgetary collapses have caused it to retrench and maintain only its most necessary programmes. Russia no longer has the resources to deploy space-based weapon systems.

China is thought to be active in research on anti-satellite (ASAT) and other satellite technologies but the true state of its research programme is unclear. Chinese satellite and space programmes are a nearly indiscernible mix of civilian and military components and research takes place at joint military and commercial facilities. As China comes to rely on its own civil and military satellite systems, it will be faced with the same vulnerabilities now faced by the USA. It seems certain that developing this technology is of great interest to China and the government has apparently committed considerable resources to satellite and space programmes.[5] China has been researching and developing ASAT technologies for several years but its degree of commitment to the production and launch of ASAT and satellite weapons is uncertain.

Reports in January 2000 suggested that ground testing of a nanometer parasitic ASAT system (designed to attach itself undetected to a host satellite, lie dormant and disable its host upon activation) was being undertaken.[6] While Chinese leaders have called for the demilitarization of outer space, it is still possible that China might target US space assets as a possible reaction to US military strength. China is responding to the growing US reliance on space *as well as* the US goal to develop 'active defensive' and offensive space systems.

The resources of the Russian space programme shrank during the 1990s. Russia had 180 satellites in operation a decade ago.[7] The 90 Russian satellites currently in orbit (of which about half have strictly military missions) are ageing, with about 80 per cent already operating beyond their intended life expectancy. Russian military commanders frequently complain about the lack of Russian satellite systems for communications and reconnaissance. Until the launch of what was believed to be an Arkon-type digital imagery satellite in July 2002, Russian photo-reconnaissance is believed to have relied completely on obsolete photo canister technology that must be retrieved and developed prior to use.[8] These systems were useful for developing strategic systems intelligence during the cold war but do not provide useful near-real-time intelligence data.[9] The Soviet Union carried out significant research and development of ASAT systems, although no Soviet systems are believed to have been placed in orbit.[10]

[5] In the past 30 years China has launched over 50 indigenous satellites of 10 types and more than 20 foreign satellites. 'Achievements of defence conversion in China's aerospace industry', *Aerospace China*, vol. 2, no. 2 (summer 2001).

[6] Cheng, H., 'China eyes anti-satellite system', *Space Daily*, 8 Jan. 2000, URL <http://www.spacedaily.com/news/china-01c.html>.

[7] 'Russia launches military satellite', Sat News Asia, 23 July 2001, URL <http://www.satnewsasia.com/Stories/512.html>; and 'Russia turns military ambitions to space', Stratfor.com, Global Intelligence Update, 21 May 2001.

[8] Banke, J., 'Proton delivers military satellite into earth orbit', Space.com, 25 July 2002, URL <http://www.space.com/missionlaunches/proton_launch_020725.html>.

[9] Zak, A., 'Russian spy sats nearly extinct, offer little help in Afghanistan', Space.com, 4 Oct. 2001, URL <http://www.space.com/news/russia_spysats_011004.html>.

[10] A functioning particle-beam weapon and a prototype laser for destroying satellites are thought to have been on board the Soviet Polyus-Skif satellite that crashed during take-off in May 1987. Oberg, J.,'The heavens at war', *New Scientist*, 2 June 2001, pp. 26–29.

The European Union (EU) Strategy for Space[11] is intended to preserve an independent and affordable access to space launchers and to maintain a broadly based industrial capability to design, manufacture and operate satellites and associated ground infrastructure. The strategy, which is the responsibility of the EU as well as its member states and the dedicated European Space Agency, seeks to develop space-based communications, navigation and environmental capacities for commercial purposes. Although these technical capacities could be applied for military purposes should a decision be taken to do so, no such decision is currently envisaged.[12] After such a decision a period of sustained resource allocation to the military space programme would be required before any military benefits could be derived.

The destabilizing effect of space weapons

The Report of the US Commission to Assess United States National Security Space Management and Organization[13] stated that the USA's interests are to promote the peaceful use of space and use space to support US domestic, economic, diplomatic and national security objectives.[14] The attempt to keep weapons out of space while exploiting it for military purposes suggests, among other things, a need to develop and deploy the means to deter and defend against hostile acts directed at US space assets and against uses of space that are hostile to US interests. However, offensive or retaliatory systems would, by their very nature, be seen as threatening by (at least some) other states.

Space-based weapons are power projection tools that enable force to be applied anywhere in the world. With such weapons, enemies anywhere face the prospect of living under a hostile sky. However, while few states will develop the technology and resources to deploy weapons in space, ground-based ASAT systems would be within the financial and technological reach of many states.

