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Safeguarding Space for All: Security and Peaceful Uses

Conference Report
25-26 March 2004

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Geneva, Switzerland

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The United Nations Institute for Disarmament Research (UNIDIR)—an intergovernmental organization within the United Nations—conducts research on disarmament and security. UNIDIR is based in Geneva, Switzerland, the centre for bilateral and multilateral disarmament and non-proliferation negotiations, and home of the Conference on Disarmament. The Institute explores current issues pertaining to the variety of existing and future armaments, as well as global diplomacy and local entrenched tensions and conflicts. Working with researchers, diplomats, Government officials, NGOs and other institutions since 1980, UNIDIR acts as a bridge between the research community and Governments. UNIDIR's activities are funded by contributions from Governments and donors foundations. The Institute's web site can be found at URL:

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PREFACE

As the peaceful uses of outer space grow in both number and scope, so too does their importance in the day-to-day lives of people across the globe. The use of space-based technologies is no longer the exclusive province of states with domestic space programmes; indeed, the widespread dissemination of information and enhanced communications enabled by these technologies have been instrumental in creating the "global village". In light of this, it is not surprising that a growing number of governments—including key space-faring powers—have signalled that the security of space is of serious concern. Developments in technology that could be used to weaponize space and the growing problem of space debris, for example, are threatening the current secure environment in space. Growing insecurity of the space environment could not only destabilize international relations, but could also severely threaten space-based assets that have become increasingly vital for a wide range of essential human activities worldwide.

Since 1990, the UN General Assembly has adopted a number of resolutions reaffirming "the importance and urgency of preventing an arms race in outer space". The political will among states to take action on this vital issue appears to be growing, but there is a need for action to ensure that space remains safe for peaceful human activity. Concerns of "creeping weaponization"—a scenario in which states, in some cases without any well-reasoned basis for doing so, move toward an arms race in outer space—seem more and more credible. The window of opportunity to act might not remain open for long.

It was in view of this imperative that a conference on security and the peaceful uses of outer space was convened in Geneva on 25–26 March 2004. Hosted by the Department of Foreign Affairs and International Trade of Canada, the Henry L. Stimson Center, Project Ploughshares Canada, the Simons Centre for Peace and Disarmament Research, the Simons Foundation, the Union of Concerned Scientists and the United Nations Institute for Disarmament Research (UNIDIR), the conference "Safeguarding Space for All: Security and Peaceful Uses drew" together experts from industry, science, governments and non-governmental organizations to explore ways of ensuring that outer space remains a non-threatening environment and available for the peaceful use of all. Prominent representatives from around the world gave panel presentations on the conference's main topics: space security and peaceful uses of outer space; means to guarantee space security and assurance; international legal approaches and the role of the Conference on Disarmament; and transparency and confidence building.

Building on the success of the 2002 "Outer Space and Global Security" conference held in Geneva by UNIDIR, the Simons Centre for Peace and Disarmament Studies and Project Ploughshares Canada,[1] the 2004 conference challenged participants to delve deeper into the issues raised two years ago, with a view to providing solid recommendations for action. The aim was to present a new framework for thinking about security in space, a holistic approach that successfully encompassed the wide range of peaceful space uses and the threats that could potentially jeopardize a secure space environment. Through this comprehensive approach, participants strove to identify useful, practical steps that policy makers could take to help safeguard space for the peaceful use of all.

1 Conference report available as UNIDIR, 2003, *Outer Space and Global Security,* Geneva, UNIDIR.

ACKNOWLEDGEMENTS

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The opinions expressed in the papers are those of the authors and the authors alone.

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ACRONYMS

ABL	Airborne Laser
ABM	anti-ballistic missile
ASAT	anti-satellite
ASTRO	Autonomous Space Transport Robotic Operations
BMD	Ballistic Missile Defense
CBM	confidence-building measure
CD	Conference on Disarmament
CFE	Treaty on Conventional Armed Forces in Europe (1990)
ComSats	communication satellites
COPUOS	Committee on the Peaceful Uses of Outer Space
CTBT	Comprehensive Nuclear Test-Ban Treaty
DARPA	Defense Advanced Research Projects Agency
DART	Demonstration of Autonomous Rendezvous Technology
ESA	European Space Agency
GEO	geosynchronous orbit
GPS	global positioning satellite
IADC	Inter-Agency Space Debris Coordination Committee
ICBM	intercontinental ballistic missile
INF	Intermediate-range Nuclear Forces
ISO	International Organization for Standardization
ITU	International Telecommunication Union
LEO	low-Earth orbit
MDA	Missile Defense Agency
MTCR	Missile Technology Control Regime
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
NEXTSat	next generation serviceable satellite
NFDD	No First Deployment Declaration
NFIRE	Near Field Infra Red Experiment
NGO	non-governmental organizations
NPT	Non-Proliferation Treaty
NSTC	National Science and Technology Council
NTM	National Technical Means
PAROS	Prevention of an Arms Race in Outer Space
SALT	Strategic Arms Limitation Talks
SSN	United States Air Force's Space Surveillance Network

START	Strategic Arms Reduction Treaty (1991)
TOA	total obligation authority
UN	United Nations
UNIDIR	United Nations Institute for Disarmament Research
US	United States
WMD	weapons of mass destruction
XSS	Experimental Spacecraft System

CHAPTER 1

CONFERENCE REPORT

EXECUTIVE SUMMARY

Over the course of the conference, several important themes emerged around which participants tended to coalesce. Some of these issues, expressed in simplified form, are as follows:

- A broader concept of "space security" deserves greater attention, as it encourages the engagement of the wider community in comprehensively considering what humanity has at stake in outer space and the importance of a weapons-free outer space for our collective security and prosperity.
- The debate surrounding space security should be widened, envisaging a greater role for civil society, corporate actors and other UN and multilateral bodies. "Cross-fertilization" between stakeholders will help ensure that all interests are taken into account and help yield effective, viable solutions.
- Greater attention should be devoted to the interests of developing countries, many of which rely on space technologies to meet vital development goals.
- For many, the ultimate goal remains an international treaty banning space weapons.
- The weaponization of space is not inevitable. Much rests on decisions taken by a small number of states in the near future. It is important for states to consider the wide range of military, commercial and scientific space uses that would be jeopardized, both today and for generations to come, by space-based weapons.
- It is not obvious that the placement of weapons in space would provide any country with a decisive military advantage. Most participants agreed that the costs of weaponization would far outweigh the benefits.

- Although early consensus on the thorny issue of non-weaponization might prove difficult to achieve, there are important unilateral steps that states can take to help safeguard outer space for peaceful uses.
- States should adopt measures, both nationally and internationally, to cope with space debris. The sooner these measures are undertaken, the safer the space environment will be.
- Confidence-building measures (CBMs), such as "no-deployment", codes of conduct or "rules of the road", are also desirable in the short to medium term to reduce the risks associated with increased human activity in space.
- Considerable international legal architecture already exists that could help lay the foundation for agreements to safeguard outer space for peaceful uses. The 1963 Partial Test Ban Treaty (or Limited Test Ban Treaty), the 1967 Outer Space Treaty, the 1972 Incidents at Sea Agreement and the 1989 Prevention of Dangerous Military Activities Agreement are just some of the existing legal instruments that could provide useful points of departure.
- Most participants agreed that incremental steps should be pursued in the short term. The establishment of international regulatory regimes through treaties, while desirable, is likely to remain challenging to achieve in the short term.
- International bodies such as the Conference on Disarmament (CD) should address those aspects of the issue that are ripe for discussion, which will help lay the foundation for cooperation on more controversial matters at a later stage.
- Like-minded governments and international organizations should consider forming "coalitions of the willing" to push the debate forward.

Following are summaries of the panel presentations and ensuing discussions, along with an overview of the synthesis and discussion session held at the end of the conference.

SPACE SECURITY

Opening the debate on the current status of space security, Jeffrey Lewis, of the University of Maryland, contended that American commitment to space weaponization might not be as strong as it appeared on the surface. Official US space policies are articulated primarily through documents drafted during the Clinton era and therefore provide little insight into the actual intentions of the Bush Administration. Lewis also pointed out that broad policy documents did not indicate which programmes would successfully surmount substantial political, technical and budgetary obstacles. Through an analysis of the administration's 2004 and 2005 budget requests, Lewis reasoned that the two "weaponization" programmes most likely to reach operational status were space-based anti-ballistic missile (ABM) systems and micro-satellites capable of autonomous proximity operations. Although the latter technology has legitimate civilian applications—namely the repairing and refuelling of satellites—it also has the ability to conduct clandestine anti-satellite (ASAT) operations and is therefore a source of international concern. Were any country to test such a proximity operation, tensions would undoubtedly mount. Lewis concluded by maintaining that, since neither programme had reached operational status, the opportunity still existed to curb their further development.

Robert McDougall, from the Department of Foreign Affairs and International Trade of Canada, presented the findings of an independent research report entitled *Space Security 2003*, commissioned by the department, which assessed the current status of space security. The report defined "space security" as "secure and sustainable access to and use of space; and freedom from space-based threats".[1] In evaluating the current environment, researchers identified 12 components of space security. These elements fell broadly within the following three categories: the space environment, the intentions of space security actors and the capabilities of space security actors. On balance, experts concluded that space security decreased somewhat in 2003. However, not all indicators of the space security index revealed the same trend. Some aspects of space security have remained static, while some improved. McDougall also reported that some indicators produced a sharp division of opinion, and emphasized that their impact is therefore unclear. Noting that the report does not represent Canadian government policy, he solicited comments from governmental and non-governmental representatives on the utility of the concept as an analytical framework for space security issues.

In the discussion that followed the conference's introductory presentations, several participants expressed support for the concept of space security as a nexus around which concerned actors could mobilize. Objective analysis of the status of space security, perhaps on an annual basis, was suggested as a means to unite the efforts of governments, non-governmental organizations (NGOs) and research institutes. Other participants expressed concerns that civilian space programmes might currently be used as smokescreens for more aggressive programmes, thereby circumventing budgetary restrictions imposed by bodies such as the US Congress. The dual-use aspect of many space technologies was identified as an area of particular concern, making it difficult to distinguish peaceful programmes from military ones.

PEACEFUL USES OF OUTER SPACE

In his address on the civil context of the peaceful uses of outer space, Victor Kotelnikov, from the United Nations Office for Outer Space Affairs, highlighted the increasing difficulty associated with separating military from civilian space-based technologies. He underscored the lack of attention paid by space-faring powers to the needs of developing countries, which—often paradoxically—rely on space technology to an even greater extent than their more developed counterparts. In Afghanistan, for example, where land-based communications remain problematic, satellite technology is crucial for providing adequate health care. E-health, e-learning and disaster management are all heavily reliant on space-based technologies, as is the monitoring and protection of natural resources.

John MacDonald, Chairman Emeritus of MacDonald Dettwiler, spoke about the commercial applications of space technology. He asserted that communications is the only field in which a commercial enterprise could be successful as an operator; in all other uses of outer space, governments have been the primary user. As a result, communications is the sole application in which the commercial sector has had any influence over the uses made of its output. MacDonald stressed that “a customer is a customer” and the commercial sector did not concern itself with the applications of its products, whether peaceful or non-peaceful. Moreover, given that the three major civilian applications of space infrastructure—communications, Earth observation and navigation—have significant military uses, outputs of the commercial sector could either greatly enhance quality of life or severely damage it, depending upon the decisions of governments.

Representing the Indian Space Research Organisation, Gopalakrishnan Narayanan outlined some of the specific ways in which space technology could be applied to development goals. Programmes that targeted critical issues such as food security and disaster management benefit enormously from sophisticated satellite imaging systems. These systems made possible the collection of important data regarding wasteland, groundwater levels and watersheds, drought and ocean productivity. Agricultural forecasting has also improved as a result of satellite imaging, helping farmers to anticipate pricing and allowing the government to determine buffer stocks for the upcoming season. In addition, the monitoring of forest and coastal areas enhance the ability of policy makers to take sound environmental decisions, a principle Narayanan called “digitally empowered decision-making for development”.

Narayanan’s presentation also underlined the importance of space-based communications technology, which enables vital information such as expert medical advice to reach even the most remote villages. Narayanan emphasized that space technologies are particularly important for developing countries with poor infrastructure. It is critical, he concluded, that the peaceful uses of space be guaranteed and protected for all.

In the discussion that followed these presentations, it was emphasized that the peaceful uses of outer space could not be meaningfully considered without also addressing space security. Given the current use of civilian space infrastructure for military purposes, peaceful and non-peaceful uses of space are inextricably linked. Therefore, the continued reluctance of states to address space security in multilateral fora has hampered efforts to collaborate in achieving scientific and developmental goals as well.

In a related vein, some participants, while expressing support in principle for an international control regime restricting the militarization of space, highlighted several potential difficulties in doing so. There were strong arguments that verification of compliance would be extremely difficult, partly as a result of the currently limited capacity to monitor space-based assets after lift-off, and partly because of the difficulty posed by the increasingly dual-use (civil–military) nature of key satellite systems. Perhaps more problematically, several participants also expressed concern that control regimes might impact negatively on the use of space technologies for peaceful purposes, and that dual-use civilian space assets would be targeted in the event of a conflict erupting in space.

MEANS TO GUARANTEE SPACE SECURITY AND ASSURANCE

Noting the continued lack of consensus at the CD, Jonathan Dean, from the Union of Concerned Scientists, nevertheless contended that there were steps that the international community could take to help safeguard outer space for peaceful uses. In particular, he advocated a series of individual national declarations from major space-faring nations pledging that they would not be the first to deploy weapons in space. He maintained that these declarations would, at no cost to states, protect space-based assets and provide a practical preparatory stage for negotiating a treaty that would prohibit weapons in space. Dean offered an example of what such a declaration might look like, including a working definition of "weapons" and an explanation of when such a weapon would be considered "in space".

Dean claimed that a major motivation for the weaponization of space is that states feared that unless they seized the initiative, another state would surely do so. Such fears, he suggested, could be mitigated by the widespread adoption of voluntary declarations, both by virtue of the reassurance value of such statements of intent and also because the declarations would become invalid if any state tested a weapon in space. He also pointed out that such an approach would help test the feasibility of a treaty to ban the weaponization of space. He stressed, however, that the proposed measure would not proscribe all military activity in space. Rather, it would prohibit the deployment in space of weapons that could destroy or damage objects in space, in the atmosphere or on the surface of the Earth. Dean underscored the practicality of unilateral moves such as these, since they avoid the burden of consensus. He concluded with an appeal to CD member states to make no first deployment declarations (NFDD) a reality.

Michael Krepon, from the Henry L. Stimson Center, also suggested measures that states might take to help safeguard space for the peaceful use of all. He contended that the United States would soon face a fundamental choice between pursuing either space weapons or "space assurance", the latter reflecting a policy choice to leave space unencumbered by weapons. He asserted that the weaponization of space was not inevitable, and therefore that it would be wise to strengthen efforts to promote space assurance. He outlined several key elements of a space assurance posture including unilateral initiatives to enhance situational awareness in space and reduce satellite vulnerability; research and development programmes to deter others from crossing important thresholds; and cooperative measures, international agreements and codes of conduct for responsible space-faring nations. In pursuing these latter CBMs, Krepon emphasized that it was wise to attempt first what was politically feasible, while still pursuing other avenues of cooperation in space that were not yet ripe for accomplishment. He identified as particularly valuable a code of conduct or agreed "rules of the road" for responsible space-faring nations. Alternatively, he noted, a single state or group of states might usefully take the lead in tackling the issue of space arms control.

Krepon emphasized that there was no need for the United States to test and deploy dedicated space weapons since, like many states, it already possessed capabilities that could, if necessary, act as space weapons. He further suggested that such latent capabilities deterred others from flight-testing and deploying space weapons. Krepon concluded that if the United States retained its ability to respond if others flight-tested or deployed space weaponry, while refraining from doing so itself, there was a reasonable chance that these thresholds would not be crossed.

Addressing the issue of space debris, Theresa Hitchens, from the Center for Defense Information, observed that there remained challenges to characterizing the exact nature of the debris problem, as well as disagreements about the gravity of the situation and how best to address it. Failure to stem the creation of debris, however, would undoubtedly undercut the security of all assets in space. Hitchens explained that the danger of space debris stemmed primarily from its potential to collide with and/or damage objects both in space and on the ground. Space debris also caused light pollution, which posed problems both for civil astronomy and for military space surveillance efforts.

Hitchens noted that it was much easier to prevent space debris than to clean it up, and that states seemed to be moving toward recognition of this fact, but she also claimed that the current legal environment was inadequate for the task. Consequently, she proposed a series of immediate steps that the international community should take to mitigate the creation of space debris. These steps were aimed both at international bodies such as the United Nations and at Member States, encouraging national and international legislation to address the problem. Hitchens allowed that some of her suggestions, particularly those that revolved around trying to create a new body of international law, would be both controversial and time consuming. This, she contended, was good reason to begin legislation at the national level. She concluded, however, by insisting that outer space is a global resource, and as such it would ultimately require protection by all if it is to be preserved for the benefit of all.

Jürgen Scheffran, from the International Network of Engineers and Scientists Against Proliferation, discussed the possibilities of verifying a weapons ban in outer space. He emphasized the close link between space security and verification. He demonstrated that a space object's ASAT capabilities are detectable by technical means. For example, satellite tracking systems and on-board sensors can detect with high probability whether an approaching space object has residual ASAT capabilities. Since any precisely manoeuvring space object can perform an ASAT attack, a regime of advance notice would also be important. Scheffran thus proposed partial arms control measures such as banning testing, deployment and use of weapons above a specific altitude, or restricting activities beyond a given stage in the life cycle of a weapon. He foresaw great danger in space-based Ballistic Missile Defense (BMD) weapons because of their inherent ASAT capabilities and urged countries to push ahead with a treaty while there are still many technical and economic obstacles to the weaponization of space.

The ensuing discussion delineated the steps that could be taken in the short term to ensure space security. Participants debated whether it would be easier to implement Dean's idea of national declarations first or to initially devise a code of conduct, with the majority calling for countries to publish national declarations first, as this was perceived as easier to achieve. It was also mentioned how similar the content of Dean's sample declaration was to the Russian–Chinese draft proposal of June 2002 to the CD (CD/1679). Some participants pointed out that "rules of the road" in space would also be practical for the United States, as they concern overall space stability. The need for an international surveillance network to monitor adherence to a code of conduct was also stressed.

Participants debated which issues should initially be included in a code of conduct. Many participants pointed out that the topics of debris mitigation and verification could be viable points of departure. One participant proposed taking the issue of ASAT weapons out of the code of conduct initially, for reasons of simplicity.

The discussion also emphasized the problem of traffic congestion and space debris. Debris in outer space could not easily be removed, participants noted, cluttering up orbits irreversibly. While some of the testing done in outer space by the United States and other countries was performed in a manner to avoid creating space debris, this was done on a voluntary basis and would presumably not apply in cases of actual conflict. One participant pointed out that the mitigation of debris was especially costly for developing countries. Furthermore, others pointed out, satellite density in lower orbits was becoming a problem; while outer space is vast, only a limited number of orbits are useful for human purposes.

INTERNATIONAL LEGAL APPROACHES AND THE ROLE OF THE CONFERENCE ON DISARMAMENT

Thomas Graham Jr., from the Eisenhower Institute in Washington, DC, spoke on the law and the military use of outer space. He pointed out that military activity in space is largely unregulated, and that there is as yet no legal regime preventing the weaponization of space. The Outer Space Treaty laid the groundwork for international order in outer space, but was limited in its application as it does not cover outer space *in toto*, but only celestial bodies. In addition, the Outer Space Treaty as well as the Partial Test Ban Treaty have few inspection or verification provisions. As Graham also pointed out, there is a large arsenal of international resolutions attesting to the intended peaceful uses of outer space. Examples included several General Assembly declarations, specific domestic national legislation governing space-related activities and parts of the Outer Space Treaty. This legal corpus might serve as a point of departure for devising an international legal regime securing outer space as a common good.

On the issue of international lawmaking on outer space, Lucy Stojak, from the McGill Institute of Air and Space Law, presented a snapshot of the current situation. She stated that effective legal norms could emerge in incremental steps and at the initiative of only a few countries. The Partial Test Ban Treaty, which prohibited nuclear weapons testing in outer space, started out as an initiative of the United Kingdom, the United States and the Soviet Union, with these countries recognizing that regulation was in their own self-interest. She also referred to the 1975 Registration Convention and the 1979 Moon Agreement as being the initial incremental steps to arms control in space, as these treaties required that certain information on satellites be provided to the United Nations by space-faring nations. Stojak also stated that the United States, even though it withdrew from the 1972 Anti-Ballistic Missile Treaty in 2002, still adhered to the principle of non-interference with foreign-owned space objects. While the CD is the designated forum to discuss outer space issues, she concluded, countries should go ahead with designing a comprehensive legal framework on outer space in any form or forum.

Rebecca Johnson, from the Acronym Institute for Disarmament Diplomacy, outlined her action plan for outer space. She advocated a holistic approach, where issues fed into each other, establishing behavioural norms and eventually resulting in legally binding treaties. Johnson advocated first making better use of networking to foster cross-fertilization between commercial and government users of space. Second, while the CD should continue to work toward a treaty on the Prevention of an Arms Race in Outer Space (PAROS)—for example, by building upon the useful Russian–Chinese draft proposal of 2002—other fora should be used in the meantime. This could include the work of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) or the First Committee of the General Assembly. Such fora should begin negotiating issues such as mitigating space debris, pre- and post-launch notification of satellites or building an international space security index. And third, legal documents could be expanded to include treaties under the International Telecommunication Union (ITU) or the 1990 Treaty on Conventional Armed Forces in Europe (CFE). Alternatively, a protocol could be added to the Outer Space Treaty—for example, detailing a code of conduct or banning ASAT weapons. Johnson urged countries to take action, as she viewed the Bush Administration space agenda's push for Mars as a clear sign on the road to the weaponization of space. More specifically, she feared that Bush's plan to establish ABM-capable satellites by 2008 was a pretext for establishing space objects with ASAT capabilities—in other words, the first weapons in space.

Anton Vasiliev, from the Permanent Mission of the Russian Federation to the CD, reiterated the Russia Federation's firm stand behind its proposal made with the People's Republic of China at the CD in 2002 (CD/1679) on the prevention of the weaponization of outer space. This proposal urged the banning of weapons placed in space, including space objects with ASAT capabilities. However, as Vasiliev pointed out, the Russian–Chinese proposal did not prohibit the militarization of space, that is, the use of space for military purposes such as surveillance or other data gathering operations. Vasiliev viewed the CD as ready to negotiate these issues. Transparency in space matters, he concluded, would lead to a framework of trust and world stability.

Participants varied in their views about the right approach to treaty making with regard to outer space, though most participants favoured a step-by-step approach as opposed to trying to negotiate a comprehensive treaty all at once. They favoured treating the outer space issue in different fora and devising an international division of labour. Regional bodies were proposed as an option.

