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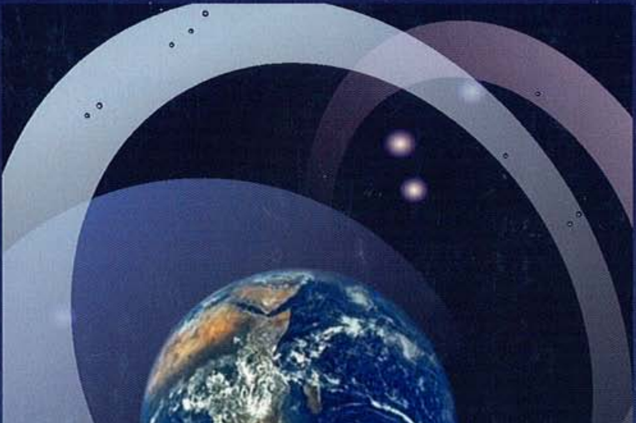
Outer Space and Global Security



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Outer Space and Global Security

UNIDIR
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Project Ploughshares Canada
Waterloo, Canada

The Simons Centre for Peace and Disarmament Studies
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PREFACE

For 50 years, human activity in outer space has been guided by the principle of the "peaceful uses of space", first enunciated in 1958 by US President Dwight Eisenhower.[a] Although the term "peaceful purposes" was never clearly defined, it was generally understood to include military, commercial, and scientific activity in space, but to exclude the placement of weapons or the targeting of objects in space. But recent developments suggest that this norm against the weaponization of space is now threatened. The Bush Administration withdrew from the Anti-Ballistic Missile (ABM) Treaty in June 2003 and has committed to deploying a multi-layered missile defence system, the first stage of which could be ready by 2004, with testing of a space-based element as early as 2008. As part of this pressure for missile defences, elements within the US Department of Defense (DoD) are pushing hard to expand the military uses of space to include war-fighting capabilities from, in, and into space.

Internationally, there is broad consensus in opposition to the weaponization of space, reaffirmed annually by virtually unanimous support for a United Nations General Assembly resolution on Prevention of an Arms Race in Outer Space (PAROS).[b] Although there is clearly broad international support for the creation of a legal instrument prohibiting the placement of weapons in outer space, to date there is still no agreement on

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a Exchange between Dwight Eisenhower and Nikolai Bulganin, Chairman, Council of Ministers, USSR, 13 January 1958 [Online]. Available from the Eisenhower Institute, in "The Historical Context" at http://www.eisenhowerinstitute.org/programs/globalpartnerships/fos/newfrontier/letters.htm.

b The 2002 First Committee vote on the PAROS resolution was 156 in favour, zero against, with Israel and the US abstaining. United Nations General Assembly, A/C.1/56/L.30, First Committee Voting Record, Fifty-seventh Session, 21 October 2002 [Online]. Available at: www.reachingcriticalwill.org/1com/1com02/vote/voteindex.html. See also the analysis of this discussion in Fiona Simpson, "Anxiety, Hope and Cynicism: the 2002 United Nations First Committee", *Disarmament Diplomacy*, No. 68, December 2002/January 2003.

ways and means of achieving such a ban. At the same time, talks on PAROS in the Conference on Disarmament (CD) have been blocked by US opposition since 1995.

It was with a view to exploring these dilemmas and developing options for future actions that an international conference on outer space and global security was held in Geneva on 26-27 November 2002. Jointly convened by the Simons Centre for Peace and Disarmament Studies, at the Liu Institute for Global Issues, the United Nations Institute for Disarmament Research (UNIDIR), and Project Ploughshares, with support from the Simons Foundation and the Canadian Department of Foreign Affairs and International Trade, the Conference brought together experts from military, industry, government, and non-governmental organizations (NGOs), representing countries with interests across the range of civilian and military space activity. The speakers gave presentations on a variety of technical, political and legal issues regarding space use and space security, including current civilian and military uses of space, technical and political considerations regarding space weapons, the legal regime governing space use, and the prospects and problems of developing a space weapons ban.

Patricia Lewis
Director, UNIDIR

Ernie Regehr
Director, Project Ploughshares Canada

Jennifer Allen Simons
President, The Simons Foundation
Director, Simons Centre for Peace
and Disarmament Studies, at the
Liu Institute for Global Issues

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We are grateful to the contributing authors to the Conference—Philip Baines, Jonathan Dean, Alain Dupas, Chris Hadfield, Atef Sherif and Andrei Vinnik—and in particular to those whose papers appear in this volume: Bruce DeBlois, Peter Hays and Rebecca Johnson for their personal and intellectual contribution to this discussion. Special thanks must go to Mark Hilborne and Sarah Estabrooks for compiling and editing the conference report. Anita Blétry at UNIDIR followed this publication through the production stage.

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ACRONYMS

ABM	anti-ballistic missile
AEHF	advanced extremely high frequency
AFM	Air Force Manual
ASAT	anti-satellite
BMD	ballistic missile defence
BNSC	British National Space Centre
C^4ISR	Communications, Command, Control, Computer, Intelligence, Surveillance and Reconnaissance
CD	Conference on Disarmament
CFE	Conventional Forces in Europe
CNES	Centre National d'Études Spatiales
COPUOS	Committee on the Peaceful Uses of Outer Space
CSBA	Center for Strategic and Budgetary Assessments
CSBM	confidence- and security-building measures
DMSP	Defence Meteorological Support Programme
DoD	Department of Defense
DSCS	Defense Satellite Communications System
DSP	Defense Support Program
EMP	electromagnetic pulse
ESA	European Space Agency
FIA	Future Imagery Architecture
GBS	Global Broadcasting System
GMES	Global Monitoring for Environment and Security
GPS	Global Positioning System
GSO	Geostationary Orbit
ICBM	intercontinental ballistic missile
ICJ	International Court of Justice
ICoC	International Code of Conduct
INSS	Institute for National Security Studies
IOSA	Integrated Overhead Signals Intelligence Architecture
ISODARCO	International School on Disarmament and Research on Conflicts
ITU	International Telecommunication Union
JDEC	Joint Data Exchange Centre
LEO	Low Earth Orbit

MILSTAR	military, strategic and tactical satellite
MEO	Medium Earth Orbit
MoD	Ministry of Defence
MSX	Midcourse Space Experiment
MTCR	Missile Technology Control Regime
NASA	National Aeronautics and Space Administration
NEO	Near Earth Object
NGO	non-governmental organization
NIMA	National Imagery and Mapping Agency
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPT	Non-Proliferation Treaty
NRO	National Reconnaissance Office
NTM	national technical means
NTMV	National Technical Means of Verification
OST	Outer Space Treaty
PAROS	Prevention of an Arms Race in Outer Space Committee
PDD	Presidential Decision Directive
PLNS	Pre- and Post-Missile Launch Notification System
PTBT	Partial Test Ban Treaty
RAND	Research and Development Corportation
RMA	revolution in military affairs
SALT	Strategic Arms Limitation Treaty
SDI	Strategic Defence Initiative
SLBM	submarine-launched ballistic missile
SPOT	French Earth Observation Satellite
START	Strategic Arms Reduction Treaty
STCS	space traffic control system
TMD	Theatre Missile Defence
TT&C	Tracking, Telemetry and Control
UFO	Ultra-High Frequency Follow-on
UNIDIR	United Nations Institute for Disarmament Research
USG	Under-Secretary-General
USSPACECOM	United States Space Command
USSR	Union of Soviet Socialist Republics
UN	United Nations
WGS	Wideband Gapfiller Satellite
WMD	weapons of mass destruction

PART I

Conference Report

Executive Summary

The Outer Space and Global Security Conference examined the current and future uses of space, assessing ways to prevent the deployment or use of weapons in and from outer space. Participants, who included governmental and non-governmental representatives, discussed a wide range of short-term and long-term measures to enhance space security, including the possibility of a ban on the deployment of any weapons in space. Short-term measures included a variety of confidence-building measures, space debris mitigation measures, cooperative space traffic control, non-offensive defences for space assets, agreements on non-interference with space assets, and increased public engagement on space security issues. In discussions of longer-term strategies, the Conference explored the potential role of the market and commercial interests in support of space security, the feasibility of negotiating a space weapons ban treaty in the foreseeable future, and plans for getting the CD back to work on the space security challenge.

The Militarization of Space

Introducing the space weaponization debate, Bruce DeBlois, of the Council on Foreign Relations, distinguished between the militarization of space—force enhancement including communications, navigational and intelligence gathering activity—and the deployment of weapons in space. He examined a wide variety of perspectives both for and against space weaponization—from those who argue it is inevitable to those who think it is costly, destabilizing and a bad precedent—noting that the debate tends to get polarized in a way that "incites emotional response and misdirects attention away from the real issue: that is, what is the best approach toward international security in space?". He emphasized the importance of exploring the middle ground of the debate and considering options, including collaborative efforts rather than unilateral action or multilateral negotiations, such as temporary deployment of weapons in space in the face of immediate threats, confidence-building measures to establish "rules of the road", and attention to immediate concerns like space debris and overcrowding (see Part II).

Civil and Commercial Uses of Space

Alain Dupas, a Paris-based consultant on space issues, examined the central role of civil space activity in creating the "global village" and raising awareness of our fragile environment. Examining the overlap between civil and military space operations, he demonstrated how activities such as remote sensing, navigation, communications and space transportation have both civil and military uses. Public funding far outweighs commercial investment in space, with the US the dominant investor; it provides 94.8% of military investment in space, but only 64.3% of public investment for civil activity in space. Predicting that revenues from commercial space applications will continue to rise, Dupas demonstrated the vast potential for expansion, arguing that this would be maximized if space systems provided relevant solutions for terrestrial needs, particularly sustainable development, and if balance was found between public and private investors, including international consortia.

Recalling the 1998 malfunction of the *Galaxy IV* satellite, a shutdown which interrupted communications, banking and other commercial activities across the globe, Atef Sherif, Director of the National Authority for Remote Sensing in Egypt, examined satellite vulnerabilities. He identified threats from both natural and synthetic space debris, arguing that the risk of a satellite or space vehicle being hit was growing exponentially as a consequence of the vast increase in human-generated debris. Considering other threats to satellites, including anti-satellite (ASAT) weapons, jamming techniques and land-based lasers, Sherif noted the need for increased attention to satellite hardening and other defensive technologies. He emphasized that the potential benefits of civilian space programmes, particularly with regard to sustainable development and communications in developing nations, must be protected from such emerging threats.

In the discussion of commercial uses of space, several participants noted that space offered immense opportunities to developing countries—for communications, access to information, monitoring of agriculture, weather trends and coastlines. Examining the threat that weaponization posed to space assets, there was particular concern that space be preserved for these peaceful purposes. The opportunities for economic growth and sustainable development were noted and it was argued that all States should have access to these benefits. Some called for increased cooperation and information-sharing with regard to civil space programmes, while one participant stated that the extreme cost of space weapons and the underlying motivation of full spectrum dominance and control were offensive and threatening to developing countries.

Colonel Chris Hadfield, an astronaut with the Canadian Space Agency currently serving as Director of Operations, National Aeronautics and Space Administration (NASA) in Star City, Russian Federation, was the keynote speaker at the Conference luncheon, hosted by the Simons Foundation. He spoke about his personal experiences training for and travelling in outer space, aboard the shuttle, the Russian space station Mir and the International Space Station. With a compelling presentation that included photographs from his space walks and work on the Canadarm 2, Colonel Hadfield illustrated the great potential for international cooperation, technological development and peaceful exploration in outer space, graphically demonstrating the need to regulate human activity and protect space assets.

Military and Security Uses of Space

Lt. Col. Peter Hays, of the United States Air Force, assessed current military uses of space, examining how space assets are used for force enhancement. Geodesy, environmental monitoring, communications, assessing position, time and velocity, navigation, integrated tactical warning and attack assessment and surveillance, intelligence and reconnaissance are some of the military activities requiring satellite technology. Arguing that "virtually all issues of space strategy and military space cooperation are shaped by [this] spectrum of views on the utility of weaponizing space", Hays identified four views on space weaponization within the military establishment—space hawks, who seek dominance and control through space weaponization; inevitable weaponizers, who believe that the weaponization of space is inevitable and so the US must be first and retain its dominance; realists who believe the US has little to gain from weaponizing space, in part because it would threaten its considerable military assets for targeting and conventional "force support"; and space doves, who advocate that space should be preserved for peaceful uses. The divergence of views, together with the development of new space technologies, the role of the commercial sector and tools of verification, complicate efforts to arrive at consensus on space arms control, but Hays suggested that commercial interests will play a deciding role in whether or not the US develops space weapons (see Part II).

Examining the implications of space weapons development, Phillip Baines, of the Canadian Department for Foreign Affairs and International Trade, argued that moves to weaponize space responded to three stimuli: missile defences responded to continued reliance upon and proliferation of nuclear weapons and their means of delivery; anti-satellite technologies responded to growing reliance upon and proliferation of artificial satellites and their means of delivery; and offensive space weapons responded to potential threats from unpredictable States. Outlining the variety of technically possible space weapons systems, Baines surveyed the perceived military advantages and disadvantages of basing weapons in space: on one hand they had a global reach, assured access, provided a rapid response, and were durable, but on the other hand they were a static defence, had predictable orbits and immense logistic expense, required a significant constellation size, and there were legal consequences for deploying space weapons. Baines argued that the deployment of space weapons would have negative implications for strategic and political stability, the environment, industry, and international cooperation—and ultimately these negative consequences, their limited military advantages and immense cost outweighed any benefits from space weapons.

Andrei Vinnik, of the Russian Ministry of Foreign Affairs, examined the political implications of the possible deployment of space weapons. He compared legitimate military use of space for strengthening strategic stability, with activities based on the logic of confrontation and the quest for military superiority—namely, space weaponization. The latter, he argued, threatened to undermine international security and stability, and to incite an arms race of symmetrical and asymmetrical space technologies. He described the June 2002 joint proposal, led by China and the Russian Federation, which put forward a possible draft treaty preventing the deployment of space weapons. He explained that that initiative was designed to facilitate peaceful activity and multilateral cooperation in space, and to protect objects currently in orbit, by preventing an arms race in outer space.

Securing Space for Peaceful Purposes

Jonathan Dean, of the Union of Concerned Scientists, assessed the current legal regime related to outer space activity, which included but was not confined to the 1967 Outer Space Treaty (OST).[1] He argued that that body of law established a legal norm against the weaponization of space, and also placed certain constraints on potential space weapons development. He argued that to use weapons against any early warning, imaging or intelligence satellite would violate the concept of non-interference with national technical means of verification, described in the Strategic Arms Limitation (SALT) and Strategic Arms Reduction (START) treaties. This principle provided the basis for General Assembly resolutions calling for non-interference with communications, weather and Global Positioning System (GPS) satellites. He also suggested that there were grounds for the United Nations General Assembly to call for an advisory opinion from the International Court of Justice (ICJ) to assess specific actions the US might take in pursuing space-based missile defence for example, and establish a legal opinion on the validity of pursuing space weapons. Articles VII and IX of the OST allow for consultations to resolve dispute over space activity, including a Liability Claims Commission. Jonathan Dean argued that immediate steps should be taken to demonstrate international concern over US intentions.