If the USA were to place weapons in space, that would clearly drive some states to develop methods to defend against and attack US satellites. If other nations develop equivalent systems, in essence starting a space arms race, it is likely to be out of fear that the USA will control access to space. However, as explained above, equivalent systems are only a theoretical possibility, at least in the short term.

The overwhelming advantage of the USA in terrestrial weapons can be seen as another primary reason for the pursuit of space weapons by other states. As this overwhelming advantage depends increasingly on space-based communications, intelligence and targeting, potential adversaries are increasingly likely to target objects in space. Attacks would not need not be carried out by systems that are themselves located in space.

A space arms race might have few potential winners but a large number of participants that could significantly alter outcomes. The 'race' would involve diverse ASAT systems and countermeasures and would be inherently asymmetrical, espe-

[11] European Commission and European Space Agency, 'Europe and space: turning to a new chapter', EC Communication COM(2000) 597 final, 27 Sep. 2000.

[12] While the Galileo European Satellite Navigation System has the potential to be used for military purposes, its use as a navigation and climate monitoring tool is currently being emphasized. European Union, Directorate-General Energy and Transport, URL <http://europa.eu.int/comm/dgs/energy_transport/galileo/index_en.htm>.

[13] The Report of the US Commission to Assess United States National Security Space Management and Organization, also known as the 'Rumsfeld Commission' after Donald H. Rumsfeld who chaired it until he was appointed Secretary of Defense.

[14] 'Report of the Commission' (note 13).

cially in the initial years when the USA would continue to enjoy a period with no close competitor.

Satellites are easily tracked and maintain steady and predictable trajectories. Missile systems can be targeted against space assets just as they can target ground facilities. Conventional and nuclear weapons could be directed at satellites, which, because of their stable orbits, make easy targets. These types of attack are difficult to defend against but are overt, easily recognizable and likely to be considered grounds for war. The USA would probably not distinguish between a ballistic missile launched against its satellites and one launched against US facilities or territory.

Deterring a space 'Pearl Harbor' through the threat of retaliation will become more difficult in the future. Retaliation supposes that the attacker can be identified. However, determining the root cause of a satellite failure may be difficult, if not impossible, if ASAT capabilities become an element of information or electronic warfare (an approach probably more attractive to most states as commercial development can be exploited to develop military capabilities). Computers can be used to hack into and 'smurf', or overload, satellite signals, jammers can block signals, and ground stations can be rendered 'inoperable'. If it becomes impossible to identify the attacker—or even to determine that an attack has taken place—deterrence cannot operate.[15]

The Rumsfeld Commission also discussed how international treaties and agreements related to space could be used as an instrument to pursue US interests. It selectively highlighted provisions in each of the treaties, searching for arguments to permit the deployment of offensive and 'active defensive' systems.[16] Rather than recommending strengthening of provisions that prevent weaponization (which only the USA is capable of achieving at present) the commission suggested that the USA exploit its advantages in space for as long as possible and only utilize treaties to prevent further weaponization if a close competitor emerges.[17]

During the cold war, deterrence involving weapons of grand design or mass destruction relied on two or more states 'pointing the gun' at each other. In future a form of 'mutually assured destruction' could also develop in space—where states have the capacity to deny the use of space to an adversary but in the process find themselves unable to operate space assets. This risk could be reduced through mutual restraint, although the problem of how to verify restraint is yet to be resolved. The potential uses of space systems are abundant and essentially there is no way to determine the function of a satellite prior to use without cultivating intelligence sources of historical proportions or introducing transparency measures that are unlikely to be acceptable.

The fact that military and commercial technologies can be applied to military space programmes lies behind the US Government's close attention to and concern about the implications of apparently benign technology transfers by US com-

[15] Deterrence is discussed in essay 4 in this volume.

[16] The commission report argues that 'by specifically extending the principles of the UN Charter to space, the [1967] Outer Space Treaty (Article III) provides for the right of individual and collective self-defense including "anticipatory self-defense". In addition, the non-interference principle established by space law would be suspended among belligerents during a state of hostilities'. . . . 'Similarly, . . . the changing character of conflict requires careful consideration of US obligations when the status of belligerents may be unclear'. 'Report of the Commission' (note 13), p. 37, p. 38.

[17] 'Because of its investment in space and its increasing dependence on space based capabilities . . . the US must promote the peaceful use of space, monitor activities of regulatory bodies, and protect the rights of nations to defend their interests in and from space'. 'Report of the Commission' (note 13), p. 36.

panies to China. While export controls are another instrument that can help the USA to prolong its advantage in space, the inherently dual nature of space technologies leaves a significant risk that benign development will be used maliciously.

The development of space weapons by other countries becomes inevitable once the USA deploys space weapons that could be used to attack terrestrial targets pre-emptively. Effectively, the utility of a treaty would become nil because the goal of other states would shift to denial. Space would have an active rather than a support role in military power projection.