The role of the CD was also debated. Most participants favoured treaty discussions in that forum, while simultaneously addressing the subject of outer space in other bodies. Some participants expressed concern that removing the issue of PAROS from the CD would complicate matters. Many participants recommended bringing in experts and conducting informal discussion meetings at the CD.

Some participants urged certain countries to simply go ahead with a treaty. They believed that this move would have a snowball effect, drawing more signatories to the treaty at a later stage.

TRANSPARENCY AND CONFIDENCE BUILDING

Peter Zimmermann, of King's College London, asked what constituted so-called "reckless driving" in space? Zimmermann insisted that the international community required "rules of the road" and increased transparency with regard to space operations. Many satellites are not yet technically able to manoeuvre in a precise manner or to detect approaching satellites. Furthermore, a change of orbit by a satellite does not have to be disclosed, nor does the payload of a satellite have to be fully laid open. These few examples show that there are huge deficiencies in regulating space traffic. Zimmermann advocated coming up with an analogue to the Incidents at Sea Agreement, where the contracting parties agree to behave with courtesy and due regard for others. Furthermore, Zimmermann saw a real need to draw scientists and technical experts into the policy-making debate on space.

Ambassador Hu Xiaodi, from the Permanent Mission of China to the Conference on Disarmament, spoke about the relevance of verification in the context of a treaty banning space weapons. He stated that verification could play an important role in ensuring observance and implementation of a treaty, but it could also delay the conclusion of treaty negotiations. Hu further clarified that two types of outer space verification measures have been envisaged: remote sensing survey and on-site inspections. He emphasized that the most important step would be to agree to a legally binding treaty on PAROS/non-weaponization, and in order to achieve this it might be advisable to put the verification issue aside for the time being, owing to political, technical and financial problems that would need to be addressed before meaningful verification provisions could be codified.

James Clay Moltz, from the Monterey Institute of International Studies, spoke about so-called restraint regimes for space from an American perspective and the chances for current American restraint in outer space. In his view, the United States chose restraint in space weapons competition in the 1960s and 1970s, as exemplified by the Outer Space Treaty. As of 2004, however, the momentum of American policy was pointing toward keeping open all defensive and offensive options in space, especially as there was no other serious competitor in sight. This development of American space policy was reflected in blueprints such as the United States Air Force's "Vision 2020" and the report of the January 2001 Commission to Assess United States National Security Space Management and Organization (the Rumsfeld Space Commission), identifying space vulnerabilities: "The United States must develop, deploy and maintain the means to deter attack on and to defend vulnerable space capabilities".[2]

Nonetheless, Moltz also pointed out that the last word on American space policy had not yet been spoken. There are people in the military that doubt the practicality and strategic usefulness of weapons in space. Instead, they prefer so-called pop-up defences that could potentially be employed during crises. There is also military opposition to the debris from tests. Furthermore, even the Republican-led US Congress had considerably cut budgets for space weapons, delaying space initiatives.

Moltz stated that the position of the United States therefore seems unclear. It wants to investigate near-term ASAT capabilities for space "denial" and to limit debris, but only on a voluntary basis. A treaty to ban space-based weapons, in Moltz's view, is unlikely in the current climate.

Moltz considered possible routes for the CD, including establishing non-offensive norms, greater civilian cooperation among key space powers, formation of “coalitions of the willing” (bilateral, multilateral), promotion of universal adherence to the Outer Space Treaty and the Partial Test Ban Treaty, as joint actions to condemn “aggressive” activities and to provide support for pre-launch notification.

Götz Neuneck, from the Hamburg Peace Research Institute, looked at incentives for space security and space cooperation and identified three core issues. First, the problem of congestion: satellites are overcrowding some orbits and space debris is irreversibly cluttering up orbits. Second, space warfare would put satellites at risk, including satellites vital for commercial use. In this respect, the civilian space industry might be a future ally in attempts to establish a regime for the prohibition of space-based weapons. Third, the potential advent of BMD weapons in space is leading to mistrust, as such weapons have inherent ASAT capabilities. It is thus vital to develop an international arms agreement banning ASAT weapons. This ban should include a ban on testing ASATs, “keep out zones” in space, radar detection and surveillance by international organizations as well as a ban on new weapon principles. Such a treaty would be more effective than costly investments in hardening satellites or space-based weapons. Furthermore, the current threat to American military satellites should not be met by the weaponization of space in the near future, but by passive measures and early warning mechanisms.

The discussion that followed focused on general CBMs and incentives for space-faring nations to keep outer space as a safe environment. Some participants maintained that the advent of more commercial space users would make a difference. In addition, drawing the private sector into the outer space debate would lead to a legal framework on space.

Some participants hoped that the issue could be moved forward through greater media attention, especially related to new topics such as micro-satellites, and recommended that civil society representatives begin lobbying their governments. If the awareness and engagement of a broad range of stakeholders increased, it then would be easier to generate political will and move forward on the issue of outer space security.

Some participants emphasized the role of developing countries in relation to outer space issues and they predicted great benefits from the peaceful uses of outer space for developing nations. Reminding governments of the humanitarian aspect of the outer space issue would help in preventing the weaponization of space.

Many participants emphasized the importance of linking different stakeholders with each other in the outer space debate, especially the public with the private sector, or civil servants with respective think-tanks and scientists.

SYNTHESIS AND DISCUSSION

Patricia Lewis, Director of the United Nations Institute for Disarmament Research (UNIDIR), provided a summary and synthesis of the issues addressed at the conference, noting a need to remain vigilant even where progress has been made. She noted that the tone of discussion during this seminar was different from that in previous seminars, perhaps because the issues had evolved. She said that the Canadian research paper *Space Security 2003* was a beneficial publication, in part because of its contribution to establishing a definition of space security, and in part because it enabled a systematic and scientific measurement of space security. Lewis continued by expressing appreciation that the conference had shown how space technology from the wealthiest countries could provide benefits to the poorest of the poor, including by contributing to education, health and environmental support. She emphasized the importance of remembering "demand issues", as those who used space considered them, and the link between the efforts made in Geneva at the Conference on Disarmament (disarmament/non-weaponization) and Vienna at the United Nations Office for Outer Space Affairs (commercial use). She called on commercial entities and governments to work more closely together, noting that space debris is now part of the security environment.

Lewis summarized some of the technical issues addressed by the conference, including micro-satellites, space-based test-beds and "rules of the road". Space debris, she maintained, is clearly a danger to space access. She reminded participants that various measures had been identified to help provide a balance between use and security, including NFDDs, "rules of the road" and codes of conduct. She also added that such assurances could underpin and support an eventual treaty and that these initiatives did not need to be seen as competing. Lewis suggested that verification and other elements of a PAROS convention required more discussion, including scientific/expert discussion. She noted that partnerships between countries are also important—for example, Russia–China—as is the avoidance of an "either/or" debate on a comprehensive versus a step-by-step approach. She called instead for an overall vision with step-by-step implementation.

Participants differed regarding the best approaches to pursuing space security and a space weapons ban. The following topics were among those considered:

- *The current American position with regard to outer space*: some participants expressed concern about indications in US policy that funding for research into space weaponization had been allocated and that deployment was already being actively planned.
- *Treaty making in a post-Cold War environment*: most participants favoured a holistic step-by-step approach to treaty making, and not exclusively confining discussions on outer space to the CD. Some participants favoured an open discussion of a protocol to the Outer Space Treaty, along with a drive for all space-faring nations to sign on to the treaty.
- *Concrete and complementary interim steps that could be taken while a comprehensive treaty is in the making*: concrete first steps—such as national NFDDs—could be encouraged in order to reduce vulnerabilities. Several participants pointed out that the issues of verification and debris mitigation could be starting points in devising a code of conduct, and could go forward with or without movement on the treaty side. Some participants called for an international agency for verification purposes; others advocated heightening compliance with existing outer space rules, such as those pertaining to pre-launch notifications.
- *General CBMs*: some participants suggested that the commercial sector and big investors had significant incentives for ensuring restraint in outer space; other participants hoped that more media attention would help to move the issue forward. Many participants emphasized that developing countries also had an important stake in ensuring space security. Attention to the humanitarian and developmental aspects of outer space security could also help prevent weaponization.

The differing views on these issues identified questions for further consideration, including the following:

- *Which proposals attracted the most support?* There was strong support for taking specific incremental steps to ensure space security. Among the potential initiatives that attracted the most support were the mitigation of space debris, "rules of the road" for both launches and satellite manoeuvres in line with the principle of non-interference with national technical means, and satellite quality standards.
- *What new issues were raised in the discussions of outer space security?* Four new issues were brought forward in the discussions. First, participants focused on developing countries and the great benefit they would increasingly reap from the peaceful uses of outer space. Second, in addition to the humanitarian dimension to space security, the conference touched upon the potential environmental devastation that could be caused by unregulated space weaponization. Third, ways for reforming the space debate were put forward, such as moving from a strategic to a humanitarian discourse, as well as enhancing the engagement of civil society in general and the interaction between governments, NGOs, and the business and the scientific communities. Many participants pointed out the importance of bringing NGOs to the table. One participant identified the need to define a specific set of space subjects to tackle and work on together—and to pick up the pace. Another noted that a main consideration now seemed to be the need to control behaviour in space, rather than the need to establish a non-weaponization treaty, stating that controls on how actors conducted themselves were fundamental. Since the CD would only address one aspect of space security, the CD's contribution should, therefore, only be considered as part of a comprehensive approach. Fourth, the conference demonstrated that there were many people in the US government and armed forces who were still undecided on the weaponization of space and maintained a middle ground; their influence could be significant.
- *Why is it in the interest of the United States to have an international treaty banning the weaponization of space?* Many participants pointed out that the strategic benefit of space-based weapons is negligible, as ground-based weapons are more effective in many ways. The high costs of developing, testing and deploying space weapons, the difficulty of subsequent calibration, maintenance and repair, and the arms race that would likely ensue compare unfavourably with the greater

security, commercial and other benefits of a legally regulated weapons-free outer space.

Lewis' remarks prompted wide-ranging discussion. One participant noted that there was a need to integrate national and international efforts, adding that the document *UK Space Strategy: 2003–2006 and beyond*[3] was a refreshing approach that incorporated both civilian use and security considerations. Another participant identified the military-industrial complex as a crucial lobby and suggested building pressure from the bottom up by mobilizing people to call on their governments to choose non-weaponization. Another participant stated that, even if the CD ever adopted a Programme of Work, it would not have sufficient time for serious discussion of space security. While there were some dissenting voices, there was general agreement that the space security issue might have to be addressed outside of the CD.

Ambassador Paul Meyer of Canada closed the workshop by concluding that space was the final frontier and that it should not be left lawless. He suggested that perhaps it could be envisioned as a world heritage park where weapons were left at the gate and guests removed all debris that they generated.

CONCLUSION AND NEXT STEPS

This conference presented participants with a broader picture of the factors influencing continued universal access to space for peaceful purposes. While this included the potential weaponization of outer space, it also introduced participants to an array of other issues that must be monitored and addressed in order to keep space secure. Topics included the US Air Force and its space aspirations as well as potential codes of conduct, "rules of the road" and NFDDs. The conference brought the multilateral community closer to a definition about what space security could look like and how space should best be seen—as a new frontier or as a common good.

A recurring theme of the conference was that the growth in the impact of space meant that the separation of CD and COPUOS space activities was no longer effective, and that some coordinating mechanism should be explored to integrate common objectives.

The following were identified as some of the possible ways to move forward: an initiation of discussions at the CD or elsewhere, possibly toward treaty negotiations; unilateral moratoria on space weapons; steps to lead to the development of "rules of the road" and codes of conduct; and clearer definitions of terms. It was suggested that if the middle ground on the issue could discredit space weapons, then political will in support of non-weaponization would increase in the United States. The enhanced interface between technology and policy through the heightened involvement of scientists was considered crucial. However, it was questioned whether the debate at the United Nations could be carried forward to regional bodies (for example, the North Atlantic Treaty Organisation, European Union, ASEAN Regional Forum, Organization of American States, African Union, Organization for Security and Co-operation in Europe) and how the success rate of existing instruments could be increased and how best to unite current actors.

One participant encouraged incremental approaches that included multilateral action and called for the immediate establishment of a norm through NFDDs by space-faring nations and other countries. Such steps would not interfere with the work of the CD or efforts to take the larger step of establishing a legal framework to ban space weapons. Governmental experts in science and technology and non-governmental observers could be brought together to discuss "rules of the road" and legal issues of space weapons, given that it would be considerable time before the CD would be able to do so. Another participant advised that the American Institute of Aeronautics and Astronautics had put forward a set of "rules of the road" for industry that should be investigated.

While this conference helped participants to think about these ends, it also helped them to begin to think about the means. How is it possible to push the issue of weaponization in space forward in a post-Cold War world, where there is no agreed definition of security and where the designated multilateral body for disarmament issues stays deadlocked? The opinion of the majority of the speakers at this conference was to widen the discourse, draw in different stakeholders and make use of different fora and legal instruments. It might very well be that issues such as security and military strategy need rethinking in the age of single-power dominance and an ever-greater divide between the poor and the rich. Furthermore, the current times of strategic transition are an excellent opportunity to address such issues. There remains hope that all space-faring nations will realize that an international legal regime on outer space is in the best interest of all. Conferences such as this are vital in providing information about current outer space issues and technical advances. However, these discussions must continue on a regular basis in order to share developments and to help shape the discourse on outer space.

Notes

1 Canada, International Security Bureau of the Department of Foreign Affairs and International Trade, 2004, *Space Security 2003,* at <www.eisenhowerinstitute.org/programs/globalpartnerships/fos/newfrontier/SpaceSecuritySurvey%202003.pdf>, p. 2.

2 United States, 2001, *Report of the Commission to Assess United States National Security Space Management and Organization*, Washington, DC, Government Printing Office, p. xvi.

3 See <www.bnsc.gov.uk/assets/channels/about/5818%20BNSC%20Brochure.pdf>.

CHAPTER 2

SPACE WEAPONS IN THE 2005 US DEFENCE BUDGET REQUEST

Jeffrey Lewis

INTRODUCTION

What are the prospects for space weaponization? The question is particularly important as the world approaches what promises to be a bruising 2005 Non-Proliferation Treaty (NPT) Review Conference. The Conference on Disarmament (CD) remains deadlocked while the United States reviews its support for the fissile material cut-off treaty. Although the 2000 NPT Review Conference identified 13 practical steps to demonstrate good faith in the commitment to pursue disarmament, the declared nuclear powers are unlikely to make progress on these steps before the 2005 NPT Review Conference. Preventing the weaponization of outer space is not explicitly one of these 13 steps. The vision of expanded military activities in outer space articulated by the current Bush Administration, however, draws heavily on the outline of the *Nuclear Posture Review* and as a result has complicated efforts to build consensus for a work plan in the CD.[1]

The US *Nuclear Posture Review* called for modernizing US strategic forces by adding anti-ballistic missile (ABM) systems and conventional long-range strike systems, both of which might include space-based elements. The US Department of Defense typically does not use the term "space weapon" to describe these systems—instead, the US Department of Defense divides military space operations into four mission areas as follows:

- space control operations provide freedom of action in space for friendly forces while, when directed, denying it to an adversary, and include protection of US and US allied space systems and negation of adversary space systems;

- space force enhancement operations multiply joint force effectiveness by enhancing battle space awareness and providing warfighter support;
- space support operations consist of operations that launch, deploy, augment, maintain, sustain, replenish, de-orbit and recover space forces, including the command and control network configuration for space operations; and
- space force application would consist of attacks against terrestrial-based targets carried out by military weapons systems operating in or through space—the force application mission area includes ABM systems and force projection.[2]

Of these four mission areas, some of the space control missions and space force projection missions are what most observers think of as "space weapons". The publication of several US military documents outlining these capabilities, including the 1998 Air Force Space Command *Long Range Plan* and the US Air Force's biennial *Strategic Master Plan*, have resulted in considerable criticism of the United States, particularly from China and the Russian Federation. Concern over US military activities in outer space has contributed to the deadlock in the CD and might complicate the NPT Review Conference.

Much of the concern centres on suspicion of the motives of the United States. But the actual intentions of the Bush Administration are not clear—the White House ordered a review of the 1996 National Space Policy, but the results regarding national security matters have not been made public. Officially, the Clinton-era National Space Policy and US Department of Defense 1999 National Space Policy continue to define US government statements regarding military activities in outer space, with the single exception of ABM systems.[3] These policies are reflected in the doctrinal statements and transformation plans outlined by the US Joint Chiefs of Staff, service headquarters and combatant commands.[4]

The final report of the Commission to Assess US National Security Space Management and Organization, chaired by Donald Rumsfeld until his nomination as Secretary of Defense, provides some evidence about the general outlook of the Bush Administration toward space. The commission, empanelled by a Republican Party-controlled Congress, called for "power projection in, through and from space". The commission also recommended that the US government "vigorously pursue the capabilities called for in the National Space Policy to ensure that the President will have the option to deploy weapons in space to deter threats to and, if necessary, defend against attacks on US interests".[5]

One commission member, General Ronald Fogelman (US Air Force, retired), drew a sharp distinction between arms control and the approach of the commission: "We, as a Commission, believe very strongly that one of the biggest threats to future space capability might be the unintended consequences of well-intentioned people signing up to certain treaties and restrictions today that in and of themselves seem to be very innocent … and as you go down the road, they could end up tying our hands in ways that would very much limit our ability to continue to be dominant".

Broad policy documents, from the National Space Policy to the Air Force Transformation Flight Plan, do not, however, indicate which programmes will survive the thicket of political, technological and budgetary hurdles. For example, the Air Force Space Command published an analysis that "depicts what resources would be required to acquire all of the *capabilities* for which the Air Force Space Command is responsible in the timeframes desired by the warfighter" against an estimate of available resources—that is, total obligation authority (TOA).[6] "Air Force Space Command TOA is inadequate," the Air Force Space Command concluded and the requirements "un-executable".[7]

Documents such as the *Strategic Master Plan* and *Transformation Flight Plan* are, in fact, largely "wish lists" designed for the budgeting process. The requirements set by such documents are typically optimistic and subject to alteration, particularly by the US Congress. Identifying the programmes that are likely to reach operational testing and deployment requires a careful examination of the documents produced to support the President's annual budget request and the authorization and appropriations bills passed by Congress.

Of the many force projection and space control programmes, which ones are the most likely to be tested and deployed in the next few years? Based on an analysis of fiscal year 2004 and 2005 budget requests, the two most important programmes—for opponents of space weaponization—are space-based ABM systems and micro-satellites capable of autonomous proximity operations.[8]

FORCE PROJECTION AND SPACE-BASED ABM SYSTEMS

Pentagon plans for space-based force projection are largely space-based ABM programmes. The Pentagon does have active research programmes to develop hypersonic vehicles and space-based kinetic energy weapons called hypervelocity rod bundles. Hypersonic vehicle concepts, however, are currently being designed to *transit* space—although there are long-term plans for space operations and space manoeuvre vehicles that would allow on-orbit basing of hypervelocity rod bundles and the Common Aero Vehicle, a hypersonic glide vehicle.

In the short-term, space-based force projection platforms are likely to appear in the form of space-based ABM interceptors to enhance the ABM system, which will stand-up in Alaska by the end of 2005. In December 2002, President Bush indicated that the United States would continue the "development and testing of space-based defenses, specifically space-based kinetic energy (hit to kill) interceptors and advanced target tracking satellites".[9]

The fiscal year 2004 budget request anticipated a major effort to research these technologies, including the creation of a space-based ABM test bed starting in 2008. After substantial Congressional resistance during the authorization and appropriations processes, the fiscal year 2005 budget request has substantially fewer funds dedicated to space-based missile defences, although several programmes remain.

The principle programme that supports space-based interceptors is the Ballistic Missile Defense (BMD) System Interceptor programme—a boost-phase kinetic energy interceptor that is intended to be based on land, at sea and in space. In fiscal year 2004, Congress reduced the line item for BMD System Interceptors by US$ 182.0 million and ordered the Missile Defense Agency (MDA) to focus on land- and sea-basing modes, rather than space. Consequently, the MDA has shifted most of the funding for the space-based component of the BMD System Interceptor programme into the land and sea components.[10] However, the fiscal year 2005 budget request contains some funding for two space-based boost-phase related activities.

- US$ 68.0 million was budgeted for the Near Field Infra Red Experiment (NFIRE) satellite, funded as Experimentation & Test in Block 2010. NFIRE, scheduled to launch during early 2006, is a risk reduction effort for the space-based interceptor. The satellite will collect data on the characteristics of missile plumes and hardbodies outside the atmosphere, as well space and Earth horizon backgrounds. The MDA will conduct two missile "fly-bys" to allow NFIRE "a close-up view of a burning intercontinental ballistic missile (ICBM) at conditions that are truly real world". During the second test, NFIRE will simulate an engagement by launching "a kill vehicle for a fly-by of a burning missile".[11] The MDA is not attempting to hit the ballistic missile and the kill vehicle lacks an axial stage that would allow it to conduct engagements in real world conditions.

The NFIRE was originally scheduled for launch in June 2004; however, Congress cut the BMD System Interceptors and ordered the MDA to focus its efforts on ground-based interceptor programmes. MDA reprogrammed about US$ 37.5 of the US$ 82 million identified for NFIRE and slipped the launch date to early 2006.

- US$ 10.6 million was budgeted in Block 2012 for Space Based Interceptor Test Bed activities. The funding is intended to initiate technology development and testing of advanced, lightweight space-based interceptor components including development of a liquid axial stage and reductions in kill vehicle and lifejacket weight. This is substantially less than the US$ 119.5 million that the MDA originally intended to request for fiscal year 2005.

The MDA also conducts a substantial amount of research that could support future space-based efforts in the Ballistic Missile Defense Technology programme, which funds the development of new component technologies and innovative concepts that can be integrated into future block improvements of the BMD system. All of the research efforts have been consolidated under a single project, 0502 Advanced Technology Development, which contains efforts such as Sensing Systems Technologies, Engagements Systems Technologies (including the Multiple Kill Vehicle programme) and the High Altitude Airship.

- Sensing Systems Technologies is a US$ 72.1 million effort that includes an unspecified amount for a micro-satellite programme to investigate "small satellite concepts, payloads and applications for future BMD technology demonstrations and test assets". In 2003, the MDA awarded California-based SpaceDev a US$ 800,000 contract "to design three formation-flying microsatellites" as an alternative to the

Space-based Tracking and Surveillance System designed to track missiles in boost-phase.[12]

- Engagement Systems Technologies is a US$ 85.4 million effort that includes an unspecified amount for the Multiple (formerly Miniature) Kill Vehicle (MKV) programme. The MDA hopes to use as many as 12 Multiple Kill Vehicles on a single ground-based interceptor to provide multiple intercept opportunities in the mid-course of a ballistic missile's flight. The MDA is reportedly exploring other basing modes, including sea-based.[13]

Remaining work on the Space-Based Laser Programme, which was cancelled in 2002, and has been shifted to the Advanced Technology Development Project. Although the MDA is soliciting proposals from the laser and electro-optics industry that could revive the Space-Based Laser Programme, the MDA appears to be focused on using lasers to improve tracking, weapon guidance and imaging. The MDA is decommissioning the Lockheed Martin facility in California where integrated ground tests of the high-power laser and optical subsystems were conducted.