Assessing options for a space security regime, Rebecca Johnson, representing the Simons Centre, argued that although the technological prospect for space weaponization was some years away, political action on this issue was of immediate relevance in view of the Bush Administration's ideological approach and military doctrine. Johnson suggested that to ensure continued dialogue with the US, the international debate needed to be framed not as a polarization of those for and against weaponizing space, but rather in terms of ensuring the present and future security and safety of the assets in space on which we currently depended, and also of advancing security on Earth. Some of the strategies Johnson proposed to lay the groundwork for a comprehensive space security treaty included alliance-

1 Others are the Partial Test Ban Treaty (1963), the Astronauts Rescue Agreement (1968), the Liability Convention (1972), the Registration Convention (1976) and the Moon Agreement (1984), as well as several General Assembly resolutions and the conditions of the SALT and START treaties.

building across military, political and industrial sectors; information-sharing to strengthen advocates of a space weapons ban and contribute towards unifying States behind a coherent concept of space security; and maximizing the engagement of global civil society around achievable goals to prevent the weaponization of space (see Part II).

Responding to these presentations, James Clay Moltz of the Monterey Institute argued that the time was right to pursue space arms control—noting that there were signs that Republican members of Congress had reservations about the push to weaponize space. He suggested some immediate steps to set the stage for a future ban, including confidence-building measures involving debris mitigation, unilateral national declarations or commitments not to develop space weapons, public education, and a United Nations Convention on non-interference with satellites.

In his response, Li Song, of the Chinese Ministry of Foreign Affairs, noted the centrality of US policy in international options for addressing the issue and encouraged wider discussion within the US and the engagement of a variety of actors, including NGOs, which he said had a role to play in providing expertise and promoting awareness for wider public debate. Acknowledging the variety of proposals and approaches on the table, he cautioned against becoming frustrated, stressing that the process itself was an important step towards promoting awareness and developing international consensus on the issue. While advocating that the CD should assume the lead in negotiations, Li Song encouraged discussion in a variety of forums to promote the issue and make steps forward.

Pursuing a Space Weapons Ban

Participants differed in opinion regarding the best approaches to pursue space security and a space weapons ban. Below is a summary of the major arguments and counter-arguments raised.

- An incremental approach was favoured by many, to achieve regulation in specific areas where there was currently agreement, thus improving space security in the short term, while preparing the ground to achieve the longer term goal of a space weapons ban. Concerns were raised, however, that though specific steps could be part of a gradual approach they needed to be integrated into a holistic strategy with the clear aim of a comprehensive space weapons ban. The fear was that interim measures could take years of negotiating, allowing the core issue to be avoided, while space weaponization continued to be pursued until it was a fait accompli;

- A market-driven approach to space regulation could have advantages in preserving and maximizing the economic benefits of the peaceful uses of space, while taking into consideration the exorbitant costs of developing space weapons. Others cautioned that commercial uses of space should not drive the debate, and that care must be taken to prevent arguments about their vulnerability being manipulated or accepted as a rationale to permit weaponization;
- Several participants addressed the role of the CD in negotiating a space weapons ban, expressing frustration with the continued stalemate and with its inability to establish a programme of work. It was recognized that compromise would be required to begin multilateral negotiations on PAROS. The CD was called the "logical" place for these discussions, but many also acknowledged that the issue might need to be addressed in a variety of forums.

Participants also proposed several measures that would immediately increase the security of outer space for current peaceful uses, and could help lay the groundwork for a space weapons ban:

- Confidence-building measures, including unilateral or bilateral statements of opposition to space weaponization, pre- and post-launch notification to build a framework of trust and increase transparency;
- Debris mitigation, tracking, and elimination to address one of the greatest concerns about space security—the increasing presence of space debris and its potential to damage and destroy space assets. Suggestions included improved tracking of debris, "space worthiness licences" granted to those in compliance with debris mitigation standards, and cooperation to develop debris elimination technologies;
- Space traffic control, or rules of the road, to regulate space activity and improve transparency. Some suggestions included management of access to orbital slots, establishment of "keep-out zones" or buffer space around satellites, improved tracking, standard practices for de-orbiting, and limitations on frequency of launch;

- Non-offensive defences—decoys and manoeuvrable satellites, and providing redundant or spare satellites—should be encouraged as effective and non-threatening alternatives to weaponization;
- A United Nations resolution on non-interference with satellites might receive support from commercial sectors and the US Government;
- Increasing public awareness about the prospect of space weaponization and the debris issue would serve to decrease space "illiteracy" and motivate public action;
- Analysis of the long-term costs of space weaponization to explore cheaper, alternative forms of space security;
- Linking members of industry, military and government who were sceptical about weaponization to maximize this opposition;
- Broader awareness and discussion within the US, to motivate public engagement in US policy development.

Conclusion

Outer space offers immense potential for commercial, military and scientific use, but these beneficial opportunities are threatened by the prospect of weapons testing and deployment in space. Broad international support for a space weapons ban has been frustrated by the continued stalemate in the CD. Meanwhile, the US drive to develop space weapons appears to be accelerating, pulled along by the current Administration's plans to deploy multilayered missile defences. By bringing together diplomats and non-governmental experts in Geneva, this Conference fulfilled its purpose of furthering an important international debate. In particular, it highlighted several immediate steps that could be taken to address the broader question of achieving security for space assets and assuring access to space for peaceful purposes, while encouraging continued discussion towards a multilateral instrument to ban the deployment and use of weapons in, from, and into outer space.

PART II

Conference Papers

CHAPTER 1

MILITARIZATION, WEAPONIZATION AND SPACE SANCTUARY: PAST DIALOGUES, CURRENT DISCOURSE, IMPORTANT DISTINCTIONS

Bruce M. DeBlois

I cannot tell you how humbled I am to be addressing this audience. I very much applaud the many of you who have dedicated the better part of your life to working on these tough international issues in your efforts to secure global stability and peace, and particularly on this day, I would like to thank our hosts:

- UNIDIR;
- The Simons Centre for Peace and Disarmament Studies;
- Project Ploughshares Canada; and
- The Simons Foundation.

While I do not pretend to fully understand the many related international disarmament issues, I do understand the state of discussions on space weaponization. Continued discussion is paramount—but many ask, when is formal negotiation appropriate? As Ms. Rebecca Johnson of the Acronym Institute adeptly put it last week in her address to the Carnegie International Non-Proliferation Conference, we must first build the ***conditions for negotiations***—and at this stage, those conditions simply do not exist.

I would add, though, that it is incumbent upon us all to mature the understanding—and not to delay discussion, because continued inaction on this issue will in all probability lead us to a future that none of us would elect.

The issue of space security, and pointedly, the potential of weapons migrating to space, is an important international concern—and needs to be addressed openly, as will be done at this Conference over the course of the next two days. We also need to work hard to keep the issue from being clouded.

Polarizing the issue as proponents of weapons and war, opposing those who favour international peace, incites an emotional response and misdirects attention away from the real issue: that is, what is the best approach towards international security in space? Or, more specifically,

> Can we—as a community of responsible nations—reasonably expect to form a secure international environment on the frontiers of space, without weapons available to those who would seek to secure that environment?

Within these discussions, I hope that we do look creatively at the largely unexplored middle ground—away from the poles of a complete ban on the one hand, and no negotiated guidelines on the other.

Will we consider as possibilities:

- Multilateral, collaborative efforts in place of unilateral action at one extreme, or a complete multilateral ban at the other extreme...

Will we consider in the face of immediate threats:

- Temporary military uses of space, that are to be withdrawn once those threats subside, as opposed to the extreme of permanently orbiting weapons, or the other extreme that offers no flexibility to respond in the face of immediate danger...

And will we consider opening confidence-building discussions in areas where we are likely to agree to some extent at the outset, establishing “rules of the road” that address:

- Space debris;
- Launch notifications;
- Verification approaches; or
- Commercially-crowded orbits.

A principle of effective discussion is to seek common grounds first. I am suggesting that path, before we take on the more difficult issues surrounding national military uses of space, and in particular, space weapons. BUT—we must also not lose sight of the ultimate goal, as it will be a far-reaching decision, IF we have the wisdom, patience, and perseverance to address it. That is, **what of space weapons**?

To be clear about what is meant by space "weaponization", the current state of affairs reflects that **space is currently militarized—but not weaponized**. Globally, we are postured with communications and intelligence-gathering capabilities that offer the possibility of everyone watching everyone—nurturing global stability. These capabilities are used in military force enhancement roles and are accurately referred to as "space militarization", but few would argue that these force enhancement capabilities constitute "space weapons". There may be latent terrestrial-to-space capable systems such as airborne lasers, but they are not dedicated ASAT systems, nor has their use as "space weapons" been exercised to any great extent. In fact, both the Russian Federation and the United States have opted in favour of restraint on ASAT deployment. So in these terms, the issue becomes clear: **Given that space is currently militarized—but not weaponized... should we allow space weaponization (either explicitly by collaborative and coordinated action, or implicitly by inaction)?**

At this juncture, I would simply like to frame the debate, by making several propositions, and several counter-propositions, as to the advent of space weapons. I will not attempt to support or attack these here, but I contend that they are credible, they are supportable, and they are at odds with each other—hence the debate.

PROPOSITION 1: *SOCIAL AND ECONOMIC INTERESTS*

Civil and commercial interests in space are rapidly outpacing military concerns and are becoming a central focus for many national economies. As a service to the nation, the military role is typically to organize, train, equip, and posture forces—complete with weapons—to defend those interests. Space weapons will necessarily follow space commerce—that is, they will "follow the money".

Proposition 2: *Technological and Doctrinal Inertia*

Seizing the high ground is a military doctrinal precept as old as warfare itself. As technology opens the new high ground of space and offers the means to exploit it, sound military doctrinal development would be grossly remiss to overlook it. Simply put, the coupling of advanced technologies with well-intended and effective military doctrine development will inevitably lead to the acquisition of space weapons, particularly, in the absence of countervailing policy direction.

Proposition 3: *Diplomatic Leverage*

We have played this game before—and one need only look to the Sputnik era: the confluence of prestige, prowess, and leverage offered by space presence—a witness to the perceived superiority of a particular ideology—will compel a space race, to include the pursuit of military dominance by way of space weapons.

Proposition 4: *Military Superiority*

The exercise of twenty-first century military power is critically dependent upon communications and intelligence, much of which is collected from and/or passed through space systems. The world witnessed the incredible advantage this supplied in the first "space war", Desert Storm. Future adversaries will not allow such an advantage to go unchallenged, and it must be defended.

Additionally, the prospect of a secure homeland and space-based defence, combined with overwhelming offensive potential, represents the ultimate military high ground. Any nation that achieves space weaponization will readily become a pre-eminent military power.

Summary Proposition favouring the advent of space weapons: *Historical Precedent*

As stated in the four propositions, social and economic leverage, technological and military doctrinal inertia, prestige and prowess afforded on the international stage, as well as military superiority provided by weapons' accession to the frontiers are the determining reasons for the historical precedent.

Where goes man, goes the clash of opposing wills, goes the instruments to effect that clash: weapons. It was true of the territorial frontiers throughout history, true of the high seas in the Middle Ages, and true of the air realm in the twentieth century. The same is destined to be true in space: the weaponization of space is inevitable.

International efforts to secure the frontiers of space need to accept this inevitability, and work towards measured and collaborative agreements to provide a stable space environment. Again, I am framing the debate, and I do not necessarily hold to these propositions—nor do I hold to the following counter-propositions.

Counter-Proposition 1: *Appropriateness*

Whatever the space posture, it must be unity-enhancing, justice-enabling, tranquillity-ensuring, defence-providing, general welfare-promoting, and liberty-securing. These constitutional precepts apply uniformly to individuals and nations. Quite apart from any perceived immediate benefit, a strong case can be made that space weapons are unity-negating, justice-inhibiting, tranquillity-disrupting, defence-inhibiting, general welfare-demoting, and liberty-constraining. As a community of responsible individuals and nations, a future of space weapons is inconsistent with basic human and national values.

Counter-Proposition 2: *Military Nonsense*

The migration of weapons to space is likely to create more military problems for the host nation than it will solve. From a military and national-security perspective alone, a space-weaponizing nation creates both:

- The powder-keg of global instability (where it has weakened its own international posture among allies and adversaries alike); and
- It also creates the spark of regional instability (where it has made itself a target of pre-emption and escalation).

Coupled with this very unstable environment, that same space-weaponizing nation will damage its own military power by extending and exposing an already vulnerable military communications and intelligence-gathering centre of gravity (that was previously protected under the open-skies environment). From the military and national security perspective alone, "nonsense" may be too weak a term; more to the point, for one nation to posture weapons in space to improve its defence posture is "counter-sense".

Counter-Proposition 3: *Exorbitant Costs*

US$ one trillion—and that is on the low side, assuming the world is not compelled into a space race. Additionally, opportunity costs go well beyond mere dollars—in the zero-sum game of government expenditures, costs must be measured in foregone investments in:

- Other necessary military and defence acquisitions;
- Domestic investments in education, pensions, and health; and
- International investments in relief efforts to save millions (and that is people, not dollars).

True—national security is often an issue of life and death. But to highlight the significance of domestic and international concerns, last year alone over six million people died of cancer worldwide, and the 2020 projection is 20 million deaths—yet our collective investment in research to combat this foe is less than 1% of defence spending. This begs the question—what real wars are to be lost while we collectively expend billions on space weapons—weapons that in all probability will merely pacify our paranoid insecurities.

Counter-Proposition 4: *Bad Precedent*

Should nations seek to move away from the precedent-based interpretation of international law that implicitly prohibits weapons in space, in favour of the literal interpretation that allows conventional weapons in space, it could pose an international precedent that would have grave consequences on the spirit of international cooperation recently built around suppressing aggression in the Middle East, and combating terrorism worldwide. It would also jeopardize broad efforts to negotiate on international issues of the gravest of import, such as weapons of mass destruction (WMD) proliferation and arms control. Principally, most nations favour the expansion of the Outer Space Treaty of 1967 to address and explicitly prohibit weapons migration to space.

SUMMARY COUNTER-PROPOSITION OPPOSING THE ADVENT OF SPACE WEAPONS: *A LOGICAL APPEAL*

Based upon the four preceding counter-propositions, weaponizing space is:

- Inappropriate (by almost any value-base);
- Military nonsense, as it is:
  - ineffective in the light of countermeasures (expanding and exposing a space centre of gravity);
  - destabilizing locally (escalatory);
  - destabilizing globally (inflammatory and threatening);
  - militarily ineffective (at the expense of many better alternatives).

additionally, weaponizing space is:

- Extremely costly (at costs that would cripple any national economy), and
- Politically unviable in a growing interdependent world of responsible nations.

It is evident that nations should simply choose to pursue avenues towards national and international objectives other than space weapons.

Again, I do not adhere to these counter-propositions either. What I have attempted to accomplish is lay a foundation at the poles of this space and global security issue:

- Are space weapons inevitable? Human nature seems to lead us there... and if so, should we not work now to create a stable international environment as they emerge? On the opposite pole...
- Counter to the natural progression... is there a better—rational—choice that we must work on now if we are to shape a future we would like to have?

To you, those actively working on such efforts here in Geneva, I would offer this closing.

Balancing the propositions that point to a "natural path" of weapons migration to space, with the counter-propositions that call for an "unnatural" and collective rational choice to prohibit weaponization is a complex and difficult challenge. A challenge that will require unprecedented levels of patient discussions—and concessions—in a context that includes many other equally important issues.

While you continue honourably to represent your country's positions, values, and people, also remember that you have a greater obligation. You are representing all future generations of this increasingly small planet and in these brief moments—your opportunity to change history—remember that agreements made here will echo in eternity. I implore each of you to work on your domestic politics and encourage support for selfless steps forward on the space weapons issue and the other critical issues addressed here in Geneva. Do not allow one issue to become a stumbling block and prevent discussions on the many issues that must be addressed.