The implications of deploying space-based elements of a missile defence system are less clear. It might be possible to overcome the dual nature of many of the systems under discussion to ensure that they have no offensive capability (e.g., forgoing active defence of the satellites themselves). An increase in funding and research into 'hardening' satellites and their onboard equipment to withstand attack, as well as the development of better diagnostic tools to discover the causes of satellite failures, should be considered important alternatives to weaponizing space if the goal is to prevent denial of access. Since the threats against satellites are well known, considerable effort should be made to harden them against attack. The necessary measures include: procedures to reduce the predictability of orbits, redundancy, the dispersal of satellites, reducing their profile, and developing passive defences, firewalls and encryption.

Redundancy could mean having more satellite systems in orbit, maintaining systems dormant in high earth orbit or having back-up systems ready for launch. The last approach, while perhaps more practical than dormant systems, would not immediately replace lost satellites—given the launch processes involved.[18]

The hardening of satellites is often overlooked as a means to combat threats to space assets. Countermeasures normally develop from an existing base of knowledge derived from a certain amount of experience or contact with a system. Satellite designers do not have that luxury. Satellites are in service for decades. Within their operational lifespan, it is unlikely that any repairs or changes in design would be possible. In this respect, designers must have the forethought to account for all possible situations the satellite may encounter, be they solar or man-made events. At present neither military nor commercial systems carry onboard sensors to determine the cause of a malfunction. They are unable to offer any warning or guidance if an attack is imminent. Even attempts to defeat or bypass uplink encryption systems and issue command overrides can go undetected.

Conclusions

Very few countries possess the technology to perpetrate a space 'Pearl Harbor'. Assuming that other states develop capabilities that are viable and sustainable (itself not a safe assumption), space weapons are not susceptible to a model of deterrence based on reciprocal action by equivalent forces. The weaponization of space might, in the short term, increase the power projection capability of the USA. It would also be greatly destabilizing and could even lead to the sort of 'Pearl Harbor' that the USA is seeking to avoid. Countries would seek to develop countermeasures (in the classic

[18] While, at present, launch demand exceeds launch capacity—making the quick replacement of lost systems problematic—trends indicate that there will be an eventual overcapacity. Dalbello, R., 'Common ground: the Satellite Industry Association agenda', Satellite Industry Association filing, 23 Sep. 2002, URL <http://www.sia.org/filings/>.

sense) to US offensive systems, much in the same way as US systems were developed to counter specific perceived threats to space assets—thereby creating a space arms race similar to the nuclear arms race.

The USA and other states pursuing these technologies should instead focus on the plethora of systems that presently exist and can be used to deter attacks against space weapon systems from the ground, as well as hardening the next generation of satellites (and their ground stations) to withstand the growing variety of potential threats.

The use of space is vital to the global economy and the functioning of modern states. Loss of space systems would have knock-on effects ranging from minor inconvenience to major critical infrastructure damage and any long-term loss would have critical economic and social impacts.

Weaponizing space would only further the development of ASAT systems that could lead to a full-scale conflict in space. Deployment of offensive or active defensive systems by the USA would produce increased pressure to counter its space hegemony. It would also immediately legitimize the use of space as a future battlefield. Any conflict in space would significantly affect the use of space for commercial and scientific purposes, both at the time of the conflict and for many years thereafter.

Classic deterrence clearly does not apply to space. Unlike nuclear weapons, there is one clear hegemonic power, one state apparently trying to develop offensive ASAT weapons, and dozens of countries with the terrestrial capability to attack satellites. In this environment, cold-war-style deterrence will not suffice. The ability to destroy space systems is not limited to two states, but rather a wide spectrum of states—some of which are considered rogue states, or 'states of concern'. By definition these nations will not be deterred by weapon systems and represent asymmetrical threats that cannot be addressed by normal doctrine.

The USA already possesses a deterrent against certain kinds of space attack—one that would be more credible if procedures and training were in place to reduce or eliminate dependence on satellites if access is denied. Active defence of satellites or ballistic missile defences may also be a reasonable response. However, developing weapons for deployment or use in space is not likely to reduce the threat. On the contrary, there is a strong risk that US policy will drive the global pursuit of space weapons rather than deter it. Even if the weaponization of space increases the power projection capability of the USA, countries would seek to develop countermeasures.

On balance, the importance of space systems for US and global economic performance, the dependence on satellites for communications and the use of satellites for intelligence gathering far outweigh any potential benefits of placing power-projection systems in space. While in the future the loss of communications and intelligence systems would be devastating, the absence of power projection from space would not significantly inhibit US policy.