SPACE CONTROL AND AUTONOMOUS PROXIMITY OPERATIONS

In the short-term, the Pentagon is focusing on reversible measures to control space, including a pair of ground-based systems to temporarily interfere with communications and reconnaissance satellites. The Counter Satellite Communications System is a mobile system "intended to disrupt satellite-based communications used by an enemy for military (command, control and communications)", while the Counter Surveillance Reconnaissance System, currently in the initial design-phase, will impair reconnaissance satellites with "reversible, non-damaging effects". The Counter Satellite Communications System was expected to reach initial operating capability by 2004, while the Counter Surveillance Reconnaissance System is expected to reach initial operating capability by 2007.

The Pentagon has a range of destructive anti-satellite programmes in various states of completion, including the mothballed programme, which programme officers believe they could demonstrate on orbit for about US$ 60 million, as well as an air launched anti-satellite missile.[14] The arms control community should monitor the development of these systems, but—for the time being—they are not serious threats to weaponization, unless the Bush Administration decides to conduct a Kinetic Energy Anti-Satellite test for purely political purposes.

The most serious prospect for the weaponization of space is from progressively smaller satellites capable of autonomous proximity operations—orbital manoeuvres that would allow satellites to inspect other satellites, diagnose malfunctions and provide on-orbit servicing. Such satellites could also provide sophisticated surveillance in space and would make excellent anti-satellite weapons.

In fact, the Defense Technology Area Plan in 2000 called for "the development of microsatellite vehicles with significant capability" including the ability to "conduct missions such as diagnostic inspection of malfunctioning satellites through autonomous guidance, rendezvous and even docking techniques".[15] The National Aeronautics and Space Administration (NASA), the Defense Advanced Research Projects Agency (DARPA) and the Air Force are planning future demonstration missions (see Table 1).

- NASA's Demonstration of Autonomous Rendezvous Technology (DART) is an advanced flight demonstrator that was scheduled for launch in 2004. Once in orbit, the DART satellite would rendezvous with a US Department of Defense communications satellite and perform several autonomous rendezvous and close proximity operations, such as moving toward and away from the satellite using navigation data provided by an advanced video guidance sensor and other on-board sensors.[16] Orbital's contract for DART is valued at US$ 47 million.[17]
- The Air Force's Experimental Spacecraft System (XSS) is a series of Air Force Research Laboratory satellites designed to demonstrate imaging applications of proximity operations. The most recent satellite, the XSS-10, was launched in 2003.[18] That satellite manoeuvred to within 35m of an expended Delta II rocket body, transmitting digital images, and conducted a number of other on-orbit manoeuvres for 24 hours before completing its mission; the next satellite in the series, the XSS-11, was scheduled for launch in 2004. Unlike the XSS-10, the XSS-11 will remain in orbit for a year and conduct close-proximity operations to multiple targets of opportunity.[19] The US Air Force requested

US$ 18.6 million in fiscal year 2005 for the XSS micro-satellites. Lockheed's contract for the XSS-11 is valued at US$ 21 million.[20]

- DARPA's Orbital Express will demonstrate the feasibility of using automated spacecraft to refuel, upgrade and extend the life of on-orbit spacecraft.[21] Boeing is building two satellites—the Autonomous Space Transport Robotic Operations Satellite (ASTRO) and a surrogate next generation serviceable satellite (NEXTSat)—for an on-orbit demonstration of autonomous satellite servicing set for launch in March 2006.[22] DARPA has allocated US$ 56.6 million in fiscal year 2005 on its Orbital Express programme. Boeing's contract for ASTRO and NEXTSat are valued at US$ 113 million.

Table 1: Upcoming autonomous proximity demonstrations

Satellite		Agency	Firm	Launch	Kg
DART	Demonstration of Autonomous Rendezvous Technology	NASA	Orbital	October 2004	48
XSS-11	Experimental Spacecraft System-11	US Air Force	Lockheed	November 2004	100
ASTRO	Autonomous Space Transport Robotic Operations	DARPA	Boeing	March 2006	700

Sources: See endnotes 16–26.

There might be other research into autonomous proximity operations at the classified level. At least one Air Force classified small satellite or micro-satellite is scheduled to launch on a Minotaur launch vehicle in 2005; however, its function is unknown.[23]

Although none of these satellites is a dedicated anti-satellite, each has that capability. As the director of the Air Force XSS programme told *Space News*, "You can't closely inspect a vehicle—say, one with an on-orbit malfunction—without getting 'close' and approaching from the right angle. To refuel, obviously you'd have to get more than close, and 'dock' with the vehicle."[24]

The three programmes are already contributing to an innocuous "anti-satellite" mission of sorts: NASA is planning to launch an autonomous "space tug" in 2006, using technology from DART, XSS and ASTRO to de-orbit the Hubble Space Telescope. "We actually think that having three programs that are funded right now to look at aspects of this issue are really going to be a great help", noted one NASA official.[25] The same might be said by Air Force officials, one of whom told *Space News* that the "XSS-11 can be used as an ASAT weapon".[26] In fact, the "single strongest recommendation" of the Air Force's 1999 Microsatellite Technology and Requirements Study was "the deployment, as rapidly as possible, of XSS-10-based satellites to intercept, image and, if needed, take action against a target satellite" based on technology from the Army's Kinetic Energy Anti-Satellite programme. The XSS-11 is a pathfinder for the national "microsat payload imager," outlined in the Air Force Space Command Strategic Master Plan, and the "flexible orbit counterspace microsat" to "neutralize [an] adversary's use of space".[27]

Given growing suspicion about motives of other space-faring states, an unannounced proximity operation might lead to a serious incident in space. One recent operation involving a relatively innocuous micro-satellite test demonstrates the level of mistrust and confusion inherent in unregulated micro-satellite programmes.

In 2000, Surrey Satellite Technology Ltd., a British company affiliated with the University of Surrey, launched two satellites: the first, TsinghuaSat-1, was built by Surrey Satellite Technology Ltd. and a group of scientists at Tsinghua (Qinghua) University in Beijing; it contained a multi-spectral camera with 40m resolution, which Surrey Satellite Technology Ltd. hoped to use as a demonstration of the possible applications of a constellation of remote sensing micro-satellites for natural disaster monitoring and mitigation.[28] The second satellite, SNAP-1, built by Surrey Satellite Technology Ltd. alone, was designed to conduct a proximity operations near TsignhuaSat-1. SNAP-1 successfully manoeuvred to within 9m of the Chinese satellite, transmitting a digital image.[29]

Despite the innocuous mission and relatively limited capabilities of TsinghuaSat-1, the US Department of Defense identified it as evidence that China is developing "parasitic microsatellites" for use as anti-satellite weapons.[30] In addition to concern that the Chinese were developing micro-satellites, the US Department of Defense might also have been concerned about Chinese affiliation with a project involving proximity manoeuvres; the launch of a Chinese micro-satellite with the capability of SNAP-1, let alone the XSS-11 or DART, would generate intense concern in many parts of the United States. If the Chinese were to conduct a proximity manoeuvre near a US satellite, the reaction would be apoplectic.

Without a legal regime to establish ground-rules for inspections and other proximity operations, serious incidents are possible. In July 1993, the US Navy stopped and inspected a Chinese ship, the *Yinhe*, which the Central Intelligence Agency claimed was carrying chemical weapons precursors to Iran. The inspection found no such weapons, but the incident was, briefly, a serious issue in the China–United States relationship. Is a *Yinhe*-type incident possible in outer space? Already, some proponents of micro-satellites are proposing that the United States develop a micro-satellite "space guard" force, analogous to the Coast Guard, to patrol low-Earth and geostationary orbit.[31] Although proponents point to the stabilizing effect of the US Navy in combating piracy, there is a plausible case to be made that such efforts might stimulate other states to pursue micro-satellites and other anti-satellite capabilities since a space guard force could just as easily be used to deny other states the ability to operate in outer space.

CONCLUSION

Regulating space-based ABM interceptors and micro-satellite proximity operations will be difficult. The Bush Administration, in abandoning the ABM treaty, clearly stated that it desires the freedom of action to develop an open-ended missile defence architecture that will eventually include space-based elements. Micro-satellites are inherently dual-use, greatly complicating any anticipated restrictions. At the same time, many members of Congress, including many moderate Republicans, are uncomfortable about space-based ABM and anti-satellite capabilities. It was, in fact, a Republican Congress that substantially reduced funding for space-based interceptors. Perhaps one solution is to focus on operational restrictions to prevent provocative manoeuvres in orbit or military activities that create debris. Michael Krepon has suggested an "Incidents in Space" agreement modelled on the 1972 Incidents at Sea Agreement.[32] Others have suggested similar "rules of the road" agreements for space operations.

An incidents in space agreement, or a set of rules of the road, might be more politically palatable to the United States than an agreement designed explicitly to constrain US military capabilities. Recently, the US Congress approved a pilot programme to sell US satellite tracking data to foreign and commercial entities, "consistent with the best interests of national security". An agreement about rules of the road would, in my view, provide a more comprehensive definition of US national interests—a definition that encompasses the common interest of all countries in preserving the orbital environment and promoting international cooperation in preserving the interest of all states in the use of outer space for peaceful purposes.

Notes

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2 These definitions are drawn from US Joint Chiefs of Staff, 2002, *Joint Doctrine for Space Operations,* Publication 3–14 (August), chapter IV, pp. 1–10.

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7 US Air Force Space Command, 2003, op. cit., p. 13.

8 The analysis of the fiscal year 2004 budget request can be found in Jeffrey Lewis, 2003, *Lift-Off for Space Weapons? Implications of the Department of Defense's 2004 Budget Request for Space Weaponization* (July), at <www.cissm.umd.edu/documents/spaceweapons.pdf>. An update for fiscal year 2005, prepared by Theresa Hitchens, Jessy Cowan and Victoria Samson is available from the Center for Defense Information web site at <www.cdi.org>.

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CHAPTER 3

THE CURRENT LEGAL REGIME GOVERNING THE USE OF OUTER SPACE

Jonathan Dean

The year 2004 marks the 37th anniversary of the Outer Space Treaty, the cornerstone of the treaty regime covering activities in space. The Outer Space Treaty was concluded at a time when the United States and the Soviet Union, fearing the disastrous results of extending their military confrontation into space, joined other United Nations Member States in deciding that space must be used only for peaceful purposes. These worries about the dangers of weapons competition in space remain equally valid today.

Outer space has been "militarized". It is already inhabited by at least 500 satellites used for military purposes, among them navigation, sensing, imaging, communications and weather. These activities are generally considered useful, passive and non-aggressive. There is no prospect and no widely shared desire for their elimination. They have never been formally challenged. On the other hand, for the past generation, the Outer Space Treaty's injunction that space should be used only for peaceful purposes has been maintained with regard to orbiting or stationing weapons in space. But there are prospects that this peaceful regime might end.

As part of its missile defence project, the United States foresees two space-based weapons—a space-based laser and a space-based kinetic kill vehicle. A space-based "test bed" for the latter has been postponed at least once and could be deployed some time after 2006. A "test bed" in this context is a space-based complex consisting of one or more prototype weapons, targets for those weapons, and observation and measurement devices in space and on the Earth's surface. Once this array is deployed in space, it will be fair to say that the red line has been crossed and that the weaponization of space has begun. Even before weapons are orbited in space, ground-based or aircraft-mounted anti-satellite (ASATs) weapons could be deployed.

A presidential directive ordered a review of US national space policies in June 2002. A wrap-up report on space strategy that was scheduled for the end of February 2003 has not yet appeared. Given the administration's approach in its Nuclear Posture Review, in its National Security Strategy featuring the possibility of pre-emptive attack, and the known views of administration leaders on space policy, it can be expected that, when it appears, this policy review will make a determined case for US domination of space by force of arms that will serve as a rallying point for supporters of weaponization.

The weaponization of space is a looming tragedy for all humanity, an immense destructive iceberg that we can see bearing down on us, even more significant in its long-term consequences than today's real worries over the proliferation of nuclear and biological weapons among rogue states and terrorists. If the weaponization of space does take place, with whatever weapons or justification, it will be the ultimate act of weapon proliferation. All of humanity will feel its self-destructive effects.

To meet these evident dangers, it is time that government and non-governmental organization (NGO) thinking begin to coalesce around a specific, fully articulated approach for preventing the weaponization of space. Given the fact that world governmental and public opinion opposes weaponization and that there is today only one potential proponent of weaponization—the US government—the objective of an agreed approach should be to convince the United States of the fact that the costs of weaponization outweigh its potential gains. This effort must be made at all levels of the US political system: executive, Congress, commercial interests, media and public.

LEGAL AND TREATY ASPECTS

The objective of this paper is to describe the legal and treaty rules covering the use of space. The biggest problem about the legal regime governing the use of space is that while the Outer Space Treaty prohibits the orbiting of weapons of mass destruction (WMD) in space, it does not specifically prohibit orbiting of weapons of other kinds. Article IV of the

Outer Space Treaty prohibits placing in orbit around the Earth any objects carrying nuclear weapons or other WMD. It also prohibits the testing and the deployment of any kind of weapon on the Moon or other celestial bodies.

In practical terms, this means that nuclear weapons mounted on missiles could transit space and that weapons other than nuclear, chemical or biological might be placed in space orbit and used to attack targets in space or on Earth. Countries could also create armed military bases on orbiting satellites. There is no ban on air-, ground- or sea-based ASATs or anti-missile weapons. However, numerous provisions of space treaties could provide obstacles to weaponization of space.

In addition to the 1967 Outer Space Treaty, five other treaties address outer space: the 1963 Partial Test Ban Treaty (or Limited Test Ban Treaty), which prohibits nuclear tests and nuclear explosions in the atmosphere or in outer space; the 1968 Astronauts Rescue Agreement; the 1972 Liability Convention, which established procedures for determining the liability of a state that damages or destroys space objects of another state; the 1975 Registration Convention, which requires the registration of objects launched into space; and the 1979 Moon Agreement, which took the first steps to establish a regime for exploiting the natural resources of space.[1]

In addition, there are five relevant United Nations General Assembly resolutions: the 1963 Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space (this preceded the Outer Space Treaty and laid out most of its content); the 1996 Declaration on International Cooperation in the Exploration and Use of Outer Space for the Use and Benefit and in the Interest of All States; the 1982 resolution on Direct Television Broadcasting; the 1986 resolution on Remote Sensing of the Earth from Outer Space (seeks to assure inexpensive access by developing countries to non-military satellite imaging); and the 1992 resolution on Use of Nuclear Power in Outer Space (designed to limit exposure of people in crash landing of nuclear-powered satellites and dealing with liability for such accidents).[2] After 13 June 2002, when US withdrawal from the Anti-Ballistic Missile (ABM) Treaty became effective, there was no longer any explicit treaty prohibition against testing or deploying weapons in space other than WMD.

The International Telecommunications Union (ITU) allocates radio frequencies and orbital slots for satellites. Both resources are limited and increasingly crowded. The constitution of the ITU has a general provision prohibiting harmful interference with satellite communication. This provision might be invoked in the event of protracted or repeated jamming. Both missile defence and weaponization of space would result in competitive requirements for more frequency bandwidth and orbital slots. New equipment is enabling more economical use of existing frequencies. However, the overall shortage could lead to cooperation among foreign governments to hinder the United States, already the biggest user, from gaining more orbital slots or frequencies.

A further complex of treaties is relevant to space weapons. It arises from the concept of non-interference with national technical means (NTMs) of verification. This first appeared in the 1972 Strategic Arms Limitation Talks (SALT I) Treaty and was taken over by the Intermediate-range Nuclear Forces (INF) Treaty, which is of indefinite duration, as well as into the Strategic Arms Reduction Treaty (START I), which has been prolonged to 2009. The intent of this measure is to preserve NTMs, including space-orbiting means, from attack or interference.

Thus, it would be a violation of the provisions on non-interference with NTMs in the INF and START I treaties to use weapons against any early warning, imaging or intelligence satellite and, by extension, against any ocean surveillance, signals, intelligence or communications satellite of the Russian Federation or the United States. This non-interference obligation was made multilateral in the 1990 Treaty on Conventional Armed Forces in Europe (CFE), which has 30 North Atlantic Treaty Organisation (NATO) and East European participants and is of unlimited duration. It is true that, to be protected by the provisions, satellites must be used to verify specific treaties, but in most cases, it will not be feasible to determine which satellites are being actually used or could be used for this purpose. Hence, in practice, all are protected.

In the spirit of these treaty provisions, I have suggested that the First Committee of the General Assembly consider adopting separate resolutions calling for non-interference with communications, weather satellites, global positioning system (GPS) satellites and others. Such resolutions might provide a measure of protection to US and other satellites and to that extent weaken the argument for weaponization and help to mobilize world public opinion on the weapons in space issue.

At a July 2002 Paris meeting on space issues of the Eisenhower Institute, a suggestion was made to elevate the status of certain space assets like GPS and other navigation satellites, telecommunication and weather satellites, and to give them special legal status as "global utilities". The Paris meeting did not suggest how this could be done, but I believe a General Assembly resolution could proclaim satellites performing these functions to be global utilities and state that they should not be interfered with.

THE NORM OF PEACEFUL USE

In addition, the 1967 Outer Space Treaty is based on "the common interest of all mankind in the ... use of space for peaceful purposes". In fact, the treaty contains four explicit references to the peaceful uses of outer space.

This language points to the fact that, during the nearly forty years of existence of the Outer Space Treaty, an important norm has emerged against the weaponization of space, for keeping armed conflict out of space and for ensuring its peaceful use.

This conclusion has been documented by General Assembly resolutions each year for the past 20-odd years calling for maintaining peaceful uses of space and preventing an arms race in space. Most of these resolutions have been unanimous and without opposition, although the United States and a few other countries have abstained.

In the most recent version adopted by the First Committee of the General Assembly in November 2003, the resolution received the support of 174 states, the highest number in years. As usual, Israel, the Marshall Islands, Micronesia and the United States abstained. The resolution asks all states to refrain from actions contrary to the peaceful uses of outer space and calls for negotiation in the Conference on Disarmament (CD) on a multilateral agreement to prevent an arms race in outer space.

These repeated, nearly unanimous resolutions with huge majorities are not only evidence for the existence of a norm against the weaponization of space. They also indicate a widespread desire to expand existing multilateral agreements to include an explicit prohibition against all weapons in space.

The Outer Space Treaty has other provisions that could be useful in the event of dispute over weaponization of space: Article VII makes treaty parties that launch objects into outer space liable for damage to the property of another treaty party—the procedure is spelled out in the Liability Convention of 1972. That convention foresees the establishment of a Claims Commission to determine the extent of liability for damage by the space objects of one country to the space objects or property of another state. Article IX of the Outer Space Treaty provides for consultations with other governments if any treaty party believes an activity planned by another treaty party could cause "potentially harmful interference with activities in the peaceful exploration and use of outer space".

These provisions present important possibilities for legal action in connection with possible moves to weaponize space. Beyond this, the General Assembly could by majority vote request an Advisory Opinion from the International Court of Justice if either the peaceful uses language of the Outer Space Treaty or if these two articles on liability and consultation come into contention, for example, as the space-based component of the missile defence system advances. The court could also be asked for its opinion on whether laser weapons should be classed as WMD and banned under the treaty.

In fact, requests for consultation under Article VII on liability or Article IX on possible interference, or a General Assembly request for an advisory opinion can and should come now, in order to make world opinion aware of the weaponization issue before the damage has been done, and to make the US government more aware of the potential costs for weaponizing space.

The request for consultation under Article IX can come from any party or group of parties to the Outer Space Treaty. George Bunn and John Rhinelander have pointed out that parties to the treaty could convene and issue an interpretation that US testing or orbiting of space weapons of any kind was contrary to the peaceful uses language of the treaty, in effect amending it to preclude weaponization. The General Assembly could then pass a resolution endorsing this interpretation.[3]

Presumably, the European Union, France or the Russian Federation, or any other state party to the CFE Treaty could also take legal action against moves toward space weaponization, basing its complaint on treaty provisions prohibiting interference with NTMs. Legal action could also be taken in US courts by foreign or US commercial users of space satellites if these satellites were endangered or destroyed by US space weapons.

In short, existing space law provides numerous opportunities to make clear to the United States that weaponization of space could be a costly and difficult process for it to pursue.

EXPANSION OF THE LEGAL REGIME

There have been many proposals to fill the gap in the Outer Space Treaty's prohibition of weapons. Canada and several NGOs have made suggestions. Probably the most important recent suggestion is a Russian–Chinese working paper presented to the CD on 27 June 2002, and subsequently expanded, which contains possible elements of an international legal agreement on the prohibition of deployment of any weapons in outer space. It would also prohibit the threat or use of force against space objects, a concept that would apply to ASAT weapons, either mounted on aircraft or ground-based. The two sponsors have collected comments on their draft and posted them on their web sites at the CD in Geneva.[4]

An important part of an organized campaign against the weaponization of space would be to encourage other space-faring countries, including the European Union and France, India and Japan, as well as the Russia Federation and China, to express to the United States their concern over the prospect of weaponization and to let the United States know, in a constructive way, that they intend to use legal means to oppose weaponization and will as needed invoke the Liabilities Convention and call for consultation under Article IX of the Outer Space Treaty. The US government should be made aware that these governments are seriously concerned about the possibility of weaponization and should see early on that the entire range of other US interests with these countries could be jeopardized by controversy over weaponization of space.

I believe these points demonstrate that the current regime of space treaties can be used even in its present incomplete form to make clear that the weaponization of space could be a very costly undertaking, as well as a very dangerous one.

Notes

1 The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"), opened for signature on 22 April 1968, entered into force on 3 December 1968, 87 ratifications; The Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention"), opened for signature on 29 March 1972, entered into force on 1 September 1972, 81 ratifications; The Convention on Registration of Objects Launched into Outer Space (the "Registration Convention") opened for signature on 14 January 1975, entered into force on 15 September 1976, 43 ratifications); The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement"), opened for signature on 18 December 1979, entered into force on 11 July 1984, 9 ratifications (as of 1 February 2001).