On the space weapons issue in particular, in a hundred years, will the historical account show man's intentional but fumbling and ad hoc migration to space, or will it show a community of nations with a noble vision, making a rational choice? If the latter, it will take selfless concession, wise decision, and commitment and perseverance of action.

What I fear most is not what decision might come of this, but the path of indecision we seem to be on. Is it possible to get to such a decision? On that, I am reminded of a comment made by Henry Ford: "In the end, if we think we can, or if we think we cannot, we are probably right."

This is a breakpoint in human history, and you are squarely at the centre of it. From one person that appreciates the responsibility you have accepted, I would like to say emphatically, THANK YOU and God's speed.

CHAPTER 2

CURRENT AND FUTURE MILITARY USES OF SPACE

Peter L. Hays

WHAT IS SPACEPOWER?

"Spacepower" is literally a cosmic concept that is complex, indeterminate, and intangible. It is pregnant with a range of possibilities but it means so many different things to different people and groups that the concept is fraught with ambiguity. Confusion swirls on the semantic level because there is no commonly accepted definition or accepted wording for this concept.[1] There is not even agreement on basic issues such as where the atmosphere ends and space begins.[2] Yet, despite these weaknesses in the conceptual foundation for spacepower, a strong and widespread consensus has developed concerning the growing importance of space to global security. Indeed, this is a central theme in much recent literature such as the Space Commission Report, Barry D. Watts' *The Military Use of Space*, Steven Lambakis' *On the Edge of Earth*, Everett C. Dolman's *Astropolitik* and Bob Preston's *Space Weapons: Earth Wars*.[3] In addition, spacepower has figured very prominently in several of the most recent Title X wargames conducted by the US Army and Air Force.[4]

This paper explores the emerging consensus on space's growing importance but takes a wide-ranging perspective on the attributes that comprise spacepower, sees the elements of spacepower as interrelated and multidimensional, and emphasizes that the determinants of space's strategic utility go beyond just international military competition. It first looks at ways to categorize spacepower such as space activity sectors, military space mission areas, and David Lupton's four military space doctrines. It also examines a broad range of factors that shape our perceptions and use of space. Throughout, it argues that economic factors now shape spacepower in fundamental ways, primarily due to rapid growth in commercial space activities and the inherently dual-use nature of most space systems.

Ways to Categorize Spacepower

Space Activity Sectors

The attributes of spacepower are often described using four sectors of space activity: civil, commercial, military and intelligence.[5] The Space Commission Report provides an outstanding, current, and comprehensive overview of the types of activities that are contained in each sector and how they contribute to national security.

Civil Space Sector

The civil space sector is approaching a long-standing goal of a permanent manned presence in space with the deployment of astronauts to the International Space Station. The US has shouldered the largest share of development and funding for this effort. Because it is an international programme, however, its benefits for scientific research, experimentation and commercial processes will be widely shared. The number of countries able to participate in manned space flight has grown substantially. In addition to the US and the USSR (now the Russian Federation), 21 other countries have sent astronauts into orbit in US and Russian spacecraft. The People's Republic of China has announced its intention to become the third nation to place human beings in orbit and return them safely to Earth. Other research and experiments in the civil sector have many applications to human activity. For example, civil space missions to understand the effects of the sun on the Earth, other planets and the space between them, such as those conducted by the Solar Terrestrial Probe missions, will help in the development of more advanced means to predict weather on Earth.

Commercial Space Sector

Unlike the earlier space era, in which Governments drove activity in space, in this new era certain space applications, such as communications, are being driven by the commercial sector. An international space industry has developed, with revenues exceeding US$ 80 billion in 2000. Industry forecasts project revenues will more than triple in the next decade. Whereas satellite system manufacturing once defined the market, the growth of the space industry today, and its hallmark in the future, will be space-based services. The space industry is marked by stiff competition among commercial firms to secure orbital locations for satellites and to secure the use of radio frequencies to exploit a global market for goods and services provided by those satellites. International consortia are pursuing many space enterprises, so ascertaining the national identity of a firm is increasingly complex. The calculations of financial investors in the industry and consumer buying habits are dominated by time to market, cost and price, quantity and quality. It is a volatile market.

Nevertheless, as a result of the competition in goods and services, new applications for space-based systems continue to be developed, the use of those products is increasing and their market value is growing. Space-based technology is revolutionizing major aspects of commercial and social activity and will continue to do so as the capacity and capabilities of satellites increase through emerging technologies. Space enters homes, businesses, schools, hospitals and government offices through its applications for transportation, health, the environment, telecommunications, education, commerce, agriculture and energy.

Space-based technologies and services permit people to communicate, companies to do business, civic groups to serve the public and scientists to conduct research. Much like highways and airways, water lines and electric grids, services supplied from space are already an important part of the US and global infrastructures. The most telling feature of the new space age is that the commercial revolution in space has eliminated the exclusive control of space once enjoyed by national defence, intelligence and government agencies. For only a few thousand US dollars, a customer today can purchase a photograph of an area on Earth equal in quality to those formerly available only to the super-Powers during the Cold War. Commercial providers can complement the photographic images with data that identify the location and type of foliage in an area and provide evidence of recent activity there. They can produce radar-generated maps with terrain elevations, transmit this information around the globe and combine all of it into formats most useful to the customer. This service is of increasing value to farmers and ranchers, fishermen and miners, city planners and scientists.

Defence Space Sector

Space-related capabilities help national leaders to implement US foreign policy and, when necessary, to use military power in ways never before possible. Today, information gathered from and transmitted through space is an integral component of US military strategy and operations. Space-based capabilities enable military forces to be warned of missile attacks, to communicate instantaneously, to obtain near real-time information that can be transmitted rapidly from satellite to attack platform, to navigate to a conflict area while avoiding hostile defences along the way, and to identify and strike targets from air, land or sea with precise and devastating effect. This permits US leaders to manage even distant crises with fewer forces because those forces can respond quickly and operate effectively over longer ranges. Because of space capabilities, the US is better able to sustain and extend deterrence to its allies and friends in our highly complex international environment. Space is not simply a place from which information is acquired and transmitted or through which objects pass. It is a medium much the same as air, land or sea. In the coming period, the US will conduct operations to, from, in and through space in support of its national interests both on Earth and in space. As with national capabilities in the air, on land and at sea, the US must have the capabilities to defend its space assets against hostile acts and to negate the hostile use of space against US interests.

Intelligence Space Sector

Intelligence collected from space remains essential to the mission of the Intelligence Community, as it has been since the early 1960s. Then the need to gain access to a hostile, denied area, the USSR, drove the development of space-based intelligence collection. The need for access to denied areas persists. In addition, the US Intelligence Community is required to collect information on a wide variety of subjects in support of US global security policy. The Intelligence Community and the Department of Defense deploy satellites to provide global communications capabilities; verify treaties through “national technical means”; conduct photo reconnaissance; collect mapping, charting, geodetic, scientific and environmental data; and gather information on natural or man-made disasters. The US also collects signals intelligence and measurement and signature intelligence from space. This intelligence is essential to the formulation of foreign and defence policies, the capacity of the President to manage crises and conflicts, the conduct of military operations and the development of military capabilities to assure the attainment of US objectives.[6]

Military Space Mission Areas

Another important typology for describing spacepower was first adopted by the US military in the 1980s and still provides a foundational and consistent framework to categorize the military missions that contribute to spacepower.[7] Under this typology, space support is a very broad category that contains all activities that enable military space mission accomplishment. Space support includes the development and acquisition of all military space hardware and software; all the infrastructure required to launch, track, and command military space systems; and all the personnel and the education and training systems required to sustain military space activities. **Force enhancement** is the primary emphasis of today's military space forces. This mission refers to all military space activities that help to increase the war-fighting effectiveness of terrestrial forces and is sometimes referred to as "space support to the war fighter". Table 1 lists current and near-term space systems most closely associated with six force enhancement missions. There is widespread consensus on the elements that constitute these two military space mission areas and general agreement that the United States should perform these types of missions from space.

By contrast, there is much less consensus on the types of functions that would be required for space control and force application or on the need for the US military to perform such missions. **Space control** "operations provide freedom of action in space for friendly forces while, when directed, denying it to an adversary, and include the broad aspect of protection of US and US allied space systems and negation of adversary space systems".[8] The use of anti-satellite (ASAT) weapons is one commonly discussed space control mission, but a wide range of missions—including conventional or unconventional attacks on terrestrial tracking, telemetry, and command (TTC) facilities—would also fall into the space control area. The final category, **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 ballistic missile defence and force projection. Currently, there are no force application assets operating in space".[9] Most military space activities fit into one of these four categories and, of course, most of today's military space activities are in the first two categories: space support and force enhancement.

Table 1: Force Enhancement Mission Areas, Primary Orbits, and Associated Space Systems[10]

Geodesy	Environmental Monitoring	Communications	Position, Velocity, Time and Navigation	Integrated Tactical Warning and Attack Assessment	Intelligence, Surveillance and Reconnaissance
Low Earth Orbit (LEO)	Polar LEO	Geostationary Orbit (GSO)	Semi-synchronous Orbit	GSO and LEO	Various
Landsat	Defense Meteorological Support Program (DMSP), National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	Defense Satellite Communications System (DSCS) II, DSCS III, Ultra-High Frequency Follow-on (UFO), MILSTAR, Global Broadcasting System (GBS), Advanced Extremely High Frequency (AEHF), Wideband Gapfiller Satellite (WGS)	Global Positioning System (GPS)	Defense Support Program (DSP), GPS, Space-Based Infrared System (SBIRS) High and Low	Legacy Systems, Future Imagery Architecture (FIA), Integrated Overhead Signals Intelligence Architecture (IOSA)

Lupton's Four Military Space Doctrines

The four military space doctrines developed by David Lupton in *On Space Warfare* provide an important and comprehensive way to analyse the strategic rationale behind military space activities (they are summarized in Table 2).[11]

Table 2: Attributes of Military Space Doctrines

<table>
<tr><th></th><th>Primary Value and Functions of Military Space Forces</th><th>Space System Characteristics and Employment Strategies</th><th>Conflict Missions of Space Forces</th><th>Appropriate Military Organization for Operations and Advocacy</th></tr>
<tr><td>Sanctuary</td><td>- Enhance Strategic Stability
- Facilitate Arms Control</td><td>- Limited Numbers
- Fragile Systems
- Vulnerable Orbits
- Optimized for NTMV mission</td><td>- Limited</td><td>NRO</td></tr>
<tr><td>Surviva-bility</td><td>Above functions plus:
- Force Enhancement</td><td rowspan="3">- Distributed Networks
- Redundancy
- Hardening
- On-Orbit Spares
- Crosslinks
- Manoeuvre
- Less Vulnerable Orbits
- Stealth
- Reconstitution Capability
- defence
- Convoy
- 5Ds</td><td>- Force Enhancement
- Degrade Gracefully</td><td>Major Command or Unified Command</td></tr>
<tr><td>Control</td><td>- Control Space
- Significant Force Enhancement</td><td>- Control Space
- Significant Force Enhancement
- Surveillance, Offensive, and Defensive Counterspace</td><td>Unified Command or Space Force</td></tr>
<tr><td>High Ground</td><td>Above functions plus:
- Decisive Impact on Terrestrial Conflict
- BMD</td><td>Above functions plus:
- Decisive Space-to-Space and Space-to-Earth Force Application
- BMD</td><td>Space Force</td></tr>
</table>

The **sanctuary** doctrine builds on President Dwight Eisenhower's concepts of "open skies" and "space for peaceful purposes" by emphasizing that space systems are ideal for monitoring military activity, providing early warning to reduce the likelihood of surprise attack, and serving as National Technical Means of Verification (NTMV) to enable and enforce strategic arms control. The basic tenet of the sanctuary doctrine is that space surveillance systems make nuclear wars less likely. Sanctuary doctrine is closely linked to deterrence theory and the assumption that no meaningful defence against nuclear attack by ballistic missiles is possible. Sanctuary doctrine advocates believe that overflight and remote sensing enhance stability and that space must be kept a weapon-free zone to protect the critical contributions of space surveillance systems to global security. **Survivability**, Lupton's second space doctrine, emphasizes broad utility for military space systems, not only at the strategic level emphasized in the sanctuary doctrine, but also at the tactical level of space support to the war fighter that has emerged as the most important force enhancement mission since the end of the Cold War.

The survivability doctrine also differs from the sanctuary doctrine because it highlights space system vulnerabilities and questions whether space can be maintained as a sanctuary due to ongoing technological improvements in systems such as ASAT weapons. Lupton's **control** doctrine is analogous to military thinking about sea or air control and asserts the need for control of space in order to apply spacepower most effectively. Thus, the control doctrine sees space as similar to other military environments and argues that both commercial activities and military requirements dictate the need for space surveillance, as well as offensive and defensive counterspace capabilities. Lupton's final doctrine, **high ground**, argues that space is the dominant theatre of military operations and is capable of affecting terrestrial conflict in decisive ways. As a primary example of such capability, the high-ground doctrine points to the potential of space-based ballistic missile defence (BMD) to overturn the dominance of offensive strategic nuclear forces.

Sea-power and Air-power Analogies

Another direct and obvious set of factors shaping our perceptions of spacepower are the oft-invoked analogies between spacepower and sea-power or air-power. There is, of course, a rich literature on sea-power and air-power theory. Seminal theorists who developed important perspectives on military operations in these two mediums include: Alfred Thayer Mahan, Julian Corbett, Giulio Douhet, William "Billy" Mitchell, and John Warden.[12] Some of the key concepts that these theorists developed or applied to the air and sea mediums are command of the sea, command of the air, sea lines of communication, common routes, choke points, harbour access, concentration and dispersal, and parallel attack. Several of these concepts have been appropriated directly into various strands of embryonic space theory; others have been modified slightly, then applied. For example, Mahan and Corbett's ideas about lines of communication, common routes, and choke points have been applied quite directly onto the space medium. Sea-power and air-power concepts that have been modified to help provide starting points for thinking about spacepower include harbour access and access to space, and command of the sea or air and space control.[13] But, of course, to date no comprehensive spacepower theory has yet emerged that is worthy of claiming a place alongside the seminal sea-power and air-power theories listed above.[14]

There are also many fundamental questions concerning the basic attributes of the space medium and how appropriate it is to analogize directly from sea-power or air-power theory when attempting to build spacepower theory. Few concepts from sea-power theory translate directly into air-power theory—why should we expect either sea-power or air-power theory to apply directly for the distinct medium of space? Questions concerning the attributes of space and the proper way to build space doctrine are also at the heart of the disagreements between the Air Force and the rest of the DoD over whether air and space should be treated as a seamless operational medium (defined as aerospace by the Air Force) or regarded as distinct air and space mediums (as seen by the rest of DoD).[15]

> [M]any of the problems with the aerospace concept and the development of space-power theory and doctrine have already been thoughtfully addressed in this [*Aerospace Power*] journal over the years. Dennis Drew, Charles Friedenstein, and Kenneth Myers and John Tockston published three of the best analyses during the 1980s.[16] These interrelated articles build on Drew's doctrine-tree model—the idea that doctrine should grow out of the soil of history, develop a sturdy trunk of fundamental doctrine, branch out into doctrine for specific environments, and only then attempt to sprout the organizational doctrine analogous to "leaves". This approach provides a comprehensive way to examine the aerospace concept and the Air Force's first official space doctrine, Air Force Manual (AFM) 1-6, *Military Space Doctrine*,

> released in 1982.[17] Friedenstein finds that "there is no doctrinal foundation for the term *aerospace*" (emphasis in original) and critiques the Air Force for attempting to produce "leaves on a nonexistent branch" because it had not developed environmental doctrine before issuing the organizational doctrine in AFM 1-6.[18] Myers and Tockston strongly critiqued the Air Force's tendency to "force-fit" space doctrine into the mold of air doctrine and argued that the three major characteristics of space forces are in fact emplacement, pervasiveness, and timeliness.[19]

Thus, despite several efforts to appropriate or adapt key concepts from sea-power and air-power theory, we are currently still adrift without a comprehensive spacepower theory to guide us and would be wise to cast our nets more widely and beyond traditional national security considerations.