2 The Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space (General Assembly resolution 1962 (XVIII) of 13 December 1963); The Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting (General Assembly resolution 37/92 of 10 December 1982); The Principles Relating to Remote Sensing of the Earth from Outer Space (General Assembly resolution 41/65 of 3 December 1986); The Principles Relevant to the Use of Nuclear Power Sources in Outer Space (General Assembly resolution 47/68 of 14 December 1992); The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (General Assembly resolution 51/122 of 13 December 1996).

3 Letter to the Editor, *Arms Control Today*, June 2002.

4 See <www.geneva.un.mid.ru/geneva-un/speeches/03.html>.

ANNEX

BACKGROUND PAPER

Union of Concerned Scientists

MULTIPLE DECLARATIONS TO REFRAIN FROM DEPLOYING WEAPONS IN SPACE

It is proposed that governments of space-faring nations consider issuing individual public declarations along the following lines:

> The government of_______ wants to do its utmost to keep outer space free of weapons. It accepts the current military uses of outer space for surveillance, intelligence-gathering and communications. However, it is concerned by the prospect of weapons in space that can destroy objects in space, in the atmosphere, or on the surface of the earth and by the possibility of an arms race in such weapons. It wishes to maintain outer space for peaceful exploitation by all nations, as proclaimed in the Outer Space Treaty. The Treaty, however, prohibits only the orbiting or stationing in space of weapons of mass destruction, leaving a gap of coverage which should be filled.
>
> The government of_______ therefore commits itself not to be the first government to test, orbit or otherwise station any weapon in space.
>
> A "weapon" is defined as any device or component of a system designed to inflict physical harm through deposition of mass or energy on any other object. A weapon is considered to be "in space" if it orbits the earth at least once, or follows a section of an orbital trajectory before being accelerated out of that orbit, or has or will acquire a stable station at some point beyond earth orbit. The reference to acquiring "a stable station beyond earth orbit" is intended to cover stationing weapons in space or on celestial bodies in addition to orbiting them.
>
> The government of_______ also commits itself to cooperate with other governments issuing this declaration to develop effective methods of verifying this commitment, which will remain in force unless another

government or organization deploys, tests, orbits or stations a weapon in space.

RATIONALE

1. This declaration can meet one major motivation for the weaponization of space: the desire to prevent other states from doing so.

2. This approach is also designed to test the feasibility of a treaty to ban the weaponization of space. But this is a different approach than a proposal for negotiating a treaty on this subject, which would require consensus among the members of the Conference on Disarmament (CD). In contrast, no one can block individual statements.

3. The present approach does not seek an agreement that would prevent another state from acting in space. Instead, it would consist of voluntary declarations that would obligate only the issuing government.

4. A series of individual national declarations could lead to useful cooperation upon verification of the declaration among those governments making the declaration. Considerable ground- and space-based technology for verification of declarations is available. It includes means such as open source information analysis, Earth-based surveillance of space such as radar and electron-optic systems, pre-launch declarations and inspections, space-based surveillance of space objects by specialized satellites and on-board sensors mounted on space objects.

5. If all major space-faring states issued such a declaration, this would provide considerable protection to existing space assets. It would also provide a practical preparatory stage for negotiating a treaty prohibiting weapons in space.

6. If most space-faring states participated in issuing a declaration, but one major space-faring state refused to do so, this refusal would indicate that it is the sole government that insists on the option of orbiting weapons in space.

7. If a considerable number of space-faring countries made individual declarations, those governments could then draft a treaty banning the weaponization of space and promote such a treaty under considerably more favourable circumstances than those they would face if they tried to launch a draft treaty without advance preparation of this kind.

8. The proposed measure would only prohibit weapons in space that could destroy or damage objects in space, in the atmosphere or on the surface of the planet—weapons that could lead to competition and to an arms race in space. The proposed measure would not ban all military activity in space. It would not ban a wide range of satellites with military functions. It also would not ban the passage of missiles through space, space-based sensors, or ground-, sea- or air-based missile defence weapons. Nor would it ban anti-satellite (ASAT) weapons other than space-based ASAT weapons. There could be separate subsequent negotiation on ASAT weapons if states so desired, but including them at the outset would make it far more difficult to gain acceptance of the declaration.

9. The statement would become invalid if another government tested a weapon in space.

POSSIBLE QUESTIONS

1. *In the proposal, "space" is not defined, why not?*

   Instead of defining "space", "weapons in space" is defined, which are those that travel on a complete or partial orbit, or are placed at a stable point beyond Earth orbit.

2. *A space weapon is defined as "any device or component of a system designed to inflict physical harm through deposition of mass and/or energy on any other object." Is there a further definition?*

   Yes. A space weapon is a device operating in space with the aim to permanently damage or destroy another object in space, in the atmosphere or on the surface of the planet. In the interests of focusing on a workable definition, this definition of a weapon omits devices such as jammers that are not designed to inflict permanent damage.

3. *Is a "weapon" a separate device or part of another system?*

   It could be either, as long as it has the capabilities of a weapon to inflict physical harm. For example, a component that is part of a system not exclusively based in space, such as a relay for a ground-based laser, would be considered a space-based weapon.

4. *What would happen if my government makes such a declaration, but other space-faring states do not issue them?*

   To address this possibility, it would be reasonable to establish a rule at the outset specifying that after an individual government makes its declaration, it could withdraw its declaration if there are fewer than five participating states within a specific period of time—for example, two years—just as it could withdraw its declaration once it became clear that another state had deployed or tested a weapon in space.

5. *What would happen in the event of testing or deployment of a space weapon?*

   States could withdraw their declarations and/or take action to deploy weapons in space.

6 *How would it become known that a space weapon has been deployed if it is not tested in space, actually used or its use threatened?*

   It should be possible to verify the nature of a new orbiting or stationed object in space through a variety of agreed measures that might include pre-launch verification, pre-launch inspection, special verification satellites or verification and warning devices mounted on satellites used primarily for other purposes. Joint discussion of verification among those issuing a declaration would test whether these means would be effective.

7. *Nonetheless, verification is complicated. What would happen if the space-faring states that have issued unilateral statements are unable to agree on a verification system?*

   It could be agreed that, if cooperative efforts to develop a specific verification system are not successful within a set period of time—for example, three years—from the date of a fourth or fifth individual declaration, this situation would be grounds for withdrawing individual declarations.

8. *Why is it urgent that a declaration be issued now?*

The urgency is that the United States missile defence budget contains funds to establish a "test bed" to begin deploying a space-based kinetic kill weapon in 2007–2008. This action will effectively begin the weaponization of space and lead to competitive counteraction.

9. *Why should these statements be individual? Could a group of similar-thinking governments issue a joint statement?*

A joint statement is a possibility. However, it is probable that waiting for a group to assemble and for all to agree to act along identical lines would delay the action since one or more states could always object. A series of individual statements could provide momentum for the entire enterprise and might generate more publicity than a single event. It could also increase the total number of states making declarations. It is not necessary to wait for others, because the individual statements will be at no cost to the issuing country and can be cancelled if others do not cooperate or in the event of adverse developments.

CHAPTER 4

SPACE ASSURANCE OR SPACE WEAPONS

Michael Krepon

The United States has an important choice to make on whether to pursue space assurance or space weapons. Space weapons are defined here as devices that are designed and flight-tested to disrupt, impair or destroy objects in space, as well as devices based in space that are designed and tested to attack terrestrial-based targets. Space assurance is defined here as a policy choice to leave space unencumbered by weapons, so as to reap commercial and scientific benefits, as well as to reduce the scope and violence of armed conflict on Earth. Space assurance can be achieved by international norms, cooperative measures, codes of conduct, treaties and military hedges designed to prevent and deter dangerous military activities in space.

The flight-testing and deployment of space weapons by the United States would surely prompt low-cost, low-tech countermeasures in the form of space mines and other anti-satellite (ASAT) devices, just as the flight-testing and deployment of space weapons by other countries would surely prompt a vigorous response by the United States. A situation in which satellites orbiting the Earth are interspersed with objects designed to destroy or disable them is inherently destabilizing, given the vulnerability of satellites and the ease with which they could be harmed. Potential adversaries in space would be faced with the dilemma of shooting first or risking the loss of critical satellites.

The quest to secure dominion over space would therefore elevate into the heavens the hair-trigger postures that plagued humankind during the Cold War. The first use of space weapons would be a historic act, and could have catalytic effects in space, as well as on the ground. All states that derive benefits from satellites would be punished by space warfare, but none more so than the United States, which employs satellites for commercial, military, communications, early warning and intelligence functions. While space warfare would complicate US military operations, it would not alter the outcome of combat. Instead, asymmetric warfare by means of attacking US satellites would, in all likelihood, increase the severity and the collateral damage of warfare. All countries would lose more than they would gain by resorting to space weapons.

Even if the United States seeks to minimize the destructive effects of space warfare by using non-explosive techniques, other nations are likely to choose different standards for defending their national security interests in space. The debris and disruption caused by space weapons would thus result in extended impairment of global commerce that relies on satellites to transmit data, while producing environmental damage and creating hazards to space exploration. Companies that depend on space-aided commerce would be particularly hard hit by the flight-testing, deployment or use of space weapons. Insurance companies that cover space-related activities would look for less risky investments, or raise their rates appreciably.

There is a widespread international desire to avoid the flight-testing and deployment of space weapons. At the same time, a number of nations appear to be hedging their bets by engaging in research and development programmes that would allow them to compete effectively in the event that another country crosses these thresholds first. Only one country—the United States—has publicly endorsed a doctrine of "space dominance" that includes "space force application". The full fruition of this doctrine would deepen fissures in alliance ties and relations among major powers, whose assistance is most needed to form "coalitions of the willing" to stop and reverse proliferation.

The choice between space assurance and space weapons is therefore fundamentally important since it will shape the contours of international security, global commerce, alliance ties and relations between major powers. The United States and other countries cannot have it both ways: the flight testing and deployment of space weapons will come at the expense of space assurance, and space assurance is undermined by the pursuit of space weapons.

The United States' choice is therefore stark and clear: it can either take the initiative to flight-test and deploy space weapons on the assumption that conflict in space is inevitable or useful, or it can seek to reinforce an interlocking network of restraints designed to avoid the crossing of these key thresholds. US restraint, however, would not ensure similar restraint by others. Indeed, potential adversaries might mistakenly conclude that they could gain advantage by covertly developing, flight-testing and then using space weapons against the United States first.

The execution of a surprise attack against the United States in space would generate a response no less resolute than previous surprise attacks in December 1941 and September 2001. Nonetheless, to further clarify the penalties to others for the first use of space weapons, the United States would be wise to adopt a hedging strategy that includes research and development—but not the flight-testing and deployment—of space weapons. As noted above, other nations are similarly poised to engage in such a competition, if it is deemed necessary to do so. There is no compelling need, however, to engage in the flight-testing and deployment of dedicated space weapons, in part because many nations already possess military capabilities designed for other missions that could, in extreme circumstances, serve as a response to the first use of space weapons by another state. Such “residual” space warfare capabilities have paradoxically served as a brake against the flight-testing and deployment of space weapons in the past.

The weaponization of space is not inevitable. If it were, it would have occurred during the Cold War. Rather than engaging in such a competition now, a far wiser course would be to strengthen efforts to promote space assurance. Key elements of a space assurance posture include unilateral initiatives that enhance situational awareness in space and reduce satellite vulnerability; research and development programmes that deter others from crossing key thresholds and hedge against adverse developments by potential adversaries; and cooperative measures, international agreements and codes of conduct for responsible space space-faring nations. Cooperative measures, including information exchanges and greater transparency regarding space launches and payloads, could lend credence to declaratory statements of peaceful intent, while also serving to clarify threatening and destabilizing activities in space. Transparency measures must be sufficient enough to alleviate concerns over worrisome activities, particularly that military capabilities designed for other purposes are not being tested in ways that are virtually indistinguishable from preparations for space warfare. If states are sufficiently concerned about the weaponization of space, they will agree to significant, intrusive and broad-ranging cooperative and transparency measures.

Cooperative behaviour could be codified in bilateral or multilateral executive agreements as well as in treaty form. Alternatively, cooperative behaviour might result from quiet consultations that do not yield written accords of any kind. It makes sense to accomplish what is politically feasible and useful first, while still pursuing other avenues of cooperation in space that are not yet ripe for accomplishment. The pursuit of initiatives that are unlikely in the short term—such as an international convention banning certain destabilizing activities in space—could still have utility, as this effort would demonstrate global sentiment in favour of space assurance and against the flight-testing, deployment and use of space weaponry. If a bipartisan consensus in Washington in favour of space assurance and against space weapons is not forthcoming, the clarification of this choice elsewhere—particularly among US allies, friends and major powers—has particular value.

While many countries have used space to support military operations, no weapons are deployed in space; interactive ASAT testing during the Cold War ended two decades ago, and no satellites have been destroyed in warfare. Thus, the weaponization of space is certainly not inevitable, unless this mindset holds sway.

The potential for space warfare has long existed in the form of long-range missiles carrying nuclear weapons, as well as additional weapon systems designed for other missions, such as missile defence interceptors. These latent or residual capabilities have not led inexorably to an arms race in space. To the contrary, these residual capabilities serve as hedges against unwelcome and unwise decisions by potential adversaries. Residual capabilities to engage in space warfare will continue to exist and serve as a necessary hedge against unwelcome surprises as well as an alternative to dedicated platforms designed for space warfare. Existing military capabilities designed for other missions that could be used for space warfare do not impair space assurance, as long as they are not tested in ways that mimic space warfare.

By virtue of its leadership position in space commerce and military power, the United States has unprecedented leverage to shape whether the peaceful conditions that now exist in space are maintained, or whether space becomes weaponized. If the United States exercises restraint in the flight-testing and deployment of space weaponry, while maintaining readiness to respond if others do so first, there is a reasonable chance that these thresholds will not be crossed. If, however, the United States takes the lead in flight-testing and deploying space weaponry in the vain pursuit of still greater military supremacy, Washington will find little diplomatic support and much low-tech competition. As a consequence, by initiating the weaponization of space, Washington will find itself isolated diplomatically while placing still greater burdens on US armed forces.

The salience of space weapons will remain low if such techniques are not flight-tested or deployed. Given the extraordinary and growing differential in power that the United States enjoys in ground warfare, sea power and air power, it is hard to find compelling arguments for seeking to supplement these advantages by weaponizing space. If the United States pushes to extend its pronounced military dominance into space, others are likely to view this pursuit through the prism of the Bush Administration's national security strategy, which places emphasis on preventive war and pre-emption.

Existing accords, regulatory regimes and treaties provide the building blocks for a space assurance regime. Key elements of a space assurance regime can be found in the 1967 Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water (the Outer Space Treaty), the 1968 Agreement on the Rescue of Astronauts the Return of Astronauts and the Return of Objects Launched into Outer Space (the Astronaut Rescue Agreement), the 1972 Convention on International Liability for Damage Caused by Space Objects (the Liability Convention), the 1975 Convention on the Registration of Objects Launched into Outer Space (the Registration Convention), and the 1979 Agreement Governing the Activities of States on the Moon and other Celestial Bodies (the Moon Agreement).

The cornerstone of space assurance remains the Outer Space Treaty, which provides the basic framework on international space law, including the strictures that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind; that outer space shall be free for exploration and use by all states; that nations shall not place nuclear weapons or other weapons of mass destruction (WMD) in orbit or on celestial bodies or station them in outer space in any other manner; that the Moon and other celestial bodies shall be used exclusively for peaceful purposes; that nations shall be liable for damage caused by their space objects; and that nations shall avoid harmful contamination of space and celestial bodies. The Outer Space Treaty also establishes the principle that governments are responsible for space-related activities carried out within national borders and for assuring treaty compliance "whether such activities are carried on by government agencies or by non-governmental entities". When space activities are undertaken by international consortia, responsibility for compliance "shall be bourne both by the international organization and by the States Parties to the Treaty participating in such organization".

One value of adding to treaty-based prohibitions on space warfare lies in the strengthening of international norms that define unacceptable behaviour in space. Treaty regimes, when combined with military capabilities to deny gains or to punish violators, have more of a salutary deterrent effect than either would have in isolation. Deterrence is further enhanced when treaties contain intrusive monitoring provisions and complementary transparency measures. When deterrence by means of treaty constraints and supplementary military capabilities fails, treaty signatories are on much firmer ground in taking compensatory military steps than in the absence of treaty norms.

Negotiating a multilateral treaty prohibiting space warfare in general and ASAT tests in particular will not be easy. The forum in Geneva established for this purpose, the Conference on Disarmament (CD), now has 66 members and operates by consensus. The United States has opposed a negotiating mandate for space arms control, and appears reluctant even to engage in preliminary discussions on this subject. Several nations are likely to be uncomfortable with the transparency measures necessary to provide assurance of compliance and early warning of troubling activities. Nor will it be simple to construct a widely acceptable, common sense definition of what constitutes the acts of space warfare to be prohibited. The mix of monitoring arrangements and transparency measures sufficient to verify that prohibited activities are not being carried out also poses a significant challenge.

If the CD remains deadlocked over space arms control, then a single state or a grouping of states might decide to take the lead in tackling these difficult questions. The model here would be the Government of Canada's role in promoting an international convention banning the use of landmines. The "Ottawa process" was given a significant boost by the technical inputs and energy provided by non-governmental organizations that convened alongside governmental experts. The advantage of this approach is that a coalition of the willing would not be constrained by the requirement for a diplomatic consensus. The disadvantage is that some key states could be absent from the drafting process and would feel no compulsion to join the draft agreement.

An alternative or complementary approach would be to pursue a code of conduct or agreed "rules of the road" for responsible space-faring nations. The resulting accords could take the form of bilateral or multilateral executive agreements. During the Cold War, the United States entered into executive agreements with the Soviet Union to prevent dangerous military practices at sea, on the ground and in the air. Comparable cooperative measures could also provide useful building blocks for a space assurance regime.

A model code of conduct for responsible sea-faring nations was negotiated in 1972 after a series of highly dangerous military manoeuvres between US and Soviet combatants and naval aircraft. The 1972 Agreement Between the Government of The United States of America and the Government of The Union of Soviet Socialist Republics on the Prevention of Incidents On and Over the High Seas ("Incidents at Sea" agreement) established important rules of the road. These include avoiding collisions at sea; not interfering in the formations of the other party; avoiding "maneuvers through areas of heavy sea traffic where internationally recognized traffic separation schemes are in effect"; requiring that "ships engaged in surveillance of other ships shall stay at a distance which avoids the risk of collision and also shall avoid executing maneuvers embarrassing or endangering the ships under surveillance"; using mutually agreed signals when ships manoeuvre near one another; not simulating attacks at, launching objects toward, or illuminating the bridges of the other party's ships; informing vessels when submarines are exercising near them; requiring the greatest caution and prudence in approaching aircraft and ships of the other party; and not permitting simulated attacks against aircraft or ships, performing aerobatics over ships, or dropping hazardous objects near them. The US–Soviet Incidents at Sea (or INCSEA) accord has served as a model for comparable agreements signed by more than 30 other navies.

Another bilateral accord of particular relevance to the establishment of a space assurance regime is the 1989 Prevention of Dangerous Military Activities Agreement, which focused on four specific categories of "dangerous military activity", including "interfering with command and control networks in a manner which could cause harm to personnel or damage to equipment of the armed forces of the other Party" as well as the use of lasers "in such a manner that its radiation could cause harm to personnel or damage to equipment of the armed forces of the other Party." It established procedures to deal with border or boundary incursions, including the provision of designating "special caution areas".

The pursuit of a code of conduct or rules of the road for responsible space-faring nations might draw and expand upon these sensible provisions. This effort would need to surmount many challenges, including how to define what constitutes dangerous military practices in space and how to devise suitable transparency measures to provide assurance of compliance or to warn of possible non-compliance. While executive agreements have the same standing as treaties in international law, this approach, even if widely replicated, is unlikely to be as inclusive as a multilateral treaty negotiated at the CD. As with efforts to negotiate an international convention, important space-faring nations might not choose to join. The choice between rules of the road and an international convention is not mutually exclusive. To the contrary, executive agreements establishing a code of conduct to prevent dangerous military practices in space could facilitate the eventual negotiation of a multilateral treaty that is more ambitious in scope.

None of these approaches will find favour with those in the United States who seek maximum freedom of military manoeuvre in space. In this view, space provides the means for quick, lethal strikes in regions that are currently remote to US power projection. US advocates of "capturing the high ground" view space as a medium in which opposing WMD could be neutralized, where information warfare could be waged and where US military dominance could be accentuated into the indefinite future. An essential corollary to this view is that weaker adversaries would seek to nullify US military superiority by attacking or disabling US space assets that have become essential for the conduct of military operations. Supporters of a space dominance posture argue that, precisely because potential adversaries are so disadvantaged in terrestrial confrontations with the United States, they will engage, perhaps covertly, in the flight-testing and deployment of space weaponry. In this view, a surprise attack in space by a far weaker foe could have significant adverse impacts for the United States. Moreover, because the first use of space weaponry could have such deleterious impacts, weaker adversaries would not follow the US example of restraint. The 2001 *Report of the Commission to Assess United States National Security Space Management and Organization (The Rumsfeld Space Commission)* reflects this perspective.[1]

By definition, any military or terrorist actions against the United States would constitute asymmetric warfare, given the overwhelming military superiority the United States now enjoys. Concerns over asymmetric warfare are completely warranted and steps need to be taken to reduce US vulnerabilities on the ground as well as in space. However, paranoia and worst-case thinking makes prioritization difficult: disruption in space is far more likely to happen as a result of a computer hacker than from a space mine or an ASAT. Attacks to critical infrastructure—including ground stations that control satellites—offer relatively low barriers to entry, multiple paths of disruption and greater potential difficulty in assessing responsibility for the crime. Adversaries would be far more likely to carry out sneak attacks against the United States in cities, ports and wherever the American flag is flown abroad, than to engage in surprise warfare in space.

The weaponization of space is an environmental as well as a national security issue. The environmental degradation of space created by space-faring nations constitutes a danger to space exploration, the space shuttle and other peaceful uses of space. Space litter also poses difficulties for the military uses of space. The weaponization of space, particularly with respect to the flight-testing of ASAT weapons, would greatly compound existing concerns over safe passage. In the event of a resumption of ASAT tests, the Pentagon would attempt to mitigate space debris, as it does with respect to missile defence tests. Other states that test ASATs might not be as conscientious about debris mitigation. The actual use of ASATs would compound these dangers exponentially. Debris fields in the upper reaches of space could be more long lasting than environmental degradation on Earth. Traffic management and debris mitigation efforts are essential components of space assurance.

In conclusion, the United States and the international community face a fundamental choice in the years ahead. That choice is between space assurance or space weapons. If space becomes another medium for deploying weapons of any kind, hair-trigger postures that plagued policy makers and humankind during the Cold War will be elevated into the heavens. The weaponization of space would impair global commerce and scientific exploration, while increasing the severity of warfare on Earth. It would also weaken US alliances and ties with major powers that are essential to counter proliferation. Without question, the United States and the international community have more to lose than to gain by flight-testing and deploying space weapons.

The weaponization of space was avoided during the Cold War, even though both superpowers jockeyed for military advantage on virtually every other front. Space weaponry can also be avoided in an era of US military supremacy—if Washington exercises restraint, adopts prudent hedges and joins others in diplomatic efforts to pursue space assurance. By advancing the peaceful uses of space rather than weaponizing this realm in previous decades, the United States and other countries have reaped extraordinary rewards. Any nation that initiates the weaponization of space, would invite the forfeiture of these benefits.

The choice before us is either space assurance or space weapons. The flight-testing and deployment of space weapons would beget space mines. ASATs would beget more ASATs. The side that shoots first in space would cross a critical threshold in the history of combat, without realizing significant or long-lasting benefits. A far wiser course would be to refrain from crossing the critical and verifiable thresholds of flight-testing and deploying space weapons. A restraint regime of this kind would require transparency measures and cooperative monitoring by China, India, Japan, the Russian Federation, the United States and other space-faring nations.

There is much to do here on Earth to deal with the challenges of environmental degradation, terrorism and proliferation. New impulses are needed to widen the benefits of economic security, pursue comprehensive threat reduction, enhance regional security, repair alliances and improve relations among major powers. The flight-testing and deployment of space weapons adds nothing to and subtracts much from this far-reaching agenda. The time is ripe to think creatively and to act energetically to build barriers against the weaponization of space.

Note

1 United States, 2001, *Report of the Commission to Assess United States National Security Space Management and Organization*, Washington, DC, Government Printing Office.

CHAPTER 5

SPACE DEBRIS: NEXT STEPS[1]

Theresa Hitchens

No one with a stake in the future of outer space would dispute the fact that near-Earth orbit has become increasingly populated with man-made junk. Space debris is the inevitable consequence of the global uses of space—every single space launch will create some amount and form of debris, just as every kind of public transport on Earth creates some amount and form of pollution. Most space scientists and operators have long recognized that pollution in space, like pollution on Earth, is dangerous. But, as with environmental problems on Earth, there remain challenges to characterizing the exact nature of the debris problem, as well as disagreements about the gravity of the situation and how best to address it. One thing that is certain is that failure to stem the creation of space debris will undercut the security of all assets in space, increasing the likelihood of collisions and possible conflict over liability for them.

The official catalogue of space objects kept by the US Air Force's Space Surveillance Network (SSN) contains about 9,000 objects, but the Air Force also tracks approximately 4,000 other objects whose origins and exact orbits are not yet confirmed. Although there is no unclassified, publicly available data on exactly how many operational satellites are orbiting at any one time,[2] US officials say that only about 6% of those 13,000 objects being watched are working satellites or spacecraft, such as the International Space Station. The rest is debris.[3]

Worse yet, the debris now tracked represents only a small fraction of the junk in orbit. Most space debris is smaller than 10cm—too small to be verifiably detected and followed with current technology.[4] Space scientists estimate that there are more than 100,000 objects between 1cm and 10cm in size—that is, larger than a marble—and perhaps trillions of pieces that are smaller yet.[5] Space debris is concentrated in the two orbits that are most useful for human space operations: Low Earth Orbit (LEO) is defined as between the ceiling of the Earth's atmosphere from around 100km to 1,000–2,000km in altitude; Geosynchronous Orbit (GEO) is roughly 36,000km above the Earth and where satellites essentially remain stationary over one spot on the ground.

Space debris is dangerous because of its potential to collide with and damage satellites and/or spacecraft. Even tiny pieces of debris such as paint flecks measured in millimetres can cause destruction. Debris is so dangerous because objects in orbit move at extremely high speeds—about 10km per second in LEO[6]—thus relative velocities and the energy generated at impact can be very high. In fact, NASA must replace one or two Space Shuttle windows after each mission as a result of damage by small pieces of debris.[7] "We get hit regularly on the shuttle", Joseph Loftus, then assistant director of engineering for NASA's Space and Life Science Directorate, as quoted by *space.com* in September 2000, noting that, as of that time, more than 80 shuttle windows had been replaced because of debris impacts.[8]

Debris can also be a danger to people and things on the ground, as some space junk in LEO will eventually de-orbit, pass through the atmosphere and land. Although such landfalls are rare, they do happen when very large space objects de-orbit. For example, large pieces of Skylab fell over Western Australia in July 1979; in April 2000, pieces of a Delta 2 second stage rocket fell over Cape Town, South Africa.[9] Debris—as well as the ever-increasing population of active spacecraft and satellites—can further interfere with astronomical observations by creating a form of light pollution (just like satellites or spacecraft, debris pieces can reflect sunlight and clutter efforts at sky mapping). Light pollution is not only a problem for civil astronomy, but also for military efforts at space surveillance, since tracking and monitoring space objects relies in large part on optical telescopes.

In yet another parallel with pollution on Earth, it is much easier to prevent space debris than to clean it up. Indeed, currently there are no technologies that can reliably "clean up" space junk put up in decades past. Unfortunately, although preventing the creation of debris might be simpler than removal, it is not easy since it would require operators to incorporate special design features into their spacecraft or satellites. Nonetheless, many space-faring nations and commercial interests have woken up to the need for debris mitigation caused by concerns that if nothing is done now, certain highly useful orbital planes might no longer be safe for satellites and spacecraft.[10] For example, the International Space Station is moved at least four times a year to avoid debris collisions.[11] Certainly, with the high costs of launching and maintaining satellites—not to mention the costs of insuring them—commercial firms have no desire to see space become more cluttered with potentially damaging debris.

Many of the major space-faring powers (including the European Space Agency, France, Japan, the Russian Federation and the United States) have put regulatory standards into place aimed at limiting the creation of debris from government-sponsored space operations; and other nations (such as China and India) are working to put into place similar "good practices". The various debris mitigation standards now in place are similar, including limiting the amount of debris produced from normal operations, such as throwaway orbital stages or components; burning off fuel at the end of a satellite's mission life; and removing non-operational spacecraft and rocket stages from orbit, either by de-orbiting objects in LEO (over a certain time) or boosting them up and out of the way into a so-called "graveyard" orbit for objects in GEO.[12]

However, these national efforts vary in scope and in application—some, for example, contain exemptions that allow waivers if a certain mitigation practice is deemed too expensive. Moreover, some space-faring powers still have not completely embraced the idea of mitigation practices, concerned that added costs might hamper their ability to develop competitive space industries.

Another problem is that not all space operations or operators are "national" in nature. Indeed, there are a growing number of international consortia launching and operating commercial satellites. One company, SeaLaunch, launches from ocean platforms and thus technically does not necessarily work within any nation's "territory". The global nature of the industry not only has resulted in debate about which nation state is responsible for licensing multinationals—not to mention which state bears liability under the Liability Convention—but also, even more generally, the international community continues to argue about what the term "launching state" actually means. In this way, space is very much like the high seas, where regulating shipping has been complicated by the ease at which shady operators "change flags".

Armel Kerrest, a French specialist in international law, wrote:

> The problem is that, by nature, outer space activities are international, they take place in an international space, involve international consortia, may be located in international domain (etc.). Moreover, mitigating space debris creation is very expensive, when private activities are concerned, there is good reasons [*sic*] to think that, given the competition, some entrepreneurs will try to avoid those measures by conducting their activities under a more favorable law. Doing so, they will get a great competitive advantage. It is already the case for sea activity; why should it be any different for outer space?[13]

In an attempt to "internationalize" an approach to debris mitigation, the United Nations and the Inter-Agency Space Debris Coordination Committee (IADC) are attempting to develop coordinated, international debris mitigation guidelines. Space debris has been on the agenda of the Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) since 1994, with COPUOS issuing the Technical Report on Space Debris (A/AC.105/720) in 1999.

The IADC comprises the space agencies from China, France, Germany, India, Italy, Japan, the Russian Federation, Ukraine, the United Kingdom and the United States, plus the European Space Agency (ESA). It was established in 1993 as an information exchange group. In 2001, COPUOS asked the IADC to develop and submit a set of voluntary international guidelines that might eventually be adopted by COPUOS and the United Nations at large. On 29 November 2002, the IADC submitted the guidelines to COPUOS, for consideration at the committee's 17–28 February 2003 session in Vienna, Austria. It was originally expected that COPOUS would endorse the guidelines in 2004; however, several nations—particularly India, which has been somewhat sceptical of the international efforts at mitigation, and the Russian Federation—have submitted comments asking for changes that require renewed IADC discussions. As both the IADC and COPUOS work on the basis of unanimity, some compromises will need to be found. Officials now are hoping that the IADC guidelines can be agreed at the next meeting of the COPUOS Science and Technical Subcommittee in 2005.[14]

The IADC guidelines ask nations to limit debris released during normal space operations, minimize the potential for on-orbit break-ups, undertake post-mission disposal and prevent collisions. In addition, the IADC recommends that a space debris mitigation plan be put together for each space project, and asks nations to voluntarily report—beginning in 2005—on mitigation efforts.[15]

However, the guidelines are voluntary, and thus include no legally binding requirements for those who adopt them. The guidelines do not recommend how nations should implement and enforce them, nor do they suggest how nations should integrate them into their current processes for approving space launches. Therefore, some experts worry that the IADC measures will simply not be enough.

For example, only about one-third of space operators now regularly boost dead spacecraft in GEO to a graveyard orbit at least 300km higher for disposal, according to Walter Flury, director of the space debris programme at ESA.[16] Only 22 of 58 non-functioning satellites in GEO were put into graveyard orbits between 1997 and 2000, according to research by ESA's European Space Operations Centre.[17]

What is the key reason for non-compliance with best practices? Costs. For example, GEO boosting could cost a company "hundreds of millions of dollars in lost revenue", according to a story in the *Edmonton Journal*.[18] While most debris mitigation measures are not extraordinarily expensive if included during a satellite's design, the small profit margins afforded to space launch firms and the competitive global market mean that achieving compliance with voluntary guidelines might be difficult.

"It is unlikely that voluntary application of mitigation measures will solve the space debris problem", Flury said, "Just think about the commercial sector of space activities with its competitive character."[19]

So what should be done? A number of actions could be taken by the international community to build upon and improve the IADC effort:

- COPUOS should adopt the IADC guidelines as soon as possible, followed by a UN resolution to enshrine them. Further, as part of the agreement to follow the guidelines, each signatory should pledge not to use launch services of countries or companies that do no comply with the guidelines. Signatories should also agree to share technology needed to enable the guidelines to be followed, with a special emphasis on helping developing nations defray costs.

- Member States of the United Nations should be encouraged to develop national legislation on space activities to incorporate the IADC guidelines into processes for launching and operating satellites.
- The COPUOS Legal Subcommittee, with the IADC, should begin work to develop recommendations to harmonize national regulations regarding debris mitigation practices and licensing processes standard to a specific minimum degree that could be put into place in 5 to 10 years time.
- The International Organization for Standardization (ISO) should continue its work with IADC (under ISO/TC20/SC14 7th Working Group) to develop underpinning engineering methods for implementation of the guidelines, including looking at the most cost-effective methods for achieving them.
- Recognizing that ISO standardization could take many years, United Nations Members States should in the near-term be encouraged to develop national standards for applying the IADC guidelines—for example, NASA already has such standards for applying the US mitigation guidelines—as a minimum approach to debris mitigation.
- The COPUOS Legal Subcommittee should be tasked with developing, by 2014, international legal standards for debris mitigation to be applied to all space operators under an international treaty that eventually could be negotiated under the auspices of the United Nations.
- Consideration should be given to how the Liability Convention might be amended with new provisions aimed at creating penalties for space operators whose failure to accept or comply with the internationally recognized debris mitigation guidelines results in debris creation or collisions.
- The international community needs to continue to develop better debris tracking technologies, methods and networks in order to improve collision prediction. In particular, there is a need to develop capabilities other than the US Space Surveillance Network to provide continuity of data to the international community and transparency. COPUOS should establish a working group to consult with amateur space tracking networks, such as SeeSat, to explore the feasibility of an open, publicly available space surveillance network and database.

Obviously, some of these suggested measures (particularly those that involve trying to create legal international standards) are likely to be controversial and time consuming to develop and implement. However, this is all the more reason for beginning efforts at the national level now. Ultimately, though, it must be recognized that outer space—like the Earth's atmosphere—is a global resource that must be protected by all if it is to be preserved for the benefit of all.

Notes

1 This presentation is drawn from a larger monograph on "Future Space: Charting a Secure Course", to be published by the author under a generous grant from the Carnegie Corporation of New York.
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13 Armel Kerrest, *Space Debris, Remarks on Current Legal Issues*, presented at the Third European Conference on Space Debris, Darmstadt, 19–21 March 2001, ESA SP-473, vol. 2, p. 869, October 2001, at <fraise.univ-brest.fr/~kerrest/IDEI/debris-Darmstadt.pdf>.

14 E-mail exchange with an official involved in the IADC and COPUOS discussions, 5 March 2004.

15 *Inter-Agency Space Debris Coordination Committee Space Debris Mitigation Guidelines*, 2002, op. cit., section 5.2, p. 8.

16 Written answers to questions from the author to Walter Flury, director of the space debris programme at ESA, Paris, 24 July 2003.

17 *Garbage Mountains in Orbit*, ESA news release, Paris, 23 March 2001.

18 Andrew C. Revkin, Highway Patrol: Outer Limits: The final frontier is becoming cluttered with garbage and satellites. Scientists are trying to set some ground rules for controlling pollution and traffic in space, *Edmonton Journal*, 2 March 2003, D9.

19 Flury, op. cit.

CHAPTER 6

RISK REDUCTION AND MONITORING IN OUTER SPACE

Jürgen Scheffran

Space is increasingly used for a variety of purposes, which leads to a growing dependence on space objects. For the largest space power, the United States, this dependence translates into vulnerability that contains the threat of a space "Pearl Harbor". This paper discusses options to reduce this threat through a combination of risk reduction measures, arms control and monitoring.

RISKS AND RISK-REDUCTION FOR SPACE OBJECTS

Space objects are designed for a hostile space environment that is characterized by vacuum, radiation, temperature extremes and a limited energy supply. They also must survive the strains of launch and sometimes the stress of re-entry. Space systems can fail as a result of a variety of reasons: component failure and degradation; design, development, production, programming or mission errors; interruption of ground communication caused by accidents, jamming or ground attacks; collision with space debris; physical attack; blinding of sensors; hacking; deception; or hijacking.

In a concrete case, it might be difficult to trace a system failure back to a specific cause, which in many cases could be space debris. More than 8,000 man-made objects larger than 10cm orbit around the Earth, including operational satellites (approximately 7%), rocket bodies (approximately 15%) and space debris (fragmentation and defunct satellites 78%). It is difficult to track all space activities and distinguish between harmless and potentially threatening objects and activities.

Vulnerabilities and threats would be considerably increased with advanced space weapons, such as manoeuvrable satellites, space mines, micro-satellites, kinetic kill vehicles, chemical and nuclear explosives, or particle, microwave and laser beams. They would contribute significantly to the complexity and instability of the strategic situation, which ultimately would not serve the security interests of any country, including the United States.

To some degree, the survivability of space objects against some of the potential attacks can be increased by passive or active protection measures including the following:

- autonomy from ground control to reduce the risk of communication failure or interruption;
- provisions for quick replacement of crucial satellites in case of a failure or attack;
- physical hardening against nuclear and laser radiation, or collision with small objects;
- attack warning sensors and sensor shutdown on-board of important spacecraft;
- redundancy and distribution of important functions to several satellites (clustering);
- evasion manoeuvres to escape a potential physical threat; and
- deception of attacking sensors and shoot back capabilities.

Some of these measures are costly and do not provide security against all kinds of attacks and technologies. For the most important satellites in the United States, some or all of these measures have already been implemented. Within the existing framework of international space law, confidence-building measures can contribute to stabilizing international security including:

- advanced notification and more detailed information about space launches and experiments (for example, with lasers);
- establishment of a crisis hotline between major missile and space powers;
- a code of conduct for responsible space behaviour, learning from the ongoing process of the Missile Technology Control Regime (MTCR);
- improved international monitoring system and information exchange; and

- strengthened international space cooperation that improves transparency and reduces incentives for indigenous space development.

In addition, rules of the road could be agreed for outer space:

- keep-out-zones, minimum flyby distances and speed limits around satellites to increase warning time against attack and reduce efficiency of attack;
- satellite immunity and non-interference with satellites; and
- reduction of space debris.

A combination of satellite hardening, confidence building and rules of the road might better protect satellites against existing residual (non-dedicated) space threats such as attacks with intercontinental ballistic missiles (ICBMs) and manoeuvrable satellites, with radio or laser beams not explicitly developed for weapon purposes. High-altitude nuclear explosions are a severe risk for all electronic components in space, not just from direct impact but even more so from captured radiation in the Van Allen radiation belt.

ARMS CONTROL MEASURES

If dedicated space weapons based on new technologies are developed, the existing regime would not be sufficient enough to substantially diminish the emerging threats. Additional risk reduction could be achieved by partial arms control measures, which by agreement would restrict or ban certain kinds of weapons or weapon uses. For example, these could include the following:

- A ban on testing, deployment and use of weapons above a specific altitude would relegate weaponization to low-Earth orbits and keep the remaining outer space a weapon-free zone. Possible altitudes range from 500 km to 5,000 km in order to protect space objects beyond that range. Protecting high-orbit navigation satellites and geostationary communication and early warning satellites is of greatest importance to military and commercial interests. However, allowing weapons development in low-Earth orbits could open the door to space weaponization, and it would not preclude the development of sophisticated low-Earth orbit weapon systems that could later be extended to higher orbits.

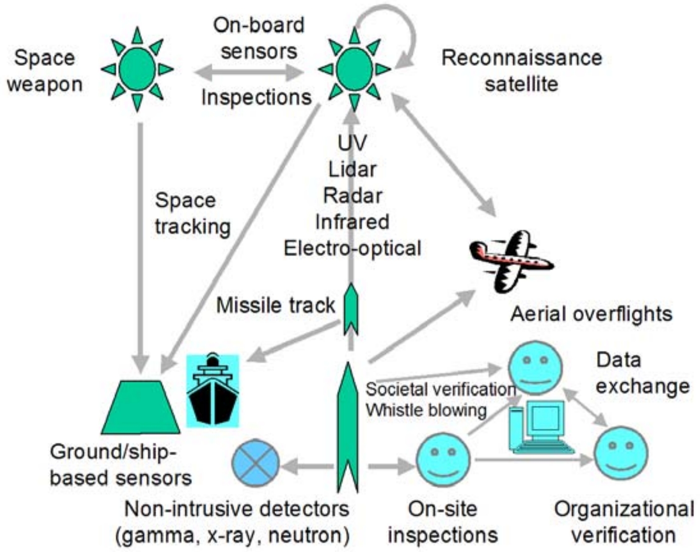
- The legal and physical protection of manned missions and the prohibition of manned military space operations could prevent people from being involved in space warfare. Most important, it would protect manned space stations by maintaining keep-out zones and shielding them against space debris and some forms of attack.
- Certain types or deployment modes of space weapon systems and technologies could be banned—in particular, ASAT or BMD systems, or weapons with a predominantly offensive role. Laser and other kinds of beam weapons could be excluded, whether ground-based or space-based. Small satellites below a specific size limit (for example, 10cm) or weight limit (for example, 10kg) could be restricted.
- States could restrict particular stages in the life cycle of a weapon such as research, development, testing, production, deployment or use. For example, an ASAT testing moratorium has been maintained since the mid-1980s between the United States and the Soviet Union (and now the Russian Federation). A ballistic missile flight test ban was also discussed.
- Specific limits on interception speeds and altitudes or the size of mirrors and power levels could be agreed.
- Partial arms control measures could be embedded into more comprehensive arms control regimes in space, including a global ban on weapons against objects in space and from objects in space against any target. Several proposals have been outlined in the last two decades.

MONITORING AND VERIFICATION

Any agreement would need some degree of verification, and even without agreement there is a need for improved monitoring of space activities. Although space is large, it is transparent and allows for remote tracking, surveillance and observation of suspicious activities on the Earth and in space with optical, infrared, radar, electronic, electromagnetic and other technology. Since all space objects are launched from the Earth, they are visible to space tracking systems, which can be complemented by inexpensive pre-launch verification measures—for example, on-site inspection of payloads or societal verification/whistle-blowing. A multitude of technologies and procedures could be employed to monitor space activities and verify space arms control, including the following (see Figure 1):

- For several decades, the United States has been maintaining a global Space Surveillance Network (SSN) under the control of the United States Space Command to detect, track, catalogue and identify all objects larger than 10cm in Earth orbit, with a primary interest in operational satellites. The SSN includes United States Army, Navy and Air Force operated ground-based phased-array and conventional radars and optical sensors (telescopes) at 25 sites worldwide. The Ground-Based Electro-Optical Deep-Space Surveillance System telescopes are upgraded to cover objects 5cm or larger. Russia operates a similar but less capable system. The European Space Agency maintains the European Space Research Organisation Tracking and Telemetry Network to track their own satellites and those of their industrial customers.
- Reconnaissance systems are suitable tools for verification purposes. These include early infrared warning satellites to detect space launches of missiles and rockets; reconnaissance satellites with optical cameras, infrared or microwave sensors to observe suspected ASAT facilities such as launchers, rockets or laser systems; and ground-, air- and space-based electronic and electromagnetic surveillance systems to intercept communication signals of suspicious facilities, which could with some probability also receive telemetry signals of prohibited weapons tests in space.
- On-board sensors on important satellites could collect pressure, acceleration, heat, and radiation data and notify ground control of any deviation from the expected status. In case of a satellite failure, the sensor data could help to determine the failure cause and exclude or confirm the likelihood of an attack.
- Inspectors could verify on-site production launch and infrastructure facilities on Earth; more permanent verification could be facilitated by observers as well as by on-site monitoring instruments and detectors. On-site inspections could be conducted in space by using dedicated remote control or manned verification spacecraft. Human intelligence and societal verification—including whistle-blowing—would add to the reliability of the verification results.
- Prohibiting interference, deliberate concealment measures and encryption that impede verification would minimize the likelihood that cheating of the treaty provisions would go unnoticed.

Figure 1. An integrated monitoring system for space arms control



Many of these systems could be integrated into an International Monitoring System, which would include a variety of global verification means and make relevant data available to all states that are part of an agreement. Each of the systems has its strength and the combination of the systems covers the diversity of activities to be monitored (see Table 1).

The highest monitoring priority would be the identification of any interference with or attack on early warning satellites since this would be a strong indicator of a forthcoming more extensive attack. As a result of the inherent dual-use potential of space objects, a particular challenge to verification is posed by the potential overlap of permitted capabilities of space objects with prohibited capabilities. Generally, the expenditures for verification should be assessed in relation to the expected security gains and the risk posed by an activity. The further the development and testing of relevant systems advances, the more the costs for eventual verification will increase and the reliability of verification will decrease. Thus, a test moratorium for space weapons would be important to stop development at an early stage, which would also facilitate verification.