Does Spacepower Constitute a Revolution in Military Affairs?

As with virtually everything else associated with spacepower, there is a wide range of opinion on this question. In order to address this question, we must first engage the issue of revolutions in military affairs (RMAs) more generally. During the 1990s, discussion of RMAs became a cottage industry within strategic studies and defence policy analysis. Unfortunately, to this analyst at least, it is unclear whether this whole endeavour has generated more light than heat. Nonetheless, in order to continue we need some working definition of RMA and some sense of what constituted past RMA.

This paper adopts the definition of RMA advanced by Dr. Andrew Krepinevich and his Center for Strategic and Budgetary Assessments (CSBA). They define an RMA as a major discontinuity in military affairs.

> They are brought about by changes in militarily relevant technologies, concepts of operation, methods of organization, and/or resources available, and are often associated with broader political, social, economic, and scientific revolutions. These periods of discontinuous change have historically advantaged the strategic/operational offense, and have provided a powerful impetus for change in the international system. They occur relatively abruptly—most typically over two-to-three decades. They render obsolete or subordinate existing means for conducting war.[20]

CSBA makes the case that there have been "at least a dozen cases of revolutionary change in the conduct of war: Chariot, Iron Age Infantry, Macedonian, Stirrup, Artillery/Gunpowder, Napoleonic, Railroad, Rifle, Telegraph, Dreadnought/Submarine, Air Superiority/Armored Warfare, Naval Air Power, and Nuclear Weapons".[21] Brief descriptions of the six most recent RMAs help to clarify the concept further:

> *The Napoleonic Revolution*. During the last decade of the eighteenth century, a social and political revolution in France transformed war. The advent of universal conscription—the *levée en masse*—dramatically expanded the size of armies and increased their reconstitutability. Equally important, the new conscript armies—composed of literate citizen soldiers—had a fundamentally different relationship to the societies from which they were drawn. All-weather roads and a new form of military organization—the corps—transformed logistics, and mass column assaults and mobile artillery transformed tactics.
>
> *The Railroad, Rifle, and Telegraph Revolution.* The commercial development of the railroad and telegraph and the military development of the breech-loading rifle between 1840 and 1870 revolutionized war on land. The railroad revolutionized logistics, the rifle transformed tactics, and the telegraph fundamentally changed strategic command and control. With the advent of the railroad and telegraph, time, i.e., speed of mobilization, became a critical measure of military effectiveness. The large-scale movements of armies made possible by the new industrial infrastructure also gave birth to a new level of war—the operational level. By often giving statesmen a better sense of the overall military situation than that possessed by senior commanders in the field, the telegraph also transformed civil-military relations.
>
> *The Dreadnought/Submarine Revolution*. The advent of steam propulsion and metal construction in naval shipbuilding ushered in a period of near constant technological change during the last decades of the nineteenth century. The completion in 1906 of the H.M.S. Dreadnought—the world's first all-big gun, turbine-driven battleship—provided existential evidence of another revolution in military affairs. With its uniform main armament—

ten 12-inch guns—Dreadnought could outshoot any older warship. A principal impetus of the Dreadnought Revolution—the submarine—proved to be equally revolutionary. As a result of the increasing threat that these new weapons posed to battlefleets, the long-standing naval strategy of close blockades of enemy ports had to be abandoned. Even more important, the "hierarchy of power" in naval warfare, which had been established with the advent of the capital ship more than three centuries earlier, had been severely undermined.

Armored Warfare/Air Superiority. The stunning victory of German forces over the French, British, Dutch, and Belgian armies in May-June 1940, marked another departure in land warfare. From then on, the unit of account in measuring any army's strength would no longer be the number of soldiers it had under arms. While the development of armored warfare depended upon the maturation of the dominant technology—the tank—technology itself was not sufficient to effect the revolution. Several other developments—in supporting technologies (e.g., tank radios), organization (combined arms formations and supporting air arms), operational concepts (deep penetrations on narrow fronts and air superiority), and climate of command (mission-oriented tactics, or *Auftragstaktik*)—were essential components of the transformation launched by the blitzkrieg.

Naval Air Power. World War II also saw a transformation of war at sea. With the advent of naval air power, fleets that formerly could not engage their enemy unless they were in visual range could now hurl blows at one another from distances of hundreds of miles. Moreover, whereas naval battles had previously been characterized by gunnery duels, destructive force could now be delivered in great pulses of power. As with armored warfare, the breakthroughs in carrier warfare depended upon a number of developments: modifying airplanes so that they were rugged enough to withstand the problems associated with landing and taking off at sea, developing techniques to manage space on a crowded deck, employing carriers in combined strike forces to attack land and sea targets, etc. By the autumn of 1943, when American building programs began to amass the sheer numbers of platforms required for sustained large-scale carrier operations, the transformation of war wrought by the ascendance of naval air power had become complete.

The Nuclear Revolution. The detonation of atomic bombs over Hiroshima and Nagasaki provided evidence of another military revolution. Far exceeding the prophesies of even the most zealous pre-war strategic bombing theorists, subsequent developments in intercontinental ballistic missiles and nuclear fusion brought the prospect of nearly instantaneous destruction of whole societies into the strategic calculus. As with previous revolutions, the advent of nuclear weapons saw the emergence of new warfighting doctrines and military organizations. In the minds of most strategists, however, the sole purpose of the new weapons had shifted from warfighting to deterrence.[22]

The question, however, remains whether the military and strategic contributions of spacepower to date constitute an RMA. Some analysts make the case that spacepower's contributions in the Gulf war (the first space war) already mark it out as an RMA. Others make the case that, regardless of its specific performance in any individual war, spacepower *is* the RMA.[23] It is probably more useful, however, to view the current relationship between spacepower and RMAs in two primary ways: first, in terms of spacepower's pre-eminent **contributions** that enable the global reconnaissance, precision strike RMA that first emerged in the Gulf war; and, secondly, in terms of spacepower's **autonomous** but nascent potential for a space weaponization RMA.

Many systems combine into the system of systems that create the global reconnaissance, precision strike RMA that has more clearly emerged and become increasingly powerful over the course of the past decade. Some of the more important systems for this RMA include: modern communications, command, control, computers, intelligence, surveillance, and reconnaissance (C^4ISR) systems, stealth platforms, and precision weapons. Spacepower makes the single most comprehensive and important contribution to this RMA. Among other things, spacepower fuels this RMA with 24/7 global ISR, it binds it together with communications connectivity, and it enables precision strike via GPS. In many cases, space provides the best or even the only medium from which to make these enabling contributions. In sum, it is clear that spacepower has now moved well beyond merely enhancing terrestrial forces and has become the single most important contribution that enables the global reconnaissance, precision strike RMA.

Space weapons also hold the potential to revolutionize warfare in even more powerful and fundamental ways. They could operate from the lowest tactical level up through the grand strategic level, could provide nearly instantaneous and simultaneous global strikes, and might even minimize the power of offensive nuclear forces. Such systems would create an RMA at least as profound as the six cases of modern RMAs discussed above. The path to space weaponization, however, still contains many extremely difficult political, fiscal, and technical challenges. Moreover, before starting down the path to space weaponization, we must avoid the fallacy of the last move by anticipating that such powerful weapons will almost inevitably provoke countermeasures in the unending dialectic between offensive and defensive weapons. Cumulatively, the breadth and depth of the challenges for space weapons to overcome mean that this RMA may not emerge for some time to come—despite all its potential. As emphasized in the *Space Commission Report*, space weaponization is probably inevitable over the long run. How and when weaponization occurs is likely to be shaped more by political factors than by technological considerations.

Military Space Cooperation: Opportunities and Challenges

Military space cooperation, like most space issues, is a complex and contentious issue area. Examining opportunities and challenges in military space cooperation may help to illuminate several of the most likely paths forward for future space activity and highlight the security implications of these developments.

Space Weaponization

At a fundamental level, virtually all issues of space strategy and military space cooperation are shaped by the spectrum of views on the utility of weaponizing space. Major questions include: whether space will be weaponized, how and when that might happen, which States and other actors might be most interested in leading or opposing weaponization, and how any of these space weaponization issues might best be controlled. At the political level, there is, of course, a broad spectrum of opinion on these issues but most of the major tenets in mainstream views on weaponizing space can usefully be grouped into four major camps: space hawks, inevitable weaponizers, militarization realists, and space doves.[24]

Space Hawks

Adherents to this camp believe that space already is or holds the potential to become the dominant source of military power. Accordingly, they believe that the United States should move quickly and directly to develop and deploy space weapons in order to control and project power from this dominant theatre of combat operations. According to Republican Senator Bob Smith of New Hampshire, for example, concerted development of space weapons by the United States "will buy generations of security that all the ships, tanks, and airplanes in the world will not provide … Without it, we will become vulnerable beyond our worst fears".[25] In addition, space hawks often point to space-based BMD as a potentially decisive weapon capable of fundamentally reordering the strategic balance. Space hawks tend to oppose virtually all space-related arms control and are lukewarm at best on military space cooperation because of the potential of these activities to slow or derail rapid and direct space weaponization.

Inevitable Weaponizers

This group believes that space, like all other environments man has encountered, will eventually be weaponized. They differ from space hawks in two important ways: they are not convinced that space weaponization would be beneficial for US or global security, and they are unsure that space will prove to be the decisive theatre of combat operations. The *Space Commission Report* is a good example of this camp: "We know from history that every medium—air, land and sea—has seen conflict. Reality indicates that space will be no different. Given this virtual certainty, the United States must develop the means both to deter and to defend against hostile acts in and from space."[26] Inevitable weaponizers take a nuanced view of space arms control and cooperation. They generally support confidence- and security-building measures (CSBMs) and other cooperative mechanisms designed to slow military competition and channel it in predictable ways. But they are less supportive of broad efforts to ban space weapons because they see them as futile or even dangerous due to their potential to lull the

United States into complacency or otherwise cause it to be outmanoeuvred by States that successfully circumvent space weaponization accords.

Militarization Realists

Members of this camp oppose space weaponization because they believe US security interests are best served by the status quo in space. They believe that the United States has little to gain but much to lose by weaponizing space because it is both the leading user of space and, enabled by this space use, the dominant terrestrial military Power. Militarization realists also believe that if the United States takes the lead in weaponizing space, it would become easier for other States to follow due to lower political and technological barriers. For these reasons, militarization realists believe that "fighting *into* space looks feasible and we should plan for the eventuality. Fighting *in* space shows little promise, while fighting *from* space looks impractical for the foreseeable future, with or without treaties" (emphasis in original).[27] Militarization realists support space-related arms control and cooperation that precludes other States from weaponizing or even militarizing space. Most of them believe, however, that this support must be balanced against the increased attention that formalized arms control efforts could draw to the United States' already formidable space-enabled force enhancement capabilities and the political, military, and arms control fallout this increased scrutiny might cause. Informal cooperation might be one of the best ways to circumvent this potential difficulty.

Space Doves

Finally, a wide range of organizations and viewpoints can be grouped together in the space dove camp because they all oppose space weaponization for a variety of reasons including moral, arms control, conflict resolution, stability, and ideology arguments. Most space doves also oppose any militarization of space beyond the limited missions they see as stabilizing—national technical means (NTM) of arms control verification, early warning, and hotline communications—because they see any military missions beyond these as the "slippery slope" to space weaponization. Most space doves emphasize how destabilizing most space militarization and all space weaponization would be. "Unlike the strategy for nuclear weapons, there exists no obvious strategy for employing space weapons that will enhance global stability. If the precedent of evading destabilizing situations is to continue—and that is compatible with a long history of US foreign policy—one ought to avoid space-based weapons".[28] They also highlight the deep roots of President Eisenhower's "space for peaceful purposes" policy and argue that, especially in the post-Cold War era, there is no rationale for space weaponization that is strong enough to overturn the basic strategic logic the United States developed at the opening of the space age. Space doves support space arms control and cooperation more strongly than any other camp. Since they do not believe the United States (or other States) would reap strategic benefits from weaponizing space, they are not overly concerned about the numerous arms control challenges identified by the other camps. Moreover, like Paul Stares, most space doves would not support using two-track approaches to space arms control.[29]

These ingrained but fundamentally divergent perspectives on space weaponization, space's strategic utility, and the role for space arms control are likely to make it quite difficult to craft cooperative approaches or even to establish a dialogue concerning the interrelationships between space and security. It is difficult to see a clear cooperative path forward for the United States or the global space community. The realist lens in global politics and Graham Allison's rational actor (Model I) lens in domestic politics portend a rocky path forward.[30] Likewise, it is also difficult to see clear lines of military space cooperation through regimes or epistemic communities or by applying Graham Allison's Models II and III to the multiplicity of organizations and individuals that contribute to the pulling and hauling of governmental decision-making within a pluralist democracy such as the United States. Clearly, it would be a formidable challenge to provide enough incentives and assemble coalitions capable of pushing forward any camp's preferred vision for space competition or cooperation. Given this environment, it seems unlikely that the United States can or will provide strong or consistent leadership for military space cooperation. It is more likely that the United States would move forward in response to external space arms control initiatives or trigger events related to the weaponization of space.[31]

On the technical side of the equation, space arms control and formalized cooperation designed to control the weaponization of space face all of the problems that plagued previous attempts to develop these control mechanisms. The most serious of these problems include: disagreements over the proper scope and object of negotiations; basic definitional issues about what a space system is and how it might be categorized as offensive or defensive and stabilizing or destabilizing; and questions concerning how any agreement might be adequately verified. These problems relate to a number of very thorny specific issues such as: whether the negotiations should be bilateral or multilateral and formal or informal; what satellites and other systems should be covered; whether the object should be control of space weapons or CSBMs for space; which types of CSBMs such as rules of the road or keep-out zones, for example, might be most useful and how these might be reconciled with existing space law such as the Outer Space Treaty (OST); and verification problems such as how to address residual ASAT capabilities or deal with the significant military potential of even a small number of covert ASAT systems.

New space system technologies, the growth of the commercial space sector, and new verification and transparency technologies interact with these existing problems in complex ways. Some of the changes would seem to favour arms control and cooperation, such as better radars and optical systems for improved space situation awareness and verification, technologies for better space system diagnostics, and the stabilizing potential of microsatellite-based distributed and robust space architectures. Many other trends, however, would seem to make space arms control and cooperation even more difficult. For example, stealthy microsatellites might be used as virtually undetectable active ASATs or passive space mines; the proliferation of space technology has radically increased the number of significant space actors, and these ranks now include a number of important non-State actors; and growth in the commercial space sector raises issues such as how quasi-military systems should be protected or negated and the unclear security implications of emerging markets for dual-use systems. Cumulatively, just as with the political factors that animate the four space camps discussed above, it is hard to see many technical factors that would clearly advance space arms control and cooperation designed to control space weaponization.