Table 1: Comprehensive coverage of an integrated space monitoring system

Verification means / Activities	Remote sensing	On-site sensors	Data exchange	Over flights	Inspections	Space tracking	Institutional verification	Societal verification
NW use in space								
NW deployment in space								
Missile test								
Missile disarmament								
Transformation of space launcher								
ASAT test								
ASAT use								
BMD test								
BMD deployment								
BMD capability								
Space weapon in orbit								
Space debris								

NW = nuclear weapon; BM = ballistic missile; ABM = anti-ballistic missile; ASAT = anti-satellite

FURTHER READING

R. Hagen and J. Scheffran, 2003, Is a space weapons ban feasible? Thoughts on technology and verification of arms control in space, *Disarmament Forum*, no. 1, pp. 42–51.

J. Scheffran, 1999, Options for Rules in Outer Space, *INESAP Bulletin*, no. 20 (August), pp. 9–14.

CHAPTER 7

SPACE AND SECURITY: EXISTING INTERNATIONAL LEGAL FRAMEWORK

Lucy Stojak

Within a year after the launch of Sputnik I, the UN General Assembly recognized that “outer space should be used for peaceful purposes only” and expressed the wish “to avoid the extension of national rivalries into this new field”. In 1958, the General Assembly created an ad hoc Committee on the Peaceful Uses of Outer Space (COPUOS) by a resolution entitled Question of the Peaceful Use of Outer Space.[1] The ad hoc COPUOS obtained permanent status in 1959 pursuant to resolution 1472 (XIV) of the General Assembly.[2]

Throughout the 1960s, numerous General Assembly resolutions were passed, all stressing the “common interest of all mankind” in the exploration and use of outer space for the benefit of all; not one of these resolutions, including the 1963 Declaration of Legal Principles, mentioned or banned arms in space. Thus, there was no attempt to address the issue of military implications of space activities.

MULTILATERAL LEGAL DIMENSION

Chronologically speaking, the 1963 Partial Test Ban Treaty (or Limited Test Ban Treaty)[3] is the first international legal regulation of a military use of outer space. The treaty was elaborated from 1958 to 1962, with negotiations eventually conducted in the Eighteen-Nation Disarmament Committee. Lack of progress in this forum led to a Trilateral Test Ban Conference between the United States, the Soviet Union and the United Kingdom. Test-ban negotiations were later transferred back to the Eighteen-Nation Disarmament Committee, as a larger multilateral committee. The negotiation process merits attention since agreement was first reached among most interested countries, and then opened to the international community.

The Partial Test Ban Treaty prohibits state parties from carrying out the explosion of nuclear devices in the oceans, atmosphere or outer space.

International space law is composed of five multilateral treaties: the 1967 Outer Space Treaty,[4] the 1968 Astronaut Rescue Agreement,[5] the 1972 Liability Convention,[6] the 1975 Registration Convention[7] and the 1979 Moon Agreement.[8] In addition, four sets of UN principles have been adopted by the General Assembly for the regulation of special categories of space activities: the 1982 Principle on Direct Television Broadcasting,[9] the 1986 Principle on Remote Sensing,[10] the 1992 Principle on Nuclear Power Sources[11] and the 1996 Declaration on International Cooperation.[12] Though these principles are not legally binding instruments, they retain a legal significance by establishing a code of conduct recommended by the General Assembly and reflecting a legal conviction of the international community on these issues.

The first three articles of the Partial Test Ban Treaty establish the framework for peaceful exploration and use of outer space: the common interest principle (Article I), the freedom principle (Article I), the non-appropriation principle (Article II), and the application of international law and the UN Charter to outer space (Article III).

Article IV is the only provision that addresses military activities. Paragraph 1 of Article IV prohibits placing in orbit around the Earth objects carrying nuclear weapons or any kind of weapon of mass destruction, installing such weapons on celestial bodies, or stationing such weapons in outer space in any other manner. Paragraph 2 specifies that the "Moon and other celestial bodies" are to be used "exclusively for peaceful purposes". As such, the "peaceful purposes" clause does not apply specifically to outer space. Thus, the wording of Article IV reveals the limits on what the international community could reach agreement upon at the time.

The term "peaceful purposes" has had two interpretations over the years. The first equates peaceful purposes with *non-aggressive* actions, while the second equates it with *non-military* intent. Over 40 years of continuous state practice has resulted in a de facto endorsement of the non-aggressive interpretation.

The Registration Convention establishes a mandatory system of registration of space objects launched into orbit and beyond. Article IV of the Registration Convention requires mandatory reporting to the United Nations Secretary-General of information on data such as the date and location of the launch, changes in orbital parameters after the launch and the recovery date of the spacecraft. This information is to be provided "as soon as practicable". In practice, this can take weeks or months. States are not obligated to disclose the true function of the satellite, but only the "general function of the space objects".[13]

There have been increased calls over the years for improved reporting by states pursuant to the Registration Convention. Various proposals have been before the Conference on Disarmament (CD) to resolve some of these shortcomings.[14]

Mention should also be made of the International Telecommunication Convention adopted in 1992[15] by the oldest UN agency, the International Telecommunications Union (ITU). The ITU governs the international use of the radio spectrum, which is considered to be a limited natural resource. As a limited natural resource, the spectrum will support a finite number of users among the radio frequencies before signal interference occurs. Article 35 of the ITU Convention stipulates that:

> all stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other members.

BILATERAL ARMS CONTROL AGREEMENTS

Several US–Soviet bilateral agreements adopted during the past 30 years or so are also relevant to international space law and space and security.

The 1972 Anti-Ballistic Missile (ABM) Treaty[16] was intended to curb the nuclear arms race and reduce the risk of nuclear war between the superpowers by placing limitations on ABM systems and to prohibit the development, testing or deployment of space-based ABM systems or components.

Verification of treaty compliance was ensured by the use of National Technical Means (NTM) of verification: a wide array of intelligence gathering capabilities were used to collect data, including reconnaissance satellites. The ABM Treaty provides for the non-interference with NTM. As such, the treaty reinforced the legitimacy of space-based reconnaissance satellites and of data collection. The ABM Treaty's bilateral ban on the development, testing or deployment of space-based ABM systems expired along with all the other treaty's provisions when the United States withdrew from the agreement in June 2002.[17] However, the principle of non-interference with NTM of verification can also be found in other US–Soviet arms control agreements, such as the 1979 Strategic Arms Limitation Talks (SALT II) Treaty,[18] the 1987 Intermediate-range Nuclear Forces (INF) Treaty[19] and the 1991 Strategic Arms Reduction Treaty (START I).[20] Moreover, the 1990 Conventional Armed Forces in Europe (CFE) Treaty[21] contains non-interference provisions with NTMs as well as multinational technical means of verification.

Other bilateral agreements such as the Hot Line Modernization Agreement[22] between the United States and the Soviet Union and the 1971 Agreement on Measures to Reduce the Risk of Outbreak of Nuclear War[23] sought to improve communications between the superpowers and provide clarification of incidents. These agreements extended protection from interference to early warning satellite systems as well as to communications facilities.

Other agreements, such as the 1988 Launch Notification Agreement,[24] the 1989 Prevention of Dangerous Military Activities Agreement[25] and the Memorandum of Understanding establishing a Joint Data Exchange Center for sharing early warning information on missile and space launches,[26] provide mechanisms for the exchange of information pertaining to missile launch warning systems for each side, all ballistic missile launches and space launch vehicles.

The bilateral agreements described above establish a limited regime that seeks to protect satellites that are identified to perform a specific function and a limited and particular goal. Existing protection is limited to three types of satellites: early warning systems, reconnaissance satellites and communications satellites. The protection is also extended in application to the corresponding ground stations. These bilateral agreements highlight the usefulness of confidence-building measures (CBMs) as a means of increasing transparency and providing stability.

INSTITUTIONAL FRAMEWORK

The key international space security-relevant institutions include the General Assembly, COPUOS and the CD.

The General Assembly has long recognized the contribution that the prevention of an arms race in outer space could make to nuclear disarmament and to the achievement of the goal of general and complete disarmament under effective international control, as undertaken by state parties to the Nuclear Non-Proliferation Treaty of 1968.

In adopting a programme of action in the field of disarmament at the 10th Special Session of the General Assembly (also referred to as the first Special Session on Disarmament) in 1978, Member States agreed that:

> in order to prevent an arms race in outer space, further measures should be taken and appropriate international negotiations held in accordance with the spirit of the Outer Space Treaty.

Member States further agreed to establish a mechanism to implement the programme of action through a "single multilateral disarmament negotiating forum", which later became known as the Conference on Disarmament (CD).

Since 1981, the First Committee of the General Assembly (Disarmament and Security) has deliberated and voted consistently and resoundingly on resolutions pertaining to the prevention of an arms race in outer space. These resolutions reflect the international community's growing concern with the inherent risks of the weaponization of outer space. Though non-binding, the resolutions are also indicative of a widespread desire to expand the existing multilateral agreements to include prohibition against weapons in space.

COPUOS has recently recognized the need for it to embark on a re-evaluation of the existing body of space law, and assess whether it is still adequate in regulating space activities of states and other entities governed by the respective rules, particularly in view of the explosive growth of private commercial space activities.

COPUOS has two standing subcommittees: the Scientific and Technical Subcommittee and the Legal Subcommittee. COPUOS and its two subcommittees meet annually to consider questions put before them by the General Assembly and to address reports submitted that raise issues by Member States. Jointly the three committees make recommendations, based on consensus, to the General Assembly.

Through its Inter-Agency Space Debris Coordination Committee (IADC), COPUOS has played an important role in developing space debris mitigation guidelines.[27] All major space actors—civil, commercial and military—have identified this as a critical issue to solve in order to ensure security in the outer space environment. The guidelines are voluntary and as such not legally binding.

On numerous occasions, delegations have voiced concerns about growing space militarization and possible weaponization. In these instances, delegations have been reminded that the mandate of COPUOS is restricted to international cooperation in the peaceful uses of outer space, and is therefore not the proper forum to discus these issues.

Since 1982, the CD has been called upon by the UN General Assembly to form an ad hoc Committee on the Prevention of an Arms Race in Outer Space (PAROS). From 1985 to 1994, the CD created such a committee, which has looked at various issues related to security challenges posed by human activity in outer space. Numerous working papers have been advanced dealing with issues such as:

- establishing rules of the road and a code of conduct;
- CBMs;
- information exchanges;
- pre-launch notification;
- keep-out zones;
- an international space inspectorate;
- space-based verification systems; and
- improving certain existing international agreements (notably the Outer Space Treaty and the Registration Convention).

The CD has been unable to agree on the formation of an ad hoc committee on PAROS since 1994. Nevertheless, a Chinese statement in 2000 and a joint Russia–China paper in 2002 contain elements of an international legal agreement on the prohibition of deployment of any weapons in outer space. It is hoped that the 2002 Five Ambassadors Initiative[28] will help break the impasse within the CD and allow the adoption of a programme of work for the ad hoc committee on PAROS.

FUTURE STEPS

Even if the CD were to adopt a programme of work, it is unlikely that it would have a mandate to negotiate a treaty. Therefore, an incremental approach in trying to prevent an arms race in outer space is the most promising approach at this point in time. Measures that should be considered include:

- establishing a mechanism for exchange of information between the CD and COPUOS;
- addressing the issue of CBMs for outer space with particular attention to pre- and post-launch notification; and
- pushing forward the adoption of the IADC debris mitigation guidelines so that it can then be added to the agenda of the Legal Subcommittee of COPUOS.

These modest steps would facilitate the process of preventing an arms race in outer space and would represent a step forward.

Notes

1 General Assembly Resolution 1348 (XIII), 15 December 1958.

2 General Assembly Resolution 1472 (XIV), 12 December 1959.

3 *Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water,* opened for signature on 7 October 1963, entered into force on 10 October 1963.

4 *Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, opened for signature 27 January 1967; entered into

force 10 October 1967. As of 1 January 2003, the treaty had 98 state parties and had been signed by an additional 27 states.

5 *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, opened for signature on 22 April 1968, entered into force on 3 December 1968. As of 1 January 2003, the agreement had 88 state parties and had been signed by 25 additional states.

6 *Convention on International Liability for Damage*, opened for signature on 29 March 1972, entered into force on 1 September 1972. As of 1 January 2003, the convention had 82 state parties and had been signed by 25 additional states.

7 *Convention on the Registration of Objects Launched into Outer Space*, opened for signature on 14 January 1975, entered into force on 15 September 1976. As of 1 January 2003, the convention had 44 state parties and had been signed by an additional 4 states.

8 *Agreement on the Activities of States on the Moon and Other Celestial Bodies*, opened for signature on 5 December 1979, entered into force on 11 July 1984. As of 1 January 2003, the agreement had 10 state parties and had been signed by five additional states. France is the only major space power to have signed this agreement.

9 *The Principles Governing the Use of States of Artificial Earth Satellites for International Direct Television Broadcasting*, General Assembly resolution 41/65 of 10 December 1982.

10 *The Principles Relating to Remote Sensing of the Earth from Outer Space*, General Assembly resolution 47/68 of 14 December 1986.

11 *The Principles Relevant to the Use of Nuclear Power Sources in Outer Space*, General Assembly resolution 47/68 of 14 December 1992.

12 *Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States Taking into Particular Account the Needs of Developing Countries,* General Assembly resolution 51/122 of 12 December 1996.

13 Article IV 1(e).

14 See *Study on the Application of Confidence-Building Measures in Outer space*, 1994, Centre for Disarmament Affairs, report of the Secretary-General, United Nations, New York, pp. 41–50.

15 *Constitution and Convention of the International Telecommunication Union: Final Acts of the Additional Plenipotentiary Conference*, 1992. For an excellent description of the role of the ITU, see F. Lyall, 1997, Communications Regulations: the Role of the International Telecommunication Union*, Journal of Information, Law and*

Technology, no. 3, 31 October, at <elj.warwick.ac.uk/jilt/commsreg/97_3lyal/lyall.DOC>.

16 *Treaty Between the United States and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems*, signed on 26 May 1972; entered into force on 3 October 1972.

17 The decision to withdraw from the ABM Treaty was based on a perceived change to the international security environment. It was argued that the new security environment required a "different approach to deterrence and new tools for defense". The strategic logic of the Cold War was deemed not applicable to the new threats.

18 *Treaty between the United States and the Union of Soviet Socialist Republics on the limitation of strategic offensive arms*, signed on 18 June 1979; not in force.

19 *Treaty Between the United States and the Union of Soviet Socialist Republics on the elimination of their intermediate-range and short-range missiles* (INF Treaty), 8 December 1987.

20 *Treaty on the reduction and limitation of strategic offensive arms* (START I), 31 July 1991.

21 *Treaty on Conventional Arms in Europe* (CFE), entered into force on 9 November 1992.

22 *Agreement on Measures to Improve the US–USSR Direct Communications Link*, signed on 30 September 1971, entered into force on 30 September 1971.

23 *Agreement on Measures to Reduce the Risk of Outbreak of Nuclear War Between the United States of America and the Union of Soviet Socialists Republics,* signed 30 September 1971, entered into force 30 September 1971.

24 *Agreement between the United States and the Union of Soviet Socialist Republics on notification of launches of intercontinental ballistic missiles and submarine launched ballistic missiles,* opened for signature on 31 May 1988, entered into force on 31 May 1988.

25 *Agreement between the United States and the Union of Soviet Socialist Republics on the prevention of dangerous military activities*, opened for signature on 12 June 1989, entered into force on 1 January 1990.

26 *Memorandum of Agreement between the United States and the Russian Federation on the establishment of a joint center for the exchange of data from early warning systems and notifications of missile launches*, entered into force on 4 June 2000.

[27] Inter-Agency Space Debris Coordination Committee (IADC), 2002, Space Debris Mitigation Guidelines, document A/AC.105/C.1/L.260 of 29 November, p. 8, section 5.2.

[28] Conference on Disarmament, 2002, *Letter dated 27 June 2002 from the Permanent Representative of the People's Republic of China and the Permanent Representative of the Russian Federation to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting the Chinese, English and Russian texts of a working paper entitled "Possible elements for a future international legal agreement on the prevention of the deployment of weapons in outer space, the threat or use of force against outer space objects",* CD document CD/1679.

CHAPTER 8

THE LAW AND THE MILITARY USE OF OUTER SPACE[1]

Thomas Graham

The consensus on space law and military activities is still incomplete. Some of the leading treaties have not been accepted by all countries, and outer space declarations by the United Nations have frequently lacked unanimity (and therefore the authoritativeness) that is desirable. In some cases, of course, the “holdout” countries are only negligible participants in outer space activities, but in others the absence of general accord on legal standards—and in a few instances, the lack of participation by the United States—is troubling. It is noteworthy that the general public often seems to regard outer space as a “special area”, a preserve from normal human competition and a sanctuary from mundane military matters.

In addition, while many of the applicable space rules are similar to the standards that govern other more familiar and longstanding zones, the law of outer space is also partially unique; on several important points, the law that is applicable in the exoatmosphere is not the same as the law that is applicable to airspace, the oceans or land masses. What follows are highlights of international law affecting military activities in space.

An assessment of the law regarding the military use of outer space must begin with reference to the UN Charter, binding upon every country in the world. Although adopted well before the launch of Sputnik in 1957, the Charter knows no geographic limitations: it is fully applicable to the behaviour of states on, under and well above the planet. Moreover, the Charter contains a unique supremacy clause: in the event of a conflict between the Charter and any other treaty—whether pre-existing or subsequently concluded—the obligations of the Charter shall prevail.

The fundamental rule regarding military activities is contained in Article 2(4): “All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations." This formulation, of course, is hardly free from ambiguity, especially in the unprecedented application to outer space—for example, would hostile employment of a beam of subatomic particles to interfere temporarily with the operation of another state's satellite constitute a forbidden use of "force"? Still, the core concept is clear: without some valid justification, such as self-defence under Article 51, or authorization by the Security Council pursuant to Chapter VII), first use of military power in outer space, like its counterpart on Earth, is per se illegal.

The "Magna Carta" of this area, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, (the Outer Space Treaty) was signed in 1967, and entered into force later that same year. As of 2004, it has attracted 96 parties, including the United States and all the other major space-faring countries and another 27 signatories. It is of unlimited (that is, permanent) duration.

The Outer Space Treaty was the modern world's second "non-armament" accord; following the 1959 Antarctic Treaty, it attempted to avoid "a new form of colonial competition" and the extension into the heavens of the Cold War's increasingly virulent military rivalry. In relatively brief form, the Outer Space Treaty provides the basic framework for international order in outer space, introducing principles that are expanded and elaborated in later documents.

The Outer Space Treaty provides, among other things, that:

- "the exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and the interests of all countries" (Article I);
- space "shall be free for exploration and use by all States without discrimination" and "there shall be free access to all areas of celestial bodes" (Article I);
- space "is not subject to national appropriation by claim of sovereignty" (Article II);
- states "undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass

destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner" (Article IV);

- "the Moon and 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" (Article IV);
- a state that launches a satellite "is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space" (Article VII); and
- "in the exploration and use of outer space", parties "shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space … with due regard to the corresponding interests of all other States Parties. … If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space ... would cause potentially harmful interference with the activities of other states parties in the peaceful exploration and use of outer space ... it shall undertake appropriate consultations before proceeding with any such activity or experiment" (Article IX).

Not surprisingly, the Outer Space Treaty's negotiators found it easiest to outlaw potential activities that no country then had the capacity or intention to undertake, such as building fortifications on the Moon or conducting military manoeuvres on Mars. Notably, the Outer Space Treaty mimics the sweeping opening line of the Antarctic Treaty ("Antarctica shall be used for peaceful purposes only") but the Outer Space Treaty does so only with respect to the Moon and other celestial bodies, not for outer space *in toto*. Moreover, the Outer Space Treaty does not define "peaceful" purposes; while some equate the term with "non-military," the majority view likens it to "non-aggressive," a much more permissive interpretation.

The Outer Space Treaty's formula, therefore, implicitly allows the following military activities:

- Objects carrying nuclear weapons or other weapons of mass destruction (WMD) can freely transit outer space—for example, intercontinental ballistic missiles (ICBMs) or submarine-launched ballistic missiles launched from Earth, going briefly through outer space en route to Earth-borne targets—as long as they do not "orbit" Earth. Likewise, WMD that escape Earth orbit are permitted, except that they may not be "installed" on celestial bodies or otherwise "stationed" in outer space.

- Other types of weapons—that is, not nuclear weapons or other WMD—may be placed in orbit, but not on the Moon or other celestial bodies and used to attack targets in space or on Earth. Armed, reusable space planes are similarly not covered.
- Weapons, including even nuclear weapons and other WMD may be tested in outer space under the Outer Space Treaty, but not on the Moon or other celestial bodies.
- Countries may create military bases, installations and fortifications in outer space—for example, on orbiting satellites—but not on the Moon or other celestial bodies. They may use satellites to perform all manner of military functions, including communications, reconnaissance and navigation.
- Nuclear powered satellites are permitted. (There might be a difficult interpretation question about a conceivable satellite-based device that would employ a nuclear explosion to power a high-energy laser anti-satellite (ASAT) weapon; arguably the power source could be characterized as a something other than a "nuclear weapon", even though it utilized a nuclear explosion and did so for weapons purposes.)
- There is no direct ban on (non-nuclear) ASAT or anti-missile weapons, whether based or operating in space or on Earth. (It should be noted that any exercise of these general permissions would be constrained by the treaty's other provisions, noted above, regarding the launching state's liability for damage caused to other states by its space objects; by the principle of "due regard" for the space interests of other states; by the requirement for consultation before undertaking "potentially harmful interference" with the activities of other treaty parties; and by the additional prohibitions contained in other treaties noted below.)

The Outer Space Treaty makes little provision for verification or inspection procedures. It does require a launching state to consider requests from other parties "to be afforded an opportunity to observe the flight" of its space objects (Article X) and it specifies that "all stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives" of other parties (Article XII).

The Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (the Partial Test Ban Treaty, also known as the Limited Test Ban Treaty) was signed, ratified and brought into force in 1963. It currently has 117 parties, including the United States. Under Article I of the treaty, each party undertakes “to prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control: in the atmosphere; beyond its limits, including outer space; or under water”.

The Partial Test Ban Treaty therefore prohibits the conduct in outer space of nuclear weapon test explosions, nuclear explosions used for fighting wars instead of for testing and nuclear explosions that might one day be employed for any other purpose, such as to power the type of laser ASAT weapon described above.

Like the Outer Space Treaty, the Partial Test Ban Treaty has little inspection or verification apparatus. The Comprehensive Nuclear Test-Ban Treaty (CTBT), signed in 1996, extended the ban on nuclear explosions to include those conducted underground, and added a panoply of verification and inspection provisions that would materially assist in monitoring the Partial Test Ban Treaty, including its ban on tests in outer space, but the CTBT has not yet entered into force.

Beyond those most prominent accords, several other multilateral treaties that concentrate principally on other aspects of the exploration and exploitation of outer space should be mentioned.

- **Rescue Agreement**: the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects launched into Outer Space was signed and entered into force in 1968. It has 88 parties, including the United States, and 25 additional signatories. It specifies that astronauts shall be rendered all possible assistance in the event of accident, distress or emergency landing.
- **Liability Convention**: the Convention on International Liability for Damage Caused by Space Objects was signed and entered into force in 1972. It provides for liability for space activities.
- **Registration Convention**: the Convention on Registration of Objects Launched into Outer Space was signed in 1975 and entered into force in 1976. It currently has 44 parties, including the United States, and four signatories. It requires each party to register each space object it

launches on a public UN roster, providing general information on the space object's designator, date and territory of launch, basic orbital parameters and general function. As a practical matter, the registration is always done after the fact of a launch, and the notification of the satellite's function is provided in such general terms that no satellites are described as performing military missions.

- **Nairobi Convention**: the 1982 International Telecommunications Convention entered into force in 1984 and has 140 parties, including the United States. This treaty is the current iteration of a longstanding series of multilateral accords that provide the basic framework for facilitating and regulating international telecommunications. Under Article 35, parties pledge "not to cause harmful interference to the radio services or communications" of other parties, which presumably would cover satellite operations as well as Earth stations. Article 38, however, provides a specific exemption for military activities: "Members retain their entire freedom with regard to military radio installations of their army, naval and air forces".

In addition, there are a number of noteworthy arms control agreements that, while focused principally on other issues or concerns, also have ramifications for selected possible military activities in outer space even though in some ways they seem the converse of the category of agreements described just above.

- **Hotline agreements**: in 1963, and intermittently thereafter, the United States and the Soviet Union concluded a series of arrangements to facilitate rapid, secure communications between their leaders in times of crisis and in implementation of arms control treaties. Beginning with the 1971 instruments, these explicitly relied upon satellite networks, and each side pledged "to take all possible measures to assure the continuous and reliable operation of the communications circuits and the system of terminals".
- **EnMod Convention**: the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques was signed in 1977 and entered into force in 1980. It now has 70 parties, including the United States. Parties undertake not to engage in military or hostile environmental modification activities, which are defined as "any technique for changing—through the deliberate manipulation of natural process—the dynamics, composition or structure of the Earth,

including its biota, lithosphere, hydrosphere and atmosphere, or of outer space".

- **Strategic Arms Reduction Treaty (START I)**: the bilateral Treaty on the Reduction and Limitation of Strategic Offensive Arms was signed in 1991 and entered into force in 1994. It commits the parties "not to produce, test, or deploy ... systems, including missiles, for placing nuclear weapons or any other kinds of weapons of mass destruction into Earth orbit or a fraction of an Earth orbit".
- **MTCR**: the Missile Technology Control Regime is a non-treaty-based coalition of 33 countries, founded in 1987, devoted to restricting the proliferation of ballistic and cruise missiles and associated technology through the coordination of unilateral national export control standards. The overlap between strategic missiles and space launch vehicles inevitably requires MTCR members to make some fine distinctions, in order to inhibit weapons-related transfers without unduly retarding civilian space programmes. The MTCR's two main categories of regulated items include a number of rockets, components and subsystems common to both weapons and non-military space applications, which are not to be exported to the problematic countries.

In addition to the treaties discussed above, the applicable international law regarding military activities in space also includes a corpus of customary international law principles, derived from the longstanding, widespread practice of sovereign states, undertaken by them out of a sense of legal obligation. It is difficult to adduce which such principles might be applicable to outer space today—the ephemeral nature of customary international law makes it much less ascertainable. But it might well be argued that at least the core principles written into the Outer Space Treaty—for example, the prohibition on sovereign claims to outer space, the banning of WMD in orbit—have risen to the level of customary international law. The consequences of such a determination would be that those principles would now be considered fully binding even on those states that have not joined the treaty.

At least 20 countries—from Great Britain and the Russian Federation to Tunisia and Slovakia—have specific domestic legislation governing space-related activities. In the United States, several provisions of internal law directly affect military activities in space: some include criminal penalties for specified violations, others state broad policy or flat prohibitions on government funding of a particular programme.

In the National Aeronautics and Space Act of 1958, for example, the United States Congress declared "it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind".

Prominent among the legislative prohibitions against selected military operations in space, the Tsongas amendment, passed in 1983 and again in 1984, barred ASAT weapon tests in space unless the president provided specified certifications regarding treaty negotiations. From 1985 through 1988, Congress extended this approach one step further, prohibiting ASAT tests against objects in space unless the Soviet Union tested its own ASAT first. Later, as attention shifted to energy beams instead of kinetic interceptors as potential ASAT weapons, Congress imposed a prohibition against the use of lasers to illuminate an object in orbit; this limitation expired in 1995. Finally, in 1997, US President Bill Clinton exercised his short-lived "line item veto" power to delete from the Department of Defense Authorization Act all funding for the Army's kinetic energy ASAT missile and two other programmes connected to space control. After the Supreme Court invalidated the line item veto procedure, Congress appropriated additional funds for those systems in the 1999 act.

The world has undertaken a variety of fruitless—or not yet fruitful—efforts to further regulate military activities in space. For example, from 1978 to 1979, the United States and the Soviet Union engaged in the three rounds of negotiations on ASAT weapons, without reaching agreement on a treaty. Likewise, during the Reagan Administration, the Nuclear and Space Arms Talks, which included the Intermediate-range Nuclear Forces (INF) and START negotiations as well as a negotiation on space arms, were conducted without concluding any document on space. The Conference on Disarmament (CD) has been struggling for the past several years with the topic of Prevention of an Arms Race in Outer Space (PAROS). China in the past has insisted that the CD should begin to draft such an instrument, while the United States has consistently resisted, saying that no new accord is necessary, and that the CD should turn its attention to other topics instead. China, however, has blocked consensus on initiating negotiations on any other topic until a PAROS treaty is also undertaken, and the CD has therefore been deadlocked for some years. Hopefully, this situation is now changing. Both China and the Russian Federation have in recent years circulated evolving texts for critical elements of a draft treaty regarding prohibition of the weaponization of space.

The United Nations General Assembly has debated and adopted a large number of resolutions on the peaceful uses of outer space. Although these are not per se legally binding, they do bespeak a widespread consensus on the issue, and might yet indicate future directions for lawmaking activities. Examples of three of the most prominent General Assembly resolutions are:

- Resolution 1962 (XVIII), Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space (1963);
- Resolution 47/68, Principles Relevant to the Use of Nuclear Power Sources in Outer Space (1992); and
- Resolution 53/76, Prevention of an Arms Race in Outer Space (1999).

The international law regarding outer space embraces a large and growing number of instruments and principles, and conveys a quantity of high-minded, rhetoric regarding protection of this unique resource and shielding it from aggressive or hostile employments. The specific mandates, on the other hand, have to date been cast in much more narrow terms. The most significant and legally binding commitments regarding militarization of space boil down to prohibitions against placing nuclear weapons in orbit, against conducting nuclear explosions in space and against interfering with satellites employed as national technical means of verification of arms control agreements. Beyond those, a wide range of military activities may still be undertaken largely without truly binding constraints.

Note

1 For this paper I am indebted to an unpublished paper on the same subject prepared by Professor David Koplow of the Georgetown University Law Center and submitted at my request to a conference in 2002 on Outer Space, which I managed for the Lawyers Alliance for World Security.

CHAPTER 9

RESTRAINT REGIMES FOR SPACE: A UNITED STATES PERSPECTIVE[1]

James Clay Moltz

While it is possible to identify a number of negative comments about the plans of the United States for space—and there are studies by the US military describing plans for aggressive "space control"—this paper offers a more positive, optimistic scenario of what could be accomplished consistent with the main trends in US space policy circles. The argument builds on the "step-by-step" approach outlined by a number of analysts, where although a more restrictive arms control treaty for space is not necessarily possible now, it is possible to envisage significant progress toward enhanced space security in phases, and perhaps leading to a treaty later on.

SPACE HISTORY REVISITED

When we consider the question of space arms control today, we should not forget that space was weaponized very early on. Both the United States and the Soviet Union conducted a series of nuclear weapons tests in space from 1958 to 1962, including tests *during* the Cuban Missile Crisis.

But it is also worth remembering that—fortunately—both countries stepped back from the brink. Instead of continuing the drive toward weaponization of space, they engaged in considerable restraint during the rest of the Cold War. US and Soviet decision makers realized that they faced some important trade-offs: continuation of nuclear testing would mean that there could be no manned space programmes (as a result of radiation in low-Earth orbit), no commercial programmes (as a result of the harmful effects of electromagnetic pulse radiation) and no satellite reconnaissance for their respective militaries. Thus, both sides promoted a series of bilateral and multilateral space agreements, including the 1963 Partial Test Ban Treaty (or Limited Test Ban Treaty), the 1963 United Nations Space Resolution, the 1967 Outer Space Treaty, and both the Strategic Arms Limitation Treaty (SALT) and the Anti-Ballistic Missile (ABM) Treaty in 1972.

These agreements paved the way for two decades of civilian achievements in space and kept military space programmes largely limited to passive activities, rather than active defences. The few exceptions were the Soviet (and fewer US) tests of conventionally armed anti-satellite (ASAT) systems and the research and development programmes conducted under the US Strategic Defense Initiative in the 1980s. But none of these systems were deployed in space.

Under President Bill Clinton, initially the focus was on theatre missile defences for US troops and allies abroad. While his policies turned toward research on a limited ground-based interceptor for national missile defence later in his term in office—in response to pressure from congressional Republicans—President Clinton declined to pursue deployment, given technical problems revealed by the test programme.

BUSH ADMINISTRATION SPACE POLICY

In 2004, at a time when the US military was increasingly dependent on space assets for communication, tracking and precision targeting, a number of new concerns emerged, particularly the perceived vulnerability of US space assets to attack. The January 2001 Rumsfeld Commission report on space management stated that the United States needed to "develop, deploy and maintain the means to deter attack on and to defend vulnerable space capabilities".

Under President George W. Bush, missile defence policy has been more aggressive, including plans for deployment of a limited system in Alaska and California by January 2005, and US space policy has pursued both defensive and offensive options, including investigation of both space-based missile defence and ASAT capabilities for space "denial". Given the lack of a Russian threat, this policy is seen within the administration as one of "freedom of action" to consider all options.

Debris mitigation is the sole area of international control for space supported by the Bush Administration, as long as such control remains voluntary. More recently, Bush sought to reinvigorate the US civilian manned programme in January 2004 by calling for a manned mission to the Moon and a follow-on mission to Mars. The ultimate goal of this effort is a permanent Moon base to serve as a staging ground for a manned mission to Mars. In theory, this effort could lead to greater international space cooperation in the civilian uses of space. However, part of the new motivation behind US space exploration plans seems to be fear of being eclipsed by China, which is pursuing an increasingly active manned and unmanned space agenda. China's military capabilities are thus far unclear, but could eventually be significant.

OTHER PERSPECTIVES IN THE UNITED STATES: CONGRESS AND THE MILITARY

Beyond the White House, it is also important to understand the main perspectives of the US Congress on space, particularly regarding space weapons, since Congress is the source of all US funding. In general, members of Congress support some form of missile defence—even Senator John Kerry and other leading Democrats are on record as advocates of some form of missile defence. However, there is a wide range of opinion on the question of space weapons.

First, to borrow a framework developed by Dr Peter Hays of the US Air Force, there are "space hawks" who believe in countering China's moves into space, supporting deployment of the kinetic energy ASAT and developing a range of space-based weapons. Second, on the opposite side of the political spectrum, lie an equally small number of "space doves". These members of Congress believe arms control is the best approach to space and are supporters of Dennis Kucinich's Space Preservation Act of 2002, which calls on the United States to end weapons research and begin negotiating a treaty to ban space weapons. But the most numerous and powerful bloc is that of less vocal congressional moderates, who support some form of missile defence but are ambivalent, and often dubious, about space-based weapons. These representatives have repeatedly reduced the president's space weapons budget, even within a Republican-controlled Congress, eliminating funding for the kinetic energy ASAT, the space-based infrared-low system and a space-based laser. They may be influenced in the future by the growing US budget deficit, particularly if costs for space-based elements of missile defence continue to grow.

Even in the US military there is considerable scepticism in some quarters about space weapons. One main concern is that space weapons simply may not work. Their successful deployment faces significant technical hurdles, including problems with providing adequate power and maintaining these systems in orbit. Some military officers indicate that the computers of terrestrially based weapons systems must be reconfigured every three months, asking, "How are we going to do that when the weapons are located in space?"[2] Such activities would be far too expensive. In addition, military officers worry that US deployment of space weapons might stimulate countermeasures, which do not currently exist, thus making their jobs harder. Finally, if US weapons have to be tested in a destructive mode, then space debris is another potential problem.

In part as a result of these concerns, Bush's Defense Science Board recommended in September 2002 that missile defence efforts should focus on near-term technologies, not on space-based elements. Even General Ronald Kadish, from the Missile Defense Agency, in recent testimony before the US Congress hardly mentioned space-based systems at all, and then only for the distant future.

Beyond the uniformed military forces, powerful actors in the US intelligence community may raise opposition to space weapons if low-Earth orbit threatens to become cluttered with space debris, since military commanders on the ground rely on space images for battlefield intelligence.

As a result of these concerns, the recent military debate has begun to generate a number of possible alternatives to space weapons. One concept is the revival of "pop-up" defences—including manned or unmanned space bombers—that would be orbited temporarily and linger in space during a wartime situation, but otherwise would not be placed into space. A second alternative would be to use space only as a medium for delivering or intercepting weapons, but not for basing weapons. A third option would be to use ground-based terrestrial weapons, such as conventionally armed hypersonic missiles. as a substitute for space weapons. A fourth option is the use of a host of non-offensive techniques to lower the vulnerability of US space assets. These might include deployment of decoys, the use of manoeuvring satellites (to avoid interception) the stockpiling of spare satellites in orbit or on the ground in a ready-to-launch mode, and equipping satellites with the ability to release radar attracting chaff.[3] Finally, a fifth option is the use of jammers or other forms of electronic interference to disrupt hostile satellites or potentially intrusive signals short of destructive means. The US military is actively investigating all of these options.

Despite the military's interest in a variety of these systems, there is little support for arms control in the armed services, largely as a result of the belief that such measures at present would limit only US forces. There is also widespread doubt as to the ability of treaties to guarantee the detection and punishment of cheaters. To be acceptable, future treaty-based approaches will have to address these concerns within the US military.

POSSIBLE ROUTES FOR THE CONFERENCE ON DISARMAMENT

Given all of this, what concepts might work within the US political context in terms of enhancing international space security? Fortunately, the Conference on Disarmament (CD) still has a number of possible avenues that might attract considerable US support.

The promotion of a strong norm of non-interference with spacecraft is worth pursuing as an initial confidence-building measure that could, over time, reduce the perceived need for space weapons by encouraging national policies of self-restraint. Another avenue might be to develop "rules of the road" among groups of countries that share common interests in safe access and use of space. By applying the concept of "coalitions of the willing" to space, increasing numbers of critical space actors might join in the creation of widely accepted guidelines that might force new actors in space to comply through the power of international pressure and persuasion. To support these efforts, all countries should encourage—and even pressure—states currently outside the Partial Test Ban Treaty (and/or the Comprehensive Test Ban Treaty) and the Outer Space Treaty to sign and ratify these agreements. Finally, the promotion of international civilian space cooperation and increased launch transparency could help build trust among states that currently doubt each other's intentions.

Fortunately, within existing US-supported treaties there is a considerable foundation for a number of the above measures. Non-interference pledges stem naturally from the existing US–Russian arms control guarantees to not interfere with the national technical means of the other party. In terms of transparency, Article IX of the Outer Space Treaty already calls for prior notification in case of planned activities that might cause harm to other countries in space, while the Registration Convention supports prior notification of launch orbits and activities, which could be made more detailed and specific.[4]

Certain new arrangements for space might involve "mixed regimes" for space that could allow defensive actions (such as missile defence) only in low-Earth orbit, but ban the space basing of weapons.[5] The logic here is that debris from collisions with orbital objects would be avoided—as would the hair-trigger tensions inherent in space-basing of weapons—yet certain interceptions of missiles would be allowed, thus garnering support from moderates in the US political establishment who have already committed themselves to some form of missile defence. This approach, notably, is consistent with the existing Russian and Chinese draft statement that would allow weapons that pass *through* space but are not based there.

CONCLUSION: GRADUAL ENGAGEMENT OF THE UNITED STATES

In many respects, the current situation of the United States is much like it was in the mid-1980s with the Strategic Defense Initiative. Though there is much being proposed and researched, the budgets are already beginning to decline for the aggressive space weapons systems originally envisaged for space. These trends are likely to continue, as costs rise and political support from Congress weakens. Unfortunately, however, this does not mean that the US Senate is likely to support a new space arms control treaty in the near future.

Given existing evidence, we can still look at the space arms control debate from either a "glass half empty or half full" perspective. While many participants in this conference have focused on the former, it is not too late to develop the latter into a meaningful alternative route toward an eventual space treaty. It is certainly true that, at present, the United States is exploring a number of alternatives for deployment of space weapons. However, such efforts were tried at various times during the Cold War and did not lead to weaponization. Thus, there are reasons to believe that restraint and new forms of cooperation may yet emerge.

Even the 2001 Rumsfeld Commission on space specifically supported maintenance of the Outer Space Treaty. More recently, Air Force Undersecretary Peter B. Teets emphasized in congressional testimony the development of non-damaging denial capabilities as a US goal for "space control", as opposed to the use of weapons. Finally, President Bush stated in January 2004 that he welcomes other nations to "join" the United States in space, emphasizing his vision of "a journey not a race". These views indicate that there is still time to create a more favourable environment in space through new forms of international cooperation. To accomplish such ends, enlightened leadership will be required not only in the United States, but also in other key countries that are active in space. Still, if the CD seeks out moderates within the US political system and works carefully on a "step-by-step" approach to the prevention of weaponization, it may yet succeed.

Therefore, what specifically should the CD do? In terms of timing, the main effort now needs to be put into reducing the lack of trust in space by reducing the vulnerabilities faced by all powers. New non-offensive norms need to be enunciated and promoted for all space-faring nations. There needs to be a gradual expansion of cooperative coalitions in space to help develop guidelines for good behaviour, especially among key space actors—such as the United States, the Russian Federation, China, India, Japan and the European Space Agency. Civilian space cooperation between key space-faring nations—and especially between the United States and China—is critical to reduce the perceived "demand" for space weapons. A strict convention on the reduction of civilian- and military-produced debris is also essential. The CD should follow up on the efforts of the Committee on the Peaceful Uses of Outer Space (COPUOS) in this regard to ensure that a catch-all agreement is reached and that all states support these efforts, including existing holdouts such as India.

With these initial steps in place, a treaty may well be possible in future years. The evolving Russian and Chinese position could be a useful starting point for such an agreement. The possible inclusion of an exception to allow for non-destructive interference with satellites during wartime (jamming) might help attract greater support from key constituencies within the US military, and thereby pave the way for future political acceptance by the US Senate and future US presidents.

In conclusion, the above points demonstrate that there is a strong need for substantive international discussions on these and other issues affecting space security. With focused effort, the members of the CD can assist in creating new forms of space diplomacy, even in this difficult and uncertain period. Such cooperation and consensus building could lay the foundation for more formal space negotiations within the near future.

Notes

1 This essay is based on a PowerPoint presentation made by the author at the conference.

2 Based on the author's interviews with Air Force officers at the Naval Postgraduate School in the fall of 2002.

3 For more on the technical aspects of this issue, see Phillip J. Baines, 2003, Prospects for "Non-Offensive" Defenses in Space, in J. C. Moltz (ed.), *New Challenges in Missile Proliferation, Missile Defense, and Space Security*, Occasional Paper no. 12, Monterey, Center for Nonproliferation Studies, at <www.cns.miis.edu/pubs/opapers/op12/index.htm>.

4 On this point, see C. Lucy Stojak, 1998, Recent Developments in Space Law, in Beier and Mataija (eds), *Arms Control and the Rule of Law: A Framework for Peace and Security in Outer Space*, Toronto, York University.

5 See James Clay Moltz, 2002, Breaking the Deadlock on Space Arms Control, *Arms Control Today*, April, at <www.armscontrol.org/act/2002_04/moltzapril02.asp>.

CHAPTER 10

INCENTIVES FOR SPACE SECURITY: TECHNOLOGY, TRANSPARENCY AND COMPLIANCE

Götz Neuneck and André Rothkirch

As commonly understood, "security" denotes the absence of threats. Today, security is a core value of modern state behaviour.[1] As humankind explores outer space, the concept of security will also be increasingly applied to the space environment. Until now, the only threats to manned spacecraft such as the International Space Station or unmanned satellites were meteoroids or man-made space debris. This situation might change significantly if a country decides to deploy weapons in orbit. An arms race in space, which will always start on Earth, is a likely outcome. The deployment of space weapons could complicate using space for other commercial and military purposes and might promote a false sense of security for objects in space and the Earth itself. Such a move also might stimulate military reactions by adversaries that currently do not possess space weapons. A space arms race would use enormous resources and would also project currently Earth-bound rivalries into space. The climate of mistrust in world politics would once again increase. Thus, the international community has a vested interest in keeping space free of weapons.

Outer space has commercial applications such as surveillance, meteorology, navigation, communication and early warning. Remote sensing satellites play an important role in urban planning, fire prevention and pollution management. Global positioning system (GPS) satellite navigation is used for many traffic, rescue and mapping applications. Satellites are creating a space-based infrastructure by extending and complementing terrestrial networks, providing global and universal connectivity in areas such as communication and the broadcast industry.

The United States is certainly the biggest space power in terms of expenditures, launches and space assets, followed by the Russian Federation, the European Union and China. Independent access to space, a global infrastructure and research and development in the field of astronautics are necessary preconditions for civilian and military space flight. In addition to the classical space-faring nations, new actors such as Brazil, India, Israel, Japan and Ukraine also have the capabilities to launch payloads into space. Until now, the number of space-faring nations has been limited, but the implications of a disruption of space applications would be global.

Most of the technology for launching and operating satellites is dual-use. Many of the early programmes of the United States and the Soviet Union were military-related such as launchers—for example, Atlas, Jupiter, Titan or R-7/SS-6, SS-18. Intercontinental ballistic missiles (ICBMs) are still used to boost some commercial payloads into orbit. Part of the ground infrastructure is military related. The civilian space industries in the United States and in Europe have strong defence branches. Many results from astronautical engineering could be used for civilian as well as for military purposes thus blurring the distinction between civilian and military technologies.