Recent Space-Related Arms Control and Regulation Issues

With the end of the Cold War, many formal arms control efforts have been de-emphasized, and most space-related arms control efforts are no exception. There have been, nonetheless, some very important space-related provisions in recent treaties and agreements. Moreover, the recent growth in commercial space activity undoubtedly creates an opportunity, if not a need, for expanded regulation and control in this area. This section briefly reviews some of the most important recent developments.

Strategic Arms Reduction Treaty (START) I and II

The 1991 START I is a bilateral treaty between the United States and the Soviet Union designed to reduce the number of deployed strategic offensive arms (warheads and delivery vehicles) maintained by each.[32] Several of the broad provisions in START I build on previous arms control treaties. For example, START I repeats the NTM provisions first contained in the ABM Treaty but also relies on extensive OST verification protocols to assure compliance.[33] In addition, START I strengthens the OST prohibition on the placement of weapons of mass destruction in outer space. Article V, paragraph 18, of the Treaty prohibits each party from producing, testing, or deploying 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.[34] This is an important provision designed to ban fractional orbital bombardment systems such as the one successfully tested by the Soviet Union from 1965 to 1971.[35]

START I has many new implications for military space operations as well. There are several restrictions on the use of intercontinental balllistic missiles (ICBMs) or submarine-launched ballistic missiles (SLBMs) as space-launch boosters. For example, the Treaty places restrictions on the number, type, and location of ICBMs and SLBMs used to boost objects into the upper atmosphere or space, and limits the number and location of space-launch facilities used to support such launches.[36] Objects launched by ICBMs or SLBMs into the upper atmosphere or space are also subject to the Treaty's telemetry requirements. In a major departure from past practice, the Treaty requires the party conducting any peacetime launch of an ICBM or SLBM to make on-board technical measurements, broadcast all telemetric information obtained from such measurements in a way that allows full access to the information, and then provide a recording and analysis of those data to the other party. For objects delivered by ICBMs or SLBMs into the upper atmosphere or space, the telemetry provisions only apply until the object(s) being delivered are either in orbit or have achieved escape velocity.[37] Furthermore, advance launch notification must be made to the other treaty party whenever an ICBM or SLBM is used as a booster for delivering objects into the upper atmosphere or space. Such notification is provided in accordance with the provisions of START I and the Ballistic

Missile Launch Notification Agreement.[38] START I might also affect ongoing space control and force application initiatives. For example, if the planned space operations vehicle was designed with a conventional strike capability, it might be held accountable under START I limitations on heavy bombers equipped for nuclear armaments other than long-range nuclear air-launched cruise missiles. No exhibition would be required, but the vehicle's distinguishing features would be listed in the START memorandum of understanding. In addition, the facility where the vehicle is based would have to be declared as a heavy bomber base but would not be subject to inspection unless it contained a weapons storage area. A determination of treaty applicability, if any, would be subject to discussion between the parties.[39]

The 1993 START II between the United States and the Russian Federation further reduces the number of deployed strategic offensive arms mandated by START I. All of the provisions of START I applicable to outer space described above also apply to START II. This Treaty is not in force, and it currently appears to have been completely superceded by the more comprehensive strategic arms control agreement signed in Moscow by Presidents George W. Bush and Vladimir V. Putin on 24 May 2002.[40] Factors currently weighing against START II entering into force or even serving as the basis for further negotiations include: the level at which the "floor" for deployed strategic offensive arms should be set, the proper relationship between strategic offensive and strategic defensive force in President Bush's "new strategic triad" and a world without the ABM Treaty, and the Bush Administration's seemingly limited enthusiasm for formal arms control.

Finally, in addition to the notifications required by the START Treaties and the Ballistic Missile Launch Notification Agreement, the United States and the Russian Federation have recently signed two new agreements expanding launch notifications to include all space launch vehicles. On 4 June 2000 at the Moscow Summit, President Clinton and Russian President Putin signed a memorandum of agreement to establish a Joint Data Exchange Centre (JDEC) in Moscow to share early warning information on missile and space launches.[41] Once JDEC is completed and commences operations, the two countries are supposed to exchange information obtained from their respective ground- and space-based early warning systems on US and Russian space launches (with rare exceptions) including time of launch, generic missile class, geographic area of the launch, and launch azimuth. Eventually this exchange of data will also include data-sharing on detected space launches of other States. On 16 December 2000, US Secretary of State Madeline K. Albright and Russian Foreign Minister Igor Ivanov signed a memorandum of understanding establishing a Pre- and Post-Missile Launch Notification System (PLNS) for launches of ballistic missiles and, with rare exceptions, space launch vehicles, identifying launch window, time of launch, generic missile class, geographic area of the launch, and launch azimuth.[42] The PLNS Information Centre will be an Internet-based system operated as part of JDEC. Both agreements provide for the voluntary notification of satellites forced from orbit and certain space experiments that could adversely affect the operation of early warning radars, and both agreements leave open the possibility of negotiations on future data-sharing on missiles that intercept objects not located on Earth's surface. JDEC and PLNS are among the most detailed and comprehensive space-related CSBMs ever negotiated. They are designed to enhance stability by limiting flexibility and clandestine operations. The wide spectrum of opinion on the utility of these latest agreements is another excellent illustration of how fundamental disagreements on military space strategy can colour all subsequent analysis.[43]

High-Resolution Commercial Imagery and Deception

Digitized data streams designed to produce imagery are ideally suited for deception. This is because digitized data must always be mathematically processed to create images, and this processing is subject to manipulation in a variety of ways—many of which are not available for manipulating film images. As Steven Livingston explains:

> Mathematically altering the value of the pixels alters *seamlessly* the representation. "Since it is purely a mathematically process, the source images can be altered fundamentally and undetectably before and/or during their production." Elements can be added or subtracted, changed in color, brightness, or contrast. Changes are made not by altering the computer code that produces the image, and not in the image itself as in analog manipulation. In fact, it is more accurate perhaps to say that no image exists beyond the mathematical equations that create a particular array of pixels. The equations are the image. Therefore as computer processors become faster and more powerful, so too does the ability to alter digital information.[44]

The phrase "altered fundamentally and undetectably" is absolutely loaded with implications. For starters, it means that virtually **anything** can be added, subtracted, or changed in digital imagery (or to any digital information) and that even experts cannot necessarily detect these changes. The possibilities for deception through manipulating digital imagery are literally unlimited. Perhaps even more alarmingly, all of this can happen in real time as the data stream is converted into manipulated imagery. It is no wonder that the digital age creates a number of legal conundrums and that the veracity of digitized information is increasingly being questioned in courtrooms.[45] At the very least, as "No More Secrets" summarizes, "[c]ommercially available high-resolution satellite imagery will trigger the development of more robust denial and deception and anti-satellite countermeasures".[46] Given this potential for deception, the USG and the news media should adopt a "dual phenomenology" requirement as a way to attempt to confirm the veracity of digitized imagery.

Control of High-Resolution Commercial Imagery

There are clearly a number of complex interdependencies that have and will continue to shape the global high-resolution commercial remote sensing market. The United States should continue to study and evaluate the evolution of this market to ensure that its policy objectives are being met. Regulatory mechanisms such as shutter control that the United States has put in place appear to provide an equitable balance between economic considerations and national security concerns. These mechanisms should also be self-regulating to a large degree. If the United States overuses shutter control, it may drive potential customers to foreign imagery providers; but such a control is required before the United States can create incentives for its high-resolution commercial remote sensing industry to dominate the global market. This area also offers the potential for novel means of control and exploitation. The requirement for imagery providers to use only USG approved encryption devices that allow USG access during periods of shutter control, especially when coupled with the potential to use digital data for deception, certainly presents some interesting possibilities for control and exploitation by leaving systems operating rather than shutting them off.

Finally, the United States should carefully and continuously re-evaluate whether the benefits that Presidential Decision Directive (PDD-) 23 is designed to create, such as greater transparency and market pre-eminence, do, in practice, actually outweigh the costs such as the use of these data for nefarious ends. So far the United States has attempted to shape the world market via mostly economic benefits rather than security considerations. It should rebalance that equation towards national security, perhaps by formal arms control restrictions on high-resolution commercial remote sensing, if the benefits do not outweigh the costs. If it becomes prudent to move in this direction, there are a number of unilateral and multilateral regulation and control options that the United States could pursue.[47]

In the latest developments in this area, during the campaign against terrorism in Afghanistan thus far, the National Imagery and Mapping Agency (NIMA) established a commercial "agreement of assured access" with the Space Imaging Corporation, reportedly for US$ 1.9 million per month. Under the terms of this agreement, Space Imaging could not sell or share its Afghanistan theatre imagery with anyone except the USG without NIMA approval until after 5 January 2002, and the contract could be extended beyond that date.[48] This agreement opens many interesting issues related to the utility of limiting information dissemination for public diplomacy, the media, and exploitation of enemy information channels. It also raises the issue of whether this agreement using market mechanisms has set a precedent that might well make it more difficult to invoke formal shutter control in the future.

Global Utilities

Because of all the growth in space systems and the services they provide, some analysts believe they should now be considered in a new way as global utilities that provide an essential foundation that enables the global information infrastructure. In some ways, the concept of global utilities is just another recognition of how much the commercial space sector has grown and how important it has become; but it is also clear that the global information infrastructure as it currently exists simply could not function without space systems and the services they provide. This section attempts to define what global utilities are and then discusses arms control and regulatory mechanisms that might help to protect and enhance these essential services.

Global utilities have been defined as: "Civil, military, or commercial systems—some or all of which are based in space—that provide communication, environmental, position, image, location, timing, or other vital technical services or data to global users."[49] To date, all space-based global utilities provide information services, but they are analogous to Earth-bound utility services that provide a foundation for modern life such as water and electricity. And like these Earth-bound utility services, space-based global utilities may be subject to regulation and control at the local, state, national, and international levels. Two recent relatively minor failures illustrate just how embedded global utilities have become in the global information infrastructure. In 1996, a controller at the Air Force GPS control centre accidentally put the wrong time into just one of the 24 satellites, and this erroneous signal was broadcast for just six seconds before automatic systems turned the signal off. That momentary error caused more than 100 of the 800 cellular telephone networks on the US East Coast to shut down, and some took hours or even days to recover.[50] In May 1998, "40-45 million pager subscribers lost service; some ATM and credit card machines could not process transactions; news bureaux could not transmit information; and many areas lost television service—all because of the loss of *one* satellite" (emphasis in the original).[51] Clearly, space systems have become an increasingly important part of the global information infrastructure, but questions remain about how they should be regulated and protected.

How global utilities should be controlled and regulated is a complex issue that depends on a number of factors such as the specific systems in question, the services they provide and the primary users. Communication satellites are already subject to significant control and regulation at the international level through the International Telecommunication Union (ITU) and in the United States through the Federal Communications Commission (FCC). This high level of regulation for communication satellites is justified both because of the threat of harmful interference in the radio spectrum and due to the lucrative nature of these services. Other areas within the commercial space sector that have yet to demonstrate much profitability such as high-resolution remote sensing are also subject to regulation and control, but it is generally at a lower level. The United States provides other global utility services such as meteorological data and GPS timing signals free to all users worldwide as a public good. Given the current range of existing regulation and control for global utility services, it is not clear what national security or economic objectives would be served by attempting to regulate these services in the same or even similar ways.

In addition, the United States should consider how global utilities might best be protected and fostered as an enabling technology within the global information infrastructure. Unfortunately, no clear or easy answers stand out, and there is a wide range of views on the best path forward. Despite the many threats detailed above, to date there has been almost "no demand from the operators of commercial communication satellites for defence of their multibillion-dollar assets".[52] The current lack of support from industry for protection of global utilities is particularly disappointing to the United States Space Command (USSPACECOM) because during the late 1990s, it had attempted to advance the argument that such protection was needed and would be demanded as space commercialization grew.[53] Some analysts believe that a multilateral approach to protection for global utilities would be best and argue that this function should be performed by an international organization such as the United Nations. This approach would, however, likely be filled with all the political, economic, and technical difficulties that have plagued almost all international space efforts. The rocky path of the International Space Station certainly does not inspire confidence in this approach to providing protection for global utilities. At the opposite end of the spectrum are those who advocate that the US military, and the Air Force in particular, should take on the global utility protection mission regardless of international opposition or a lack of support from industry. On top of the political opposition to this approach, creating a viable defense for global utilities also faces daunting economic and especially technical challenges such as those posed by a high-altitude nuclear detonation. Based on the technologies currently being examined, only a robust space-based system would stand much chance of providing an effective defence against the most threatening attacks on global utilities.[54]

Spectrum Crowding, Orbital Debris and Space Traffic Control

The final contentious area examined in this paper is related to the cumulative effects of greater use of space. Current and projected use of space is creating challenges particularly in the areas of crowding of the radio spectrum for space, orbital debris, and the possible need for space traffic control. This section discusses these issues and outlines some potential control and regulation mechanism that might help to address them.

Recent growth in commercial space activity has exacerbated crowding of the radio spectrum for space applications and there are currently significant pressures on portions of the spectrum now allocated to military uses. In particular, today there is a great deal of pressure to move DoD out of the 1755 to 1850 MHz band in order to auction it off for third-generation communications applications. It is not clear, however, that US national security or even economic interests would benefit from moving DoD out of this band. As the General Accounting Office report on this issue makes clear, more study is required, and, in particular, the issue must be carefully reconsidered in the light of the radically reduced bandwidth requirements that will undoubtedly accompany the economic recession the global economy seems to be entering. More generally, the increasing pressure on the radio spectrum due to more commercial use of space has been somewhat balanced by the use of new technologies and different orbits that lessen the effects of increased use. For example, modern satellites in GSO have only two degrees of spacing between them (versus three or more degrees in the past) for most systems providing fixed satellite services. Likewise, increasing use of non-GSO communication satellite networks may decrease the pressure on overcrowding GSO in terms of spectrum and spacing. In sum, then, current trends for the space radio spectrum do not augur major changes in the current regulatory structure. Moving ITU to auctions for its coordination/registration process would undoubtedly produce greater efficiency and generate income, but these benefits would need to be weighed against the equal access concerns of the developing world and the fact that there currently seems to be little support for moving in this direction.

Orbital debris may represent the single, most potentially useful window of opportunity for cooperative space arms control and regulation for the United States and the global spacefaring community through 2015.[55] The National Aeronautics and Space Administration (NASA) defines “orbital debris” as “any man-made object in orbit about the Earth which no longer serves a useful purpose”.[56] Human space activity has generated a lot of debris: there are over 9,000 objects larger than 10cm and an estimated 100,000-plus objects between one and 10cm in size.[57] The largest single source of this debris has been intentional and unintentional satellite explosions on orbit.[58] Orbital debris generally moves at very high speeds relative to operational satellites and thereby poses a risk to these systems due to its enormous kinetic energy.[59] Only three collisions between operational systems and orbital debris are known to have occurred thus far, but concerns about this hazard are growing due to the increasing number of operational space systems and the five per cent growth rate in LEO orbital debris each year.[60] There is even concern about the potential for orbital debris "chain reactions" due to collisions in big-LEO communication satellite constellations or due to the debris clouds that could be created by use of kinetic energy ASATs in LEO.

Since the 1980s, the United States has led the world in publicizing the risks due to orbital debris and it has made programmes to mitigate debris an increasingly important part of its overall space policy.[61] There is, however, undoubtedly more the United States could do on the orbital debris front. The United States should explore several options such as unilaterally pledging not to create space debris through testing or operations of any ASAT system, creating strict unilateral regulations that mandate debris mitigation for US commercial space operators (perhaps as part of a "space worthiness licence"), multilateral efforts to "clean up" debris using lasers and other techniques, and creating strict multilateral regulations for debris mitigation. These and other creative approaches should be explored vigorously in order to ensure that man's increasing use of space does not impose unacceptable risks on this activity.

Finally, due again to the increasing use of space, the United States must consider the need for, and implications of, space traffic control systems (STCS) that could be analogous to current air traffic control systems. The idea for such a system is obviously related to the orbital debris problem discussed above, but it goes well beyond just this problem to include a wide range of factors such as: how space traffic might coordinate and be approved for specific orbital positions, how space traffic would be located and tracked, sanctions and liability for non-compliance and collisions under an STCS, and how such a regime might be established and funded. As with many space-related issues, the technology to at least begin implementing such a system appears to be closer at hand than is the political will to begin down this path. For example, the Ballistic Missile Defense Organization's Midcourse Space Experiment (MSX) satellite launched in April 1996 is the only operational space-based surveillance instrument. It has found some "150 objects in the last three years that were completely lost" and demonstrated the potential value of space-based sensors to an STCS.[62] Likewise, GPS positioning signals could be used very accurately to locate many space systems and a transponder-like system aboard space systems could automatically provide these data in response to queries from the STCS.[63] On the political side of the equation, however, the United States must consider very carefully how its objectives in space might benefit or be harmed via the creation and operation of an STCS. It is not obvious that an air traffic control model is the appropriate regime for space, or that the political and financial costs of creating and operating such a system (many of which would likely be borne by the United States) would be outweighed by its benefits. Most of the benefits would seem to be in the commercial and civil space sectors while the potential drawbacks might be most severe for the military and intelligence sectors. The United States most likely would not, for example, want the ephemeris on its military and intelligence-gathering satellites to be pre-approved and available worldwide through an STCS. At the very least, since an STCS could be such a powerful tool for denial, deception and even targeting, the United States must think through very carefully exactly what type of control regime would be most appropriate for space and how such a regime would operate in practice.

Notes

1 This paper uses spacepower as one word; it is also commonly expressed as two words. United States Air Force Chief of Staff Thomas D. White first used the word *aerospace* in 1958, and the concept that air and space form a seamless operational medium has been the foundational component of Air Force thinking about space ever since. Unfortunately, however, the Air Force is primarily talking to itself by using this word in this way because none of the other services or DoD offices use the word aerospace according to the Air Force's definition. Aerospace, for example, is only used as an adjective describing industry in the *Space Commission Report* and the word does not even appear in the DoD current space policy statement (Department of Defense Directive 3100.10, *Space Policy*, 9 July 1999).

2 Prior to the opening of the space age, the United States, in particular, was very reluctant to define where space began. The Eisenhower Administration's highest priority space policy was expressed in NSC-5520 of May 1955. This policy was designed to distinguish between aerial and satellite overflight and to established the legitimacy and legality of the latter. It called for using the civilian face of the United States' International Geophysical Year scientific satellite programme as a "stalking horse" to establish the precedent of legal overflight in order to open up the closed Soviet State to photo reconnaissance via the secret WS-117L spy satellite system. The term *stalking horse* is taken

from R. Cargill Hall, "Origins of US Space Policy: Eisenhower, Open Skies, and Freedom of Space", in *Exploring the Unknown: Selected Documents in the History of the US Civil Space Program,* John M. Logsdon (ed.), Vol. 1, *Organizing for Exploration,* Washington, D.C.: NASA History Office, 1995, pp. 213-29. The United States has not subsequently revisited the issue of where space begins in the light of the changed geopolitical context and declassification of satellite reconnaissance. By using unclassified sources, primarily at the Eisenhower Library, Walter A. McDougall was the first to break through the veil of secrecy surrounding early US space policy in *The Heavens and the Earth: A Political History of the Space Age*, New York: Basic Books, 1985. His book won the Pulitzer Prize for History in 1986.

3 Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment*, Washington, D.C.: Centre for Strategic and Budgetary Assessments, February 2001; Steven Lambakis, *On the Edge of Earth: The Future of American Space Power*, Lexington: University Press of Kentucky, 2001; Everett C. Dolman, *Astropolitik: Classic Geopolitics in the Space Age*, London: Frank Cass, 2002; and Robert Preston et al., *Space Weapons: Earth Wars*, Santa Monica: RAND Corporation, 2002.

4 Military use of commercial satellites was a major issue in the 1998 Army After Next wargame and space weaponization, deterrence and pre-emption, and space-to-Earth force application were all critical parts of the Air Force's Schriever 2001 and Future Concepts 2001 wargames. See, for example, "Air Force gains insights from first space wargame", *Air Force News Archive*, available from http://www.af.news/Jan2001/n20010129_0124.shtml.

5 Many US Government documents list three rather than four space sectors. Upon closer examination, however, these documents reveal the important contributions of each of the four sectors discussed above. For example, the most recent National Space Policy discusses civil, national security (defence and intelligence) and commercial sectors: National Science and Technology Council, "Fact Sheet: National Space Policy", Washington, D.C.: The White House, 19 September 1996. The term "space sectors" was first used as an organizing typology in President Jimmy Carter's 1978 National Space Policy: National Security Council, "Presidential Directive/NSC-37: National Space Policy", Washington, D.C.: The White House, 11 May 1978.

6 *Space Commission Report*, pp. 10-14.

7 This section and the next are adapted from Peter L. Hays, James M. Smith Alan R. Van Tassel, and Guy M. Walsh (eds), *Spacepower for a New Millennium: Space and US National Security*, New York: McGraw-Hill, 2000, pp. 3-6.

8 *Joint Doctrine for Space Operations* (Joint Publication 3-14), Washington, D.C.: The Joint Staff, 9 August 2002, IV-5, JP-14 (p. IV-6-IV-8) describes space control as follows:

> "b. **Missions.** Space control operations include surveillance of space, protection, prevention, and negation functions. These operations change in nature and intensity as the type of military operations changes. Prevention efforts can range from deterrence or diplomacy to military action. If prevention efforts fail, protection and negation functions may be performed to achieve space superiority. Negation focuses on denying an adversary's effective use of space. Prevention, protection, and negation efforts all rely on the ongoing surveillance of space and Earth to make informed decisions and to evaluate the effectiveness of their efforts.
>
> • **Surveillance of Space.** Situational awareness is fundamental to the ability to conduct the space control mission. It requires: robust space surveillance for continual awareness of orbiting objects; real-time search and targeting-quality information; threat detection, identification, and location; predictive intelligence analysis of foreign space capability and intent in a geopolitical context; and a global reporting capability for friendly space systems. Space surveillance is conducted to detect, identify, assess, and track space objects and events to support space operations. Space surveillance is also critical to space support operations, such as placing satellites in orbit. Further, space situational awareness data can be used to support terrestrially-based operations, such as reconnaissance avoidance and missile defence.
>
> • **Protection. Active and passive defensive measures** ensure that US and friendly space systems perform as designed by overcoming an adversary's attempts to negate friendly exploitation of space or **minimize adverse effects** if negation is attempted. Such measures also provide some protection from space environmental factors. Protection measures must be consistent with the criticality of the mission's contribution to the war fighter and are applied to each component of the space system, including launch, to ensure that no weak link exists. Means of protection include, but are not limited to, ground facility protection (security; covert facilities; camouflage,

concealment, and deception; mobility), alternate nodes, spare satellites, link encryption, increased signal strength, adaptable waveforms, satellite radiation hardening and space debris protection measures. Furthermore, the system of protection measures should provide unambiguous indications of whether a satellite was under attack or in a severe space weather environment when any satellite anomaly or failure occurs. Finally, attack indications could be so subtle or dispersed that individually, an attack is not detectable. At a minimum, a common fusion point for possible indications from all USG satellites should be provided to allow centralized analysis.

• **Prevention.** Measures to preclude an adversary's hostile use of US or third party space systems and services. Prevention can include military, diplomatic, political, and economic measures as appropriate.

• **Negation.** Measures to **deceive, disrupt, deny, degrade,** or **destroy** an adversary's space capabilities. Negation can include action against the ground, link, or space segments of an adversary's space system.

•• **Deception.** Measures designed to **mislead** the adversary by manipulation, distortion, or falsification of evidence to induce the adversary to react in a manner prejudicial to their interests.

•• **Disruption. Temporary impairment** (diminished value or strength) of the utility of space systems, usually without physical damage to the space system. These operations include the delaying of critical, perishable operational data to an adversary.

•• **Denial. Temporary elimination** (total removal) of the utility of an adversary's space systems, usually without physical damage. This objective can be accomplished by such measures as interrupting electrical power to the space ground nodes or computer centres where data and information are processed and stored. For example, denying US adversaries position navigation information could significantly inhibit their operations.

•• **Degradation. Permanent partial or total impairment** of the utility of space systems, usually with physical damage. This option includes attacking the ground, control, or space segment of any targeted space system. All military options, including special operations, conventional warfare, and information warfare are available for use against space targets.

•• **Destruction. Permanent elimination** of the utility of space systems. This last option includes attack of critical ground nodes; destruction of uplink and downlink facilities, electrical power stations, and telecommunications facilities; and attacks against mobile space elements and on-orbit space assets."

9 Ibid., p. IV-10.

10 Satellites in LEO fly in the region of less than 100 miles to several hundred miles altitude and complete each orbit in approximately 90 minutes. Polar LEO is ideal for many spy satellite and weather applications because from this orbit satellites can look down on all parts of the Earth several times each day as the Earth rotates beneath and they can also be aligned in Sun Synchronous Orbits that arrive overhead the same location at the same time each day. Satellites in Semi-Synchronous Orbit are located at approximately 12,500 miles altitude and complete an orbit every 12 hours. GSO is located approximately 22,300 miles above the equator, a location where the satellites' orbital velocity matches Earth's rate of rotation and the satellite appears to remain motionless above the same spot—a very valuable attribute for communications satellites. NPOESS is a system that is currently being jointly developed by the National Oceanic and Atmospheric Administration (NOAA) and DoD that will merge their separate meteorological satellite systems into one system scheduled for its first launch in 2005. The AEHF programme is developing the successor to the MILSTAR system and currently plans its first launch in 2006. The WGS is scheduled to launch a satellite in 2004. It is designed to bridge the gap between the current DSCS and GBS systems and a future advanced wideband system. For more information, see the Air Force Association's "Major Military Satellite Systems" web page at http://www.afa.org/magazine/space/satellite_systems.html.

11 Lt. Col. David E. Lupton, *On Space Warfare: A Space Power Doctrine*, Maxwell Air Force Base, Alabama: Air University Press, June 1988.

12 Several of these individuals were quite prolific; the following list represents their best known works: Alfred Thayer Mahan, *The Influence of Sea Power upon History, 1660-1783*, Boston: Little, Brown, 1980; Julian S. Corbett, *Some Principles of Maritime Strategy*, Eric J. Grove (ed.), Annapolis: Naval Institute Press, 1988, first published 1911; Giulio Douhet, *The Command of the Air*, Richard H. Kohn and Joseph P. Harahan (eds), Washington, D.C.: Office of Air Force History, 1983, first published 1921; William Mitchell, *Winged*

Defense: The Development and Possibilities of Modern Airpower—Economic and Military, New York: Dover, 1988, first published 1925; and John A. Warden III, *The Air Campaign: Planning for Combat*, Washington, D.C.: National Defense University Press, 1988. On the importance of these works see Jon Tetsuro Sumida, *Inventing Grand Strategy and Teaching Command: The Classic Works of Alfred Thayer Mahan Reconsidered*, Washington, D.C.: Woodrow Wilson Centre Press, 1997; Philip S. Meilinger (ed.), *The Paths of Heaven: The Evolution of Airpower Theory*, Maxwell Air Force Base, Alabama: Air University Press, 1997; and David R. Mets, *The Air Campaign: John Warden and the Classical Airpower Theorists*, Maxwell Air Force Base, Alabama: Air University Press, April 1999.

13 Virtually all of these concepts are applied throughout the Chief of Staff-directed year-long study by Air University that is published as *SPACECAST 2020*, Maxwell Air Force Base, Alabama: Air University, 1994. See also, for example, Arnold H. Streland, "Clausewitz on Space: Developing Military Space Theory through a Comparative Analysis", Air Command and Staff College research paper, April 1999; and Charles H. Cynamon, "Protecting Commercial Space Systems: A Critical National Security Issue", Air Command and Staff College Research Paper, April 1999.

14 In 1997, Howell M. Estes III, then Commander-in-Chief of CINCSPACE, attempted to remedy the lack of a comprehensive spacepower vision or theory by commissioning Dr. Brian R. Sullivan to write a book on spacepower theory. This project was taken over by James Oberg and published as *Space Power Theory*, Washington, D.C.: Government Printing Office, 1999. On the enduring nature of strategy and problems with developing spacepower theory, see also Colin S. Gray and John B. Shelton, "Spacepower and the Revolution in Military Affairs: A Glass Half-Full", in *Spacepower for a New Millennium*, pp. 239-258; and Colin S. Gray, *Modern Strategy*, Oxford: Oxford University Press, 1999, pp. 243-267. The 2001 publications by Watts, Lambakis, and especially Dolman (*The Military Use of Space*, *On the Edge of Earth* and *Astropolitik*) will undoubtedly go a long way towards filling the yawning spacepower theory gap in the literature.

15 Hays and Mueller, "Going Boldly—Where?", p. 37.

16 Lt. Col. Dennis M. Drew, "Of Leaves and Trees: A New View of Doctrine", *Air University Review*, Vol. 33, No. 2, January-February 1982, pp. 40-48; Lt. Col. Charles D. Friedenstein, "The Uniqueness of Space Doctrine", *Air University Review*, *Vol.* 37, No. 1, November-

December 1985, pp. 13-23; and Col. Kenneth A. Myers and Lt. Col. John G. Tockston, "Real Tenets of Military Space Doctrine", *Airpower Journal*, Vol. 2, No. 4, Winter 1988, pp. 54-68.

17 The Air Force published AFM 1-6 on 15 October 1982 and its release was designed to coincide closely with the stand-up of Air Force Space Command on 1 September 1982. For a detailed critique of AFM 1-6, see Peter L. Hays, "Struggling towards Space Doctrine: US Military Space Plans, Programs, and Perspectives during the Cold War", unpublished Ph.D. dissertation, Fletcher School of Law and Diplomacy, Tufts University, May 1994, pp. 400-422.

18 Friedenstein, pp. 21-22.

19 Myers and Tockston, p. 59. A more up-to-date and outstanding blueprint for developing space doctrine is provided by Maj. Robert D. Newberry, *Space Doctrine for the Twenty-First Century*, Maxwell Air Force Base, Alabama: Air University Press, October 1998.

20 Available from the Center for Strategic and Budgetary Assessments web site, http://www.csbaonline. org/2Strategic_Studies/1Revolution_in_ Military_Affairs/Revolution_Military_Affairs.htm.

21 Ibid.

22 Ibid.

23 Gray and Shelton, "Spacepower and the Revolution in Military Affairs", in Spacepower for a New *Millennium*, pp. 239-258. Emphasis in original.

24 The four camps are presented from a US national security perspective; they could also be used for analysis at the global security level. There are also many strands of thought within any of these camps, and some of them might even be contradictory. The four camps are similar to the four space doctrines discussed in Lt. Col. David E. Lupton, *On Space Warfare: A Space Power Doctrine*, Maxwell Air Force Base, Alabama: Air University Press, June 1988 and have been derived from the schools of thought about space weaponization discussed in Lt. Col. Peter Hays and Dr. Karl Mueller, "Going Boldly—Where?", Aerospace Integration, the Space Commission, and the Air Force's Vision for Space", *Aerospace Power Journal*, Vol. 15, No. 1, Spring 2001, pp. 34-49. The growing importance of commercial space activity adds a new dimension to this analysis that few of the traditional approaches seem well prepared to incorporate or even address. For a groundbreaking analysis that advocates using economic criteria to separate traditional military space functions from more regulatory functions that would be performed by a new US Space Guard (modelled after the Coast

Guard), see Lt Col Cynthia A. S. McKinley, "The Guardians of Space: Organizing America's Space Assets for the Twenty-First Century", *Aerospace Power Journal*, Vol. 14, No. 1, Spring 2000, pp. 37-45.

25 Sen. Bob Smith, "The Challenge of Space Power", *Airpower Journal*, Vol. 13, No. 1, Spring 1999, p. 33. Prominent space hawk groups include High Frontier, the Heritage Foundation, and the Centre for Security Policy.

26 *Report of the Commission to Assess United States National Security Space Management and Organization*, Washington, D.C., 11 January 2001, p. x. Hereafter *Space Commission Report.* Most US space policy, military space doctrine, and military officers probably fall into this camp.

27 Maj. William L. Spacy II, United States Air Force, "Does the United States Need Space-Based Weapons?", *CADRE Paper 4*, Maxwell Air Base, Alabama: Air University Press, September 1999, p. 109. See also Maj. David W. Zeigler, "Safe Heavens: Military Strategy and Space Sanctuary", in Col. Bruce M. DeBlois (ed.), *Beyond the Paths of Heaven: The Emergence of Space Power Thought*, Maxwell Air Force BAse, Alabama: Air University Press, September 1999, pp. 185-245.

28 Lt. Col. Bruce M. DeBlois, "Space Sanctuary: A Viable National Strategy", *Aerospace Power Journal*, Vol. 12, No. 4, Winter 1998, pp. 41-57. This article is one of the most comprehensive and persuasive expositions of the space dove camp.

29 Paul B. Stares, *The Militarization of Space, U.S. Policy 1945-1984*, Ithaca: Cornell University Press, 1985.

30 Model I (rational actor), Model II (organizational process) and Model III (bureaucratic politics) are commonly used lenses for examining governmental decision-making that were developed by Graham T. Allison in *Essence of Decision: Explaining the Cuban Missile Crisis*, Boston: Little, Brown and Company, 1971.

31 See, in particular, the outstanding analysis of trigger events for space weaponization in Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment*, Washington, D.C.: Center for Strategic and Budgetary Assessments, February 2001, pp. 97-106. Watts argues that: "There are at least two paths by which orbital space might become a battleground for human conflict. One consists of dramatic, hard-to-miss trigger events, such as the use of nuclear weapons to attack orbital assets. The other class involves more gradual changes such as a series of small, seemingly innocuous steps over a period of years that would, only in hindsight, be recognized as having crossed the boundary from

force enhancement to force application. For reasons stemming from the railroad analogy ... the slippery slope of halting, incremental steps toward force application may be the more likely path of the two." Watts discusses high-altitude nuclear detonations, failure of nuclear deterrence, and threats to use nuclear ballistic missiles during a crisis as the most likely dramatic trigger events. He illustrates what he considers the most likely of the gradual paths to weaponization by using the development and military implications of railroads as an analogy for space:

> "First, orbital mechanics makes satellites more like railroads than aircraft or capital ships; secondly, the main function of these orbital railroads is to collect and transport information to users on Earth, particularly information about enemy forces and capabilities. If this information collection-and-transport use is the main value of satellite systems, then it follows immediately that there are a lot more ways to interrupt space-based or space-dependent information flows than physically destroying satellites. For instance, if an enemy happened to be deriving military information about American force deployments from commercial satellites, an entirely non-lethal solution would be to use diplomatic pressure to cut off the opponent from further information. Other approaches could range from jamming vulnerable segments of the information chain to using terrestrial forces to interdict the satellite ground stations or other nodes through which the information was being routed.
>
> These possibilities have an important implication for our understanding of space warfare. If a terrestrial attack on an adversary's satellite ground station can deny use of certain space-dependent information, then it is plausible to argue that capabilities for space warfare exist today, even though lethal weapons are not currently deployed in orbital space.
>
> It is not difficult to foresee, then, how nations could begin gradually sliding down a slippery slope towards the weaponization of near-Earth space without being fully cognizant of the eventual end state. Over a period of years nations could engage in numerous activities short of outright weaponization that, in the long run, could lead to an environment in which the deployment and use of weapons in or from space would emerge as a logical and natural next step. Consider the following activities:

• using Earth-based lasers to dazzle the optical arrays of electro-optical imaging reconnaissance satellites whenever they appear above the horizon;
• active jamming of imaging radar satellites;
• widespread jamming of GPS location and timing information;
• positioning satellites in orbit in close proximity with the satellites of one's military, economic or political competitors;
• the use of satellites with active, high-power radars to degrade the electronics of adversary satellites; and
• capturing or corrupting the data streams to or from competitors' satellites."

32 Treaty between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms (START I), signed on 31 July 1991, entered into force on 5 December 1994. Most of the discussion and analysis on START I and II below is drawn directly from T. W. Billick, "Arms Control Implications for Military Operations in Space", pp. 24-30. Lt. Col. Billick developed his outstanding analysis after working on START I and II issues while serving at the Nuclear and Counterproliferation Directorate on the Air Staff.

33 See "Article-by-Article Analysis of Treaty Text" online, Internet, available from http://www.state.gov/www/global/arms/starthtm/start/abatext.html#IX.
Paragraph 2 of Article IX in START I is adopted verbatim from paragraph 2 of Article XII of the ABM Treaty and is essentially identical to subparagraph 2(a) of Article XII of the Intermediate-range Nuclear Forces (INF) Treaty. It prohibits each Party from interfering with the national technical means of verification of the other Party operating in accordance with paragraph 1 of Article IX. This means, for example, that a Party cannot destroy, blind, jam, or otherwise interfere with the national technical means of verification of the other Party that are used in a manner consistent with generally recognized principles of international law. Note that while paragraph 2 of Article IX prohibits interference with national technical means, the prohibition on interference with inspectors during inspections is in the Inspection Protocol.

34 Ibid.

35 See the discussion of the Fractional Orbital Bombardment System (FOBS) in the OST regime section above.

[36] START I, Article IV of Paragraph 4 provides limits on ICBMs and SLBMs used for delivering objects into the upper atmosphere or space. The parties recognized that such use of ICBMs and SLBMs is valid and economical, but they also recognized that such use must be limited because such missiles could also be used for their original purpose of weapons delivery. In order to limit the potential for breakout, paragraph 4 limits each Party to no more than five space launch facilities, which are defined as specified facilities from which objects are delivered into the upper atmosphere or space using ICBMs or SLBMs. Paragraph 4 also provides that these facilities may not overlap ICBM bases; limits each Party to a total of no more than 20 ICBM or SLBM launchers at those facilities, of which no more than 10 may be silo and mobile launchers, unless otherwise agreed; and limits the number of ICBMs or SLBMs at a given space launch facility to no more than the number of launchers at that facility. Space launch facilities are not subject to inspection. The number of space launch facilities and the number of launchers at those facilities may be increased or decreased if the parties agree. Such changes would not require an amendment to the Treaty. These treaty provisions also affect tensions in the commercial space sector between launch service users such as satellite builders and launch service providers. In general, the former have advocated greater use of deactivated ballistic missiles for space launch while the latter do not support such use because it has the potential to flood the market with deactivated ballistic missiles used as space launchers.

[37] START I, Article X, and the Telemetry Protocol. During the Cold War, the United States invested billions of dollars in intelligence-gathering equipment designed primarily to obtain telemetry data on Soviet ballistic missiles. Gathering and analysing this information was among the most difficult intelligence challenges of the Cold War.

[38] Agreement between the United States of America and the Union of Soviet Socialist Republics on Notification of Launches of Intercontinental Ballistic Missiles and Submarine-Launched Ballistic Missiles (Ballistic Missile Launch Notification Agreement), signed in Moscow on 31 May 1988, entered into force on 31 May 1988.

[39] START I article-by-article legal analysis makes specific reference to the national aerospace plane in describing the treaty definition of *airplane* and the treaty prohibition against flight-testing, equipping, and deploying nuclear armaments on an airplane that was not initially constructed as a bomber but has a range of 8,000km or more or an

integrated platform area over 310 sq m. However, the parties did not reach agreement on the applicability of the treaty to future non-nuclear systems. During the negotiations, the United States stated its view that a future non-nuclear system could not be considered a new kind of strategic offensive arm and, thus, would not be subject to the Treaty. The Soviet Union did not accept this view. The parties agreed, in the Second Agreed Statement, that, if "new kinds" of arms emerge in the future and if the parties disagree about whether they are strategic offensive arms, then such arms would be subject to discussion in the Joint Compliance and Inspection Commission. Of course, if one party deploys a new kind of arm that it asserts is not subject to the Treaty, and the other party challenges this assertion, the deploying party would be obligated to attempt to resolve the issue. There is, however, no obligation to delay deployment pending such resolution.

40 Treaty between the United States of America and the Russian Federation on Further Reduction and Limitation of Strategic Offensive Arms (START II), signed on 3 January 1993. The US Senate provided its advice and consent to ratification of START II on 26 January 1996. The Russian Duma completed ratification on 14 April 2000 with conditions. US Senate review of the modified treaty is pending.

41 Memorandum of Agreement between the United States of America and the Russian Federation on the Establishment of a Joint Centre for the Exchange of Data from Early Warning Systems and Notifications of Missile Launches was signed in Moscow and entered into force on 4 June 2000. According to the fact sheet released about it:

> This agreement—which is the first time the United States and Russia have agreed to a permanent joint operation involving U.S. and Russian military personnel—is a significant milestone in ensuring strategic stability between the United States and Russia. It establishes a Joint Data Exchange Center (JDEC) in Moscow for the exchange of information derived from each side's missile launch warning systems on the launches of ballistic missiles and space launch vehicles. The exchange of this data will strengthen strategic stability by further reducing the danger that ballistic missiles might be launched on the basis of false warning of attack. It will also promote increased mutual confidence in the capabilities of the ballistic missile early warning systems of both sides. The JDEC will build upon the successful establishment and operation during the millennium rollover of the temporary joint center for Y2K Strategic Stability in Colorado Springs. The JDEC will be staffed 24 hours a

day, seven days a week, with American and Russian personnel. The JDEC is also intended to serve as the repository for the notifications to be provided as part of an agreed system for exchanging pre-launch notifications on the launches of ballistic missiles and space launch vehicles. This agreement is currently being negotiated separately.

Online, Internet, available from http://www.clw.org/coalition/summit060400launch.htm.

At least implicitly, JDEC is one response to the potentially dangerous weaknesses the United States perceives in the post-Cold War Russian Federation strategic early warning system. The most chilling example of this took place on 25 January 1995 when the Russian strategic command and control system was activated after computers mistakenly identified a Norwegian research rocket launch as an attacking US Trident II SLBM. Reportedly, the Russians raised their nuclear alert status and President Boris Yeltsin was prepared to activate his nuclear launch codes out of the Russian version of the "football" before the situation was reassessed and the alert status decreased back to normal several minutes later. See Nikolai Sokov, "Could Norway Trigger a Nuclear War? Notes on the Russian Command and Control System", Program on New Approaches to Russian Security Policy Memo Series, memo No. 24, online, Internet, available from http://www.fas.harvard.edu/~ponars/POLICY%20MEMOS/Sokovmemo2.html; and Center for Security Policy Decision Brief, 21 November 2000, "Clinton Legacy Watch #50: Stealthy Accord With Russia Threatens to Foreclose US Space Power", online, Internet, available from http://www.security-policy.org/papers/2000/00-D91.html.

42 Memorandum of Understanding on Notifications of Missile Launches, signed on 16 December 2000.

43 On the spectrum of opinion concerning JDEC and PLNS see, for example, John Steinbruner, "Sharing Missile Launch Data", Pugwash, online, Internet, available from http://www.pugwash.org/publication/nl/nlv38n1/essay-steinbruner.htm; and "National Security Alert", Center for Security Policy, 8 December 2000, online, Internet, available from http://www.security-policy.org/papers/2000/00-A44.html.

44 Steven Livingston, "Transparency or Opacity? Technology and Deception Operations", paper presented at the International Studies Association Annual Convention, Chicago, 21-24 February 2001.

Livingston's quotation is from Don E. Tomlinson, *Computer Manipulation and Creation of Images and Sounds: Assessing the Impact*, Washington, D.C.: The Annenberg Washington Program, 1993. See also Ivan Amato, "Lying with Pixels", *Technology Review*, July/August 2000.

45 Kimberly Amaral, "The Digital Imaging Revolution: Legal Implications and Possible Solutions", online, Internet, available from http://www.umassd.edu/Public/People/KAmaral/Thesis/digitalimaging.html.

46 Dehqanzada and Florini, *No More Secrets*, p. viii.

47 On 9 June 1999, the Canadian Ministries of Foreign Affairs and Defence announced that they had formed an interdepartmental team of experts charged with developing new "access control" legislation to control Canadian commercial remote sensing satellites. The principles guiding the interdepartmental team are very similar to PDD-23, and the process of drafting and implementing the policy is expected to take up to two years. The News Release and a Backgrounder are online, Internet, at http://198.103.104.118/minpub/Publication.asp?FileSpec=/Min_Pub_Docs/101271.htm. Unlike many other dual-use technologies (pharmaceutical plants, for instance), high-resolution remote sensing systems are limited in number, expensive to build, and very difficult to launch or operate covertly. They could, therefore, be more easily controlled than many other types of dual-use technology.

48 Kerry Gildea, "NIMA Extends Deal with Space Imaging for Exclusive Imagery Over Afghanistan", *Defense Daily*, 7 November 2001, p. 2; "Eye Spy", *The Economist*, pp. 10-16, November 2001; and Pamela Hess, "DoD Won't Release Pix Until 5 Jan", *Washington Times*, 7 November 2001. In addition, the French Ministry of Defence barred SPOT Image from selling or distributing images of Afghanistan and the surrounding regions to anyone except that Ministry. "Shutter Control for SPOT Over Afghanistan", *Space Newsfeed*, 28 October 2001, online, Internet, available from http://www.spacenewsfeed.co.uk/2001/28October2001.html. These decisions have left Cyprus-based ImageSat International as the only company able to provide one-metre commercial imagery of Afghanistan and the surrounding region. Barbara Opall-Rome, "US Data Purchase Opens Doors for ImageSat", *Space News*, 22 October 2001, p. 6.

49 Lt. Gen. Bruce Carlson, United States Air Force, "Protecting Global Utilities: Safeguarding the Next Millennium's Space-Based Public Services", *Aerospace Power Journal*, Vol. 14, No. 2, Summer 2000, p. 37. For a more detailed discussion of why GPS does not fit exactly

into existing categories of "natural monopoly", "public good", "utility", or "dual-use technology" see Scott Pace et al., *The Global Positioning System: Assessing National Policies*, Washington, D.C.: RAND Critical Technologies Institute, 1995, pp. 184-189.

50 Carlson, loc. cit., p. 38. All modern "digital compression" telecommunication protocols such as time division multiple access or code division multiple access require highly accurate timing signals to operate.

51 Ibid., p. 37. The PanAmSat Corporation's *Galaxy 4* satellite failed on 19 May 1998.

52 John M. Logsdon, "Just Say Wait to Space Power", *Issues in Science and Technology*, Spring 2001; online, Internet, 24 April 2001, at http://www.nap.edu/issues/17.3/p_logsdon.htm.

53 USSPACECOM perhaps made this "Flag Follows Trade" argument most strongly in *Long Range Plan: Implementing USSPACECOM Vision for 2020*, Peterson Air Force Base, Colorado: USSPACECOM, Director of Plans, March 1998.

54 Carlson, loc. cit., p. 41.

55 Planetary defence or the effort to track and eventually defend against potentially life-threatening Near Earth Objects (NEOs) that might impact Earth is another high-profile window for cooperation on a space-related issue, but it does not appear to be a traditional control or regulation effort and is not discussed in this essay. For more information about planetary defence, see, for example, "Preparing for Planetary Defense: Detection and Interception of Asteroids on Collision Course with Earth", *SPACECAST 2020,* online, Internet, at http://www.au.af.mil/Spacecast/app-r/app-r.doc; *Air Force 2025* research paper, "Planetary Defense: Catastrophic Health Insurance for Planet Earth", online, Internet, at http://www.au.af.mil/au/2025/volume3/chap16/v3c16-1.htm; and Brig. Gen. S. Pete Worden, "NEOs, Planetary Defense and Government: A View from the Pentagon", online, Internet, at http://www.spaceviews.com/2000/04/article2a.html.

56 "Frequently Asked Questions about Orbital Debris", NASA-Johnson Space Centre, Space Science Branch, online, Internet, at http://orbitaldebris.jsc.nasa.gov/faq/faq.html.

57 Ibid.

58 The European Space Agency estimates that 44% of the catalogued orbit population (larger than 10cm) originated from the 129 on-orbit fragmentations recorded since 1961. See European Space Agency,

"Introduction to Space Debris", online, Internet, at http://www.esoc.esa.de/external/mso/debris.html; and the Aerospace Corporation's "What is Orbital Debris?" web site at http://www.aero.org/cords/orbdebris.html. Until fairly recently, several spacefaring States (the Russian Federation in particular) routinely blew up their satellites at the end of their useful life. Inadvertent mixing of propellant and oxidizer and overpressurization of residual fuel or batteries are the most common causes of unintentional explosions.

59 In LEO (less than 2,000km altitude) the average relative velocity at impact is 10km per second. At this speed: "An aluminum sphere 1.3mm in diameter has damage potential similar to that of a .22-calibre long rifle bullet. An aluminum sphere 1cm in diameter is comparable to a 400lb safe travelling at 60mph. A fragment 10cm long is roughly comparable to 25 sticks of dynamite." In GSO, average relative velocity at impact is much lower (about 200m per second) because most objects in the geostationary ring move along similar orbits. See "What are the Risks of Orbital Debris?", online, Internet, at http://www.aero.org/cords/debrisks.html.

60 Aerospace Corporation, "What is the Future Trend?", online, Internet, at http://www.aero.org/cords/future.html. The space shuttle must infrequently (every year or two) manoeuvre away from known orbital debris. Critical components on the International Space Station have been designed to withstand the impact of debris up to 1cm in diameter.

61 Historic Space Policy documents are available from the Air War College's Gateway, online, Internet, at http://www.au.af.mil/au/awc/awcgate/histpol.htm. The first emphasis on orbital debris in National Space Policy came in President Reagan's 11 February 1988 National Space Policy and by the Clinton Administration's 19 September 1996 National Space Policy, mitigation of orbital debris was a major intersector guideline:

"(7) Space Debris

(a) The United States will seek to minimize the creation of space debris. NASA, the Intelligence Community, and the DoD, in cooperation with the private sector, will develop design guidelines for future government procurements of spacecraft, launch vehicles, and services. The design and operation of space tests, experiments and systems, will minimize or reduce accumulation of space debris consistent with mission requirements and cost effectiveness.

(b) It is in the interest of the U.S. Government to ensure that space debris minimization practices are applied by other spacefaring nations and international organizations. The U.S. Government will take a leadership role in international fora to adopt policies and practices aimed at debris minimization and will cooperate internationally in the exchange of information on debris research and the identification of debris mitigation options."

62 Leonard David, "Eye in Sky to Track Space Junk", *Space.com*, 7 November 2000, online, Internet, at http://www.space.com/ businesstechnology/technology/ space_trafficcontrol_001102.html.

63 For a detailed discussion of STCS (especially the technical requirements for such a system), see "Space Traffic Control: The Culmination of Improved Space Traffic Operations", *SPACECAST 2020*, online, Internet, at http://www.au.af.mil/Spacecast/app-d/app-d.html.

CHAPTER 3

SECURITY WITHOUT WEAPONS IN SPACE: CHALLENGES AND OPTIONS[1]

Rebecca Johnson

From H.G. Wells' futuristic fiction to Arthur C. Clarke's *2001: A Space Odyssey*, and from *Solaris* to *Star Trek*, space has captured our imagination as a place of exploration, challenge and mystery. The first Sputnik could have led to a Cold War battlespace, but grew instead into the International Space Station. In the intervening decades, outer space has become much more than a realm of imaginary quests. It has become a site for commercial development, global communication, conflicting ambitions, and an important military resource and domain for power projection.

Outer space surrounds our planet, the "heavens" above us, wherever we happen to be on Earth. It is visible to all but, at present, accessible to only a few. We will have to decide early in the twenty-first century whether to cooperate internationally to protect outer space as a sanctuary and shared resource for the benefit of billions, or whether to allow the "ultimate high ground" of space control to be captured on behalf of the military of one nation.[2] This is not a decision that can be avoided. Already the structures for space weaponization are being embedded by a small, but influential coterie of US military officials, politicians and arms contractors. Delayed international action or a failure to decide will result in the weaponization of space as surely as a deliberate decision to deploy weapons for use in and from space.

The 11 September attacks on the World Trade Centre and the Pentagon ratcheted up the perceived threats from terrorism and nuclear, chemical and biological weapons. For many, the idea of dangers and insecurities from the future weaponization of space seems too remote to be considered a priority for political action now. Yet history teaches us that by the time a particular weapon or military doctrine becomes an obvious political priority, it is usually too late to intervene and halt its development. Moreover, proliferation to other States or to non-State actors will follow from the possession by a few, though economic, technical or counter-proliferation hurdles may slow it down for a while.

As it is responsible for some 95% of military satellites and more than two thirds of the world's expenditure on the commercial uses of space, it is hardly surprising that Washington desires to protect US space assets from being disabled or destroyed. The US military and political leaders need urgently to examine the implications of testing and deploying weapons for use in or from space, and whether they would actually increase or decrease the security of space assets. More fundamentally, would such weapons be likely to diminish or enhance the security of life here on Earth? With these questions in mind, this article considers initiatives for addressing space vulnerabilities and long-term security objectives.

The Politics of Space Weaponization

At a time when much political and military attention is focused on terrorism, why should the international community be concerned about some future possibility of weapons in space? The "Desert Storm" Gulf war of 1991, the strikes on Yugoslavia in 1999, and the 2001 war in Afghanistan have demonstrated the enhanced power and precision of weaponry that depends on US military satellites. This space-reliant "revolution in military affairs" (RMA), funded by a US defence budget that in 2002 exceeded the combined total of the next 19 largest national defence expenditures, has placed the United States far ahead of any other country in the technology and hardware of warfare. Such levels of dominance are not necessarily good for the United States or its allies. Potentially destabilizing, they may also be self-defeating in security terms, provoking adversaries to direct attacks at the "soft belly" (i.e. undefended civilians), as happened on 11 September.

The drive towards weapons for use in or from space has two principal justifications: first, that space weaponization is essential to protect space assets from a pre-emptive attack, dramatically called a "Space Pearl Harbor" by the Commission to Assess United States National Security Space

Management and Organization (known as the 2001 Space Commission, chaired by Donald H. Rumsfeld);[3] and secondly, that who ever controls space will control the Earth and obtain an unassailable military and commercial dominance. In addition to the assumptions of vulnerability and space power, some also argue from historical analogy that space weaponization is inevitable, and that whoever gets there first will enjoy an overwhelming advantage. The weaponization of space has to be seen in the context of missile defence, increasingly accepted by US allies in the post-11 September political environment. Advocates of US weapons in space have difficulty comprehending the degree to which their plans are viewed as a security threat by others because they assume that US superiority is beneficial for international stability.

From the mid-1990s on, all three types of argument could be found in US policy documents, most notably: the 1996 *National Space Policy*;[4] the 1999 *Department of Defense Space Policy*;[5] US Space Command's *Vision for 2020* (1997)[6] and *Long Range Plan* (1998);[7] the US Air Force *Strategic Master Plan for FY02 and Beyond*;[8] the January 2001 *Report of the Commission to Assess United States National Security Space Management and Organization*;[9] the Defense Department's 2001 *Transformation Study Report*;[10] and the 2001 *Quadrennial Defense Review*.[11] After *Vision for 2020* declared that "the medium of space is the fourth medium of warfare—along with land, sea and air",[12] the 2001 Space Commission argued that the US Government should pursue the relevant capabilities "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".[13] United States Space Command (USSPACECOM) foresaw its role in "dominating the space dimension of military operations to protect US national interests and investment … [and] integrating space forces into war fighting capabilities across the full spectrum of conflict."[14] The Space Commission concluded that space interests be regarded as a top national security priority and that the United States must ensure continuing superiority in space capabilities in order "both to deter and to defend against hostile acts in and from space", including "uses of space hostile to US interests".[15]

Though this steady stream of US policy documents extolling "combat theories and concepts related to space warfare"[16] has provoked increasing anxiety among other nations, the United States has persisted in dismissing diplomatic initiatives to address "prevention of an arms race in outer space"

(PAROS) arguing that there is "no need for new outer space arms control agreements".[17] While the "space hawks" and "inevitable weaponizers" in the United States Department of Defense would endorse the Bush Administration's opposition to arms control, there are "militarization realists" and "space doves" in the US armed forces and political arena who believe that some kind of arms control or international legislation to prevent the weaponization of space is an urgent necessity.[18] Although the Democratic Party's opposition to Republican plans for space-based missile defences was largely silenced in the aftermath of the 11 September attacks, the former Democratic Leader in the Senate, Tom Daschle, has called the weaponization of space "the single dumbest thing I have heard so far from this administration ... It would be a disaster for us to put weapons in space of any kind under any circumstances. It only invites other countries to do the same thing".[19]

Addressing the Vulnerability of Space Assets

To garner support for space weaponization, the Space Commission evoked the spectre of a space Pearl Harbour, focusing on the vulnerability of space assets and the increasing dependence of US military forces on satellite-based technology. Emphasis is placed on the risks of a pre-emptive attack from anti-satellite (ASAT) weapons or the detonation of a nuclear device at high altitude. Any international approach to address space security needs to take into account both US concerns about the vulnerability of its military and space assets and also the concerns of other Governments regarding their vulnerability to US military superiority.

One characteristic of asymmetric conflict is that the push for military invulnerability will tend to increase civilian vulnerability. The major driver behind space weaponization may be missile defence, but concepts such as full spectrum dominance and space control are mirrored in the Bush Administration's approach to combating terrorism. Notions of full spectrum dominance, as outlined in USSPACECOM documents, are perceived as a security threat by countries that have no political desire or intention to threaten the United States, but which would be expected by their own citizens and militaries to develop countermeasures to deter the United States nevertheless. This is a version of the classical security dilemma, whereby the attempts of some States to look after their security needs by strengthening their military resources lead to rising insecurity for others.

Regardless of its intentions, overwhelming military security and the current US mission to police the world feed other nations' threat perceptions. In space, as with other issues, the United States needs to be more aware that its actions could be self-fulfilling, and may well provoke asymmetric security responses in others that create greater international threats and vulnerabilities.

Undoubtedly, one or more nuclear detonations at very high altitude would disable satellites in Low Earth Orbit (LEO)[20] that had not been previously hardened against the effect of a nuclear weapon's electro-magnetic pulse (EMP). Although the United States has hardened many of its key military satellites, many commercial assets and several other countries' satellites would be jeopardized. Though the technology to prevent a high-altitude nuclear detonation does not exist, it would be extremely difficult for the perpetrator to evade detection. Such a detonation would indiscriminately damage the space assets and communications and navigational systems of friends as well as foes, and there would be high political costs to crossing the nuclear threshold.

The Space Commission's answer appears to be more weapons, but weaponizing space would be likely to accelerate the threats to US assets rather than deterring or preventing them.[21] A more sensible approach would combine the physical and technical hardening of satellites, which would contribute to deterring such an attack, and arms control—with particular emphasis on nuclear disarmament, strengthening the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), and efforts to restrict missile proliferation, such as the Missile Technology Control Regime (MTCR) and the recently concluded International Code of Conduct against Ballistic Missile Proliferation (ICC).

For many technological and political reasons, a high-altitude nuclear detonation is unlikely, though in an age of asymmetric warfare, it cannot be completely ruled out. A much more immediate danger to commercial and military assets in space, already arising from careless human actions in the first 45 years of space activities, comes from space-crowding and orbital debris.

LEO is teeming with human generated debris, defined by NASA as "any man-made object in orbit about the Earth which no longer serves a useful purpose". There are some 9,000 objects larger than 10cm and over

100,000 smaller objects. As orbiting debris may be travelling at very high velocities, even tiny fragments can pose a significant risk to satellites or spacecraft, as experienced by US astronaut Sally Ride, when an orbiting fleck of paint gouged the window of the space shuttle during her first flight.[22] If instead of paint, the projectile had been harder or larger, it could have put the lives of the crew at risk.

As noted by Joel Primack, one of the premier experts on the problems of space debris, "Weaponization of space would make the debris problem much worse, and even one war in space could encase the entire planet in a shell of whizzing debris that would thereafter make space near the Earth highly hazardous for peaceful as well as military purposes".[23] Such a scenario would cause the Earth to be effectively entombed, jeopardizing the possibility of further space exploration and greatly complicating civilian uses. In addition, Joel Primack speculates that even a small number of "hits" in space could create sufficient debris to cause a cascade of further fragmentation (a kind of chain reaction). This, in turn, could potentially damage the Earth's environment and, as the sun's rays reflect off the dust, cause permanent light pollution, condemning us to a "lingering twilight".[24]

States with the capabilities to launch intercontinental ballistic missiles (ICBMs) or to put satellites in space will also be capable of launching an ASAT attack. A few may develop ASAT laser weapons suitable for an attack against anything in LEO. As such States are likely to have their own space assets in orbit, however, the destruction or fragmentation of satellites would exacerbate the problem of space debris and so be counter-productive for their own security interests. Military and commercial systems in space depend on ground facilities (telemetry, tracking and control, communications, data reception, etc.) and radio links (carrying commands, communications, telemetry and data), both of which provide much more accessible opportunities for interference, disablement or destruction. It is unlikely that adversaries would risk a direct, physical attack when electronic hacking, jamming or "spoofing" provide a low-tech, low-cost means of disrupting space assets. The weaponization of space as a proposed response to potential vulnerabilities needs to be placed in a much wider context than USSPACECOM literature suggests