Using space assets such as communication satellites (ComSats), GPS or surveillance satellites are becoming a prerequisite for the "revolution in military affairs" and the conduct of modern warfare. In the coming years, more countries will try to obtain these capabilities by developing space capabilities in pursuit of their national interests. Outer space is an important medium for warfare on Earth, but no "weaponized" satellites—for example, collision devices, shooters or lasers—exist in orbit. It is important to preserve this situation and to avoid a costly arms race in space.

THE TECHNOLOGY OF SPACE WEAPONS

Generally, it is important to differentiate between weapons deployed in space and weapons directed against objects in space. Space-based weapons can hit targets in space (space-to-space weapons, or they can be directed against objects on the ground (space-to-Earth weapons). Earth-based weapons can hit objects in space (Earth-to-space). Earth-based weapons such as ICBMs directed against Earth-based targets might temporarily use or transit space or enter the space plane (Earth-to-Earth).

Technically, several "principles" exist to hit, blind or destroy objects in space, including nuclear explosions in orbit, directed energy weapons and kinetic energy weapons.

Nuclear explosions in orbit

Civilian and military satellites can be disabled by a low-yield (10–20kt), high-altitude (125–300km) nuclear detonation. The US project HALEOS came to the conclusion that a nuclear detonation against low-Earth orbit (LEO) satellites could "disable all LEO satellites not specifically hardened to withstand radiation generated by that explosion".[2] In addition, the lifetime of a satellite might decrease as a result of increased ambient radiation in LEO; however hardening or replacement of satellites might be effective countermeasures.

A simple nuclear warhead could be delivered to space by a medium-range ballistic missile in a very short time, causing much harm to civilian as well as to military satellites. However, the Outer Space Treaty and the (yet to enter into force) Comprehensive Test Ban Treaty prohibit the deployment of a nuclear device in outer space. Such an event could easily be traced to the culprit. A country that decides to use nuclear weapons in orbit would face severe international consequences.

There are various ways to limit such scenarios. The most obvious are to restrict missile proliferation and to strengthen the nuclear non-proliferation regime. Another possibility is to introduce regional zones that are free from ballistic missiles. Strengthening the Outer Space Treaty by explicitly prohibiting explosions in space or the Comprehensive Test Ban Treaty entering into force are two additional options.

Directed energy weapons

Directed energy weapons (for example, laser or particle beams) might seem like an exotic technology, but the high-energy laser research and development currently underway within the US Ballistic Missile Defense (BMD) programme has an inherent anti-satellite (ASAT) capability.[3] The reason is simple: a missile air-frame body is in principle less vulnerable than a satellite. The Airborne Laser (ABL) is designed to use a high-energy laser to intercept a missile in its boost phase. It is a megawatt chemical laser (mounted on a modified 747 aircraft) that aims at a ballistic missile body, causing structural damage. Certainly such a system, if it works one day, also has an inherent ASAT capability against LEO satellites. Even if the ABL does not use its full power, it can still blind satellite sensors. Another high-energy laser was chosen for the space-based laser being developed for BMD purposes. In December 2002, the Missile Defense Agency announced the start of a "test bed" for space-based weapons. The first space-based laser tests are planned by the US for 2008–2010.

The technology is far from operational, but a space-based laser could have the capability to reach satellites in a geosynchronous orbit (GEO). There is a fear that other nations could use ground-based lasers to blind satellites. A future challenge is to create a regime to preventively prohibit "new weapons principles" such as lasers or microwaves. Methods to detect and verify such weapons near the source have already been developed.

Kinetic energy weapons

Satellites circulate on predictable orbits around the Earth and are much more vulnerable to kinetic attacks than warheads from ballistic missiles, which are hardened for re-entry. The hit-to-kill technology of the planned US BMD programme can also be effective against satellites. The ground-based interceptors could lift the "kill vehicle" to a height of 6,000km and can reach satellites in LEO. The US Ground Midcourse system also includes ground-based radars (X-Band) and space-based sensors (for example, Space-Based Infrared System satellites), which are, together with the deep space surveillance network and the NORAD radars, capable of precisely tracking satellites in outer space. Previous space-based missile defence systems (such as Brilliant Pebbles) were planned under the Global Protection Against Limited Strikes Programme. In Brilliant Pebbles, several hundred autonomous manoeuvring small satellites were intended to intercept missiles in the midcourse phase of a ballistic missile. The current Bush Administration's missile defence programme is dedicated to boost-phase intercept, but could have also the capability to lift to higher orbits to attack satellites.

Another possibility is lightweight satellites, so called micro-satellites.[4] The 2001 *Report of the Commission to Assess United States National Security Space Management and Organization (The Rumsfeld Space Commission)* stated that "micro-satellites can perform satellite inspection, imaging and other function and could be adapted as weapons".[5] Because these systems are small, light, inexpensive (in terms of launch and development costs) and accessible to many states, there is concern that these satellites could also be used as space weapons. But it is important to remember that even a micro-satellite must have sufficient propulsion to manoeuvre or to move to the target satellite. It also needs sensors for detection and discrimination and a guidance system for homing in on the target. Existing satellites lack many of these capabilities. Another counterargument is that even small satellites can be detected and tracked after launch.

The efficiency of a potential space weapon depends on several important factors:

- the vulnerability of the target (for example, solar panels, sensors, energy supply);
- the characteristics of orbit (for example, altitude and motion in LEO or GEO);
- the deployment and manoeuvrability of the space-based weapon and the target;
- access to space and space technologies to launch space-based weapons (for example, launch capabilities, space launch vehicles or ballistic missiles); and
- ground stations and radar components.

These parameters have to be more or less defined and restricted if a "space arms control regime" is established. One key problem is the definition of a space weapon. This is complex because the characterization of a space weapon can vary due to technical, geographical and political perspectives. Furthermore, the deployment region or the target area (for example, space or Earth) of such weapons is decisive. Definitions could be based on specific parameters, technical lists, legal agreements and functional or purpose-oriented measures, among others.

However, a simpler solution might be to first define "outer space", for example in relation to the legal airspace of a country or by a specific altitude threshold. Once there was an agreed definition of "outer space", the definition of a space weapon could be based on it—for example, "deployed in" or "the use of outer space". Another option is to use concrete parameters such as "deployment altitude" or that the "object must be in orbit".

Whereas strict measures like a technical list can provide short-term solutions by banning specific equipment, functional- or purpose-oriented definitions might be preferable for long-term solutions. For example, ballistic missiles pass through space at high altitudes—but generally are not considered as space assets.

VULNERABILITY OF CIVILIAN SATELLITES AND INFRASTRUCTURES

Destroying or deactivating a space system does not necessarily mean shooting down a satellite in orbit. A space system consists of several elements: ground stations with an uplink and a downlink connection and a space segment. Uplink jamming requires very high power from fixed sites and downlink jamming is not a significant threat because close proximity to the user is necessary. There is concern about terrorist attacks on ground stations, but the best protection for ground stations is sufficient security at key facilities. ComSats are often in geostationary orbits and are safe given today's technologies. With regard to space launchers that are capable of hitting satellites in space, only a threat from major space-faring nations seems plausible. Conventional ASATs against GEO satellites are not easy to handle and need a lot of time for manoeuvring and testing. Directed energy weapon threats are unlikely for many years to come. Satellites will operate increasingly within networks, which imply some form of redundancy. This means that inactive ground stations can be replaced or other satellites can be used.

SPACE DEBRIS

A decision to test and deploy weapons in space might not only make space weapons more attractive to other nations, it also affects the common use of space in general. Space is not "empty"—natural (meteoroids or comets) and artificial (man-made) objects can be found in the space environment. They travel through Earth orbital space at high velocities and pose a risk to orbiting objects. Orbital debris is not of natural origin, rather it is the result of about 45 years of space exploration—parts of spacecraft, remains of intentional and unintentional explosions as well as mission-related objects. Each of these objects can be classified by its source (debris type) or its size. With particle size, a distinction is made between small objects (less than 1mm), medium-sized objects (from 1mm to 1cm) and large objects (more than 10cm). The number of objects varies with orbit parameters and size. Small-sized objects are more prevalent than larger objects, resulting in different mean times of debris impacts on target objects (for example, spacecraft). Mean times of impacts can vary from days to several thousand years. Although the probability of a spacecraft colliding with a large fragment is low, such an impact could have catastrophic results. Collision with medium fragments would cause significant damage to a spacecraft and possibly result in mission failure. Small fragments can cause component damage, spallation or degradation of spacecraft surfaces.

A spacecraft can be protected against space debris by shielding the craft or by manoeuvring to avoid a collision. Shields can protect against fragment sizes up to approximately 1cm, depending on the shield type. Despite the progress in shield development, spacecrafts in near-Earth orbits are at increasing risk of being damaged. Small fragments less than approximately 1cm are particularly dangerous because they are not trackable—or only barely so. In this case, manoeuvring is not applicable. The chance of failure as a result of collision with small fragments is about 1% per year for an average small satellite in an 800km orbit.[6] Scientists expect there will be an increasing number of collisions until at least 2025, which will also increase the number of fragments in orbit. Depending on the their specific characteristics (for example, specific orbit, fragment mass, fragment cross sectional area, radiation pressure) fragments can remain in Earth orbit up to several thousand years. To paraphrase one analyst, if humankind continues its use of space in the way that it has until now, space will be overflow with debris to the point that it will be no longer utilizable. While we don't know if this will take 70 or 130 years, that it appears is assured.[7]

Space weapons might aggravate the danger of space debris. Although there are now no weapons deployed in space, several weapons to attack satellites have been developed[8] and various scenarios highlighting the benefit of space weapons have been considered. The successful tests of the

Russian co-orbital ASAT programme and the destruction of the Solwind satellite by the US military created hundreds of fragments of trackable debris. Remaining fragments can still be found in orbit. Since the increasing amount of debris raises the possibility of damaging spacecraft, it must be recognized that every launch to deploy space assets also creates more potentially dangerous debris. Kinetic ASAT systems like Brilliant Pebbles are based on hundreds of satellites and will create a significant amount of debris simply through their deployment. In addition to the generation of space debris there is also an economic impact. An American Physical Society study[9] reports that about 1,600 interceptor satellites are needed for a boost-phase intercept using space-based interceptors. The mass of the constellation was found to be approximately 2,000t, requiring a 5–10 times increase in the current launch capacity of the United States to deploy such a system.

An effective and cheap space weapon might release a larger debris cloud—for example, pellets made of steel balls—to destroy a satellite or a weapon system in LEO. In a worst-case scenario the balls and the remaining fragments of the asset, in conjunction with the existing space debris, would further increase the fragmentation of the approximately 3,000 tons of existing debris. The emerging debris would then endanger all existing satellites in LEO and might make it unusable for a limited time. The increasing dangers caused by space debris will be a growing problem for both civilian and military satellites. Hence, the "vulnerability problem" of space infrastructure by space debris and by military attacks can be a common basis to link the civilian space industry interests and the concerns of the security community for a future control regime.

ACTIVE AND PASSIVE MEASURES TO IMPROVE SPACE SECURITY

A unilateral but costly answer to the problem of space debris or direct threats to satellites is the hardening of space systems. The following "passive countermeasures" are possible but will certainly raise the costs of spacecraft:

- hardening of satellites against heat, shock, radiation and jamming;
- evasive action of satellites by manoeuvres, hiding and decoys;
- redundancy and repair;
- deployment in less threatened orbits; and

- substituting destroyed satellites.

Another possibility would be to include "active countermeasures" such as the deployment of new ASATs—defensive satellites, bodyguard satellites—or the integration of active defence systems. But these measures might fuel an arms race in space where space-faring nations feel under pressure to introduce orbital weapons to protect their own space assets. In the end, treaties to prevent testing and use of ASATs would be more effective than costly investments in hardening satellites or deploying space weapons, which might not work effectively anyway.

STRENGTHENING EXISTING ARMS CONTROL TREATIES

The 1967 Outer Space Treaty is a key document for arms control in space.[10] The preamble recognizes "the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes". It extends international law, including the United Nations Charter, to outer space (Article III), prohibits orbiting around the Earth and the stationing of weapons of mass destruction, especially nuclear weapons in outer space (Article IV.1) and demilitarizes the Moon and other celestial bodies (Article IV.2). The treaty does not ban the transit of ballistic missiles equipped with nuclear weapons through space nor the use of nuclear equipped interceptors for missile defence purposes.

The Outer Space Treaty provides the cornerstone for peaceful space activities. It does not include provisions for verification, but it foresees consultations in the case of one member believing that the activity of another member could cause "potentially harmful interference" with peaceful activities.[11] Additional agreements regulate other space activities through launch notification or liability regulations.[12] The members are obligated to provide information about the date, location of the launch site and purpose of the space object. The discipline of the notifying states as well as the details of the registered information is generally quite low. There are delays in announcing launches or in describing the mission in detail. Transparency in outer space can be drastically improved by providing precise orbital data and the size and detailed characteristics of the satellite, such as energy sources, manoeuvring capabilities, payload, luminance and fuel availability. An agency that has the capability to monitor or to check the compliance of the extended convention should be established.

Other instruments also regulate military operations in space. Article I of the 1963 Partial Test Ban Treaty (or Limited Test Ban Treaty) prohibits nuclear weapon tests "or any other nuclear explosions in … outer space". Articles I and II of the 1977 Environmental Modification Convention prohibit the military use of environmental modification techniques affecting outer space. Article V of the defunct 1972 Anti-Ballistic Missile (ABM) Treaty prohibits "the developing, testing or deployment of ABM systems which are … space-based".[13] The ABM Treaty as well as other arms control treaties—for example, the 1987 Intermediate-range Nuclear Forces Treaty (INF), the 1990 Conventional Armed Forces in Europe (CFE) Treaty and the 1991 Strategic Arms Reduction Treaty (START I)—include provisions not to interfere with national technical means (NTM) such as satellites that are operated for verification purposes. These agreements are a good foundation for strengthening legal regimes, but it should be understood that the legal obligations and norms for prohibiting the use of new "conventional technologies" for space weapons are rather weak.

PROPOSALS FOR BANNING SPACE WEAPONS

Resolutions to ban space weapons have been proposed by the international community at the United Nations for many decades. The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) deals with civilian space traffic issues but excludes arms control problems. The United States and other countries insist that military-related problems in outer space must be addressed in the Prevention of an Arms Race in Outer Space (PAROS) talks at the Conference on Disarmament (CD) in Geneva. Unfortunately, any progress on the issue is blocked at the CD by some space-faring nations, especially the United States. On 27 June 2002, China and the Russian Federation introduced a working paper, which banned the deployment of weapons in outer space, though testing of space weapons and missile defence interceptors would be allowed. Verification is not mentioned in this proposal because verification is seen as "rather complicated and the ideas are diversified".[14]

However verification of any future agreement limiting or banning space weapons is a key subject.[15] Adequate verification is important because it helps to identify launches from Earth to space and it monitors the behaviour of space objects in both the short and long term. In particular, verification helps to discriminate between permitted civilian satellites and banned space weapons. As was learned from the development of verification throughout arms control history, the efficiency of an arms control treaty is highly dependent on the confidence in its verification system. There have been "robust verification systems" such as the CFE Treaty and the Open Skies Treaty, as well as agreements without any verification provision such as the Outer Space Treaty or the Biological Weapon Convention. Agreements can have different degrees of intrusiveness and use different human (inspections) and technical verification instruments. Effective verification measures in space would be dependent upon the treaty's scope (the application area, whether in space or on Earth), verification subject (for example, space launch vehicles, weapon principles, satellites) or the mission mode (for example, development, testing, manufacture, deployment, transfer, use, dismantlement). A space weapon treaty should ban all weapons in space, because a zero-weapon treaty "is easier to verify than a treaty that differentiates between different numbers and kinds of weapons in space". Another important issue is whether the verification data would be available for all members of the treaty, an agency would be established to monitor compliance, or specific state parties would use NTM—for example, remote sensing satellites or space surveillance networks—to verify compliance.

Only the biggest space powers have space surveillance capabilities on the ground. Optical capabilities—such as the American DEEPSTAR or GEODSS—are inexpensive but are also highly weather dependent. Radar surveillance networks are already used by the United States to monitor space activities. Civilian capabilities are mainly used to coordinate satellite traffic and monitor debris in order to prevent collisions. In addition, the military is also interested in the rapid characterization of launches and the identification of mission modes. Early warning satellites and signals intelligence satellites for the interception of telemetry data can be used for remote observation. Besides long-term monitoring from the Earth's surface, monitoring launch activities or outdoor testing can also be done from space. Routine or challenge inspections at the final assembly site, as permitted under the INF and CFE treaties, could complement these pre-launch verification efforts. Commercial satellite imagery could be used to locate preparations at fixed launch sites or testing areas. The Canadian PAXSAT satellite was an attempt to design a special monitoring tool for space verification purposes. Additional radio frequency or infrared sensors on board can help to detect the function of inspected satellites. Another way to help identify satellites is to include proximity sensors in operating satellites, which can alert ground stations if satellites are approaching at a specific distance.

The effectiveness and robustness of arms control treaties are often assessed on the basis of verification and compliance. Verification requires monitoring treaty-limited equipment and activities, as well as assessing compliance on the basis of observing and collecting other information. Transparency measures help to meet these objectives by openly presenting treaty-relevant information to demonstrate good will to other parties. These processes create different levels of confidence to achieve the objectives of an arms control accord. Depending on the scope and the subject of a treaty, verification has different functions: it can improve confidence building between different parties or it can have an early warning instrument to determine compliance or non-compliance with the treaty objectives.[16] Verification is also a key factor for the efficiency and the strictness of a compliance regime, because it determines the detectability of significant violations. Universality in geographic as well as political terms is important. A useful space weapon agreement needs an enforcement mechanism as well as barriers to withdraw from such a treaty.

Elements of a future comprehensive space control regime can be found in existing treaties—for example, the Outer Space Treaty—or in historical proposals.[17] Other proposals from academia emphasize banning attacks on the International Space Station or preventing all military activities beyond GEO.[18] Jonathan Dean, retired ambassador from the US State Department, proposed that the International Court of Justice could give an advisory opinion on whether testing or deployment of space weapons would be compatible with the key principle of the Outer Space Treaty: the peaceful uses of outer space. Coyle and Rhinelander proposed a caucus of states and parties to amend the Outer Space Treaty and a ban of shooters in space.[19] And other comprehensive proposals have been made since 2000.[20]

There are good arguments to start with confidence building and transparency measures to build-up trust by introducing procedures to improve space security in the areas of space debris, traffic in space or the expansion of launch notification. A code of conduct for not attacking military or commercial satellites might be in the interest of all space-faring nations. After the end of the Cold War, it is time not only to begin serious discussions on a future space accord, but also to establish a new space order to keep outer space free of weapons

Notes

1 Graham Evans and Jeffrey Newnham, 1998, *The Penguin Dictionary of International Relations*, London, Penguin Books.

2 High Altitude Nuclear Detonations (HAND) Against Low Earth Orbit Satellites ("HALEOS"), Defense Threat Reduction Agency (DTRA), Advanced Systems and Concepts Office, April 2001, at <http://www.fas.org/spp/military/program/asat/haleos.pdf (13.11.02)>.

3 For details see, David Wright and Laura Grego, Anti-Satellite Capabilities of Planned US Missile Defense System, *Disarmament Diplomacy*, December 2002/January 2003, at <www.ucs.usa.org/global/space_weapons>.

4 The mass of a micro-satellite ranges per definition from a few kilograms to 500kg. Several hundred satellites have been launched over the last 25 years.

5 United States, 2001, *Report of the Commission to Assess United States National Security Space Management and Organization*, Washington, DC, Government Printing Office.

6 A presentation by Joel R. Primack, *Debris and Future Space Activities*, at a conference on future security in space, Southampton, England, 28–29 May 2002, at <physics.ucsc.edu/cosmo/mountbatten.pdf>.

7 Paraphrase of Dietrich Rex, 1996, *Wird es eng im Weltraum? Die mögliche Überfüllung erdnaher Umlaufbahnen durch die Raumfahrt*, at <http://www.ilr.ing.tu-bs.de/forschung/raumfahrt/spacedebris/space/spacedebris.html>.

8 For example, ASATs such as Gorgon (Russian) or Safeguard/Sentinel (US); an orbital ASAT system such as Istrebitelny Sputnik (Russian) or the Air Launched Miniature Vehicle (ALMV) (US). The orbital and the ALMV ASAT have been tested successfully. The status of the systems has not been disclosed.

9 American Physical Society, 2003, *Report of the American Physical Society Study Group on Boost-Phase Intercept Systems for National Missile Defense: Scientific and Technical Issues,* Washington, DC, at <www.aps.org/public_affairs/popa/reports/nmdfull-report.pdf>.

10 See J. Goldblat, 2003, Efforts to Control Arms in Outer Space, *Security Dialogue*, vol. 34, no. 1 (March), p.103–108.

11 Op. cit., p. 104.

12 For example, the Convention on International liability for Damage Caused by Space Objects (1972); the Convention on Registration of Objects Launched into Outer Space (1975), also see <www.islandone.org/Treaties/>.

13 There are voices that argue that the real reason for withdrawing from the ABM Treaty was not the extended missile defence testing programme of the US Administration, but rather to remove this "barrier" to the testing and deployment of future space weapons.

14 Fu Zhigang, 2002, The Joint Working Paper by China and the Russian Federation, *International Network of Engineers and Scientists Against Proliferation Information Bulletin*, no.20 (August).

15 Regina Hagen and Jürgen Scheffran, 2003, Is a space weapon ban feasible? Thoughts on technology and verification of arms control in space, *Disarmament Forum,* no. 1, pp. 41–51.

16 See Joseph Pilat, 2003, Verification and Transparency: Relics of Future Requirements?, in Jeffrey Larsen (ed.), *Arms Control: Cooperative Security in a Changing Environment*, Boulder, Lynne-Rienner Publishers, pp. 79–96.

17 Reiner Labusch, Eckart Maus and Wolfgang Send, 1984, *Space-Based Missile Defense*, Report by the Union of Concerned Scientists, Cambridge.

18 Clifford E. Singer and Amy Sands, 2002, *Keys to Unblocking Multilateral Nuclear Arms Control*, University of Illinois at Urbana-Champaign.

19 Philip E. Coyle and John B. Rhinelander, 2002, Drawing the Line: the Path to Controlling Weapons in Space, *Disarmament Diplomacy,* no. 66 (September).

20 See James Clay Moltz, 2002, Breaking the Deadlock on Space Arms Control, *Arms Control Today*, April, pp. 3–9; Rebecca Johnson, 2001, Multilateral Approaches to Preventing the Weaponization of Space, *Disarmament Diplomacy*, no. 56 (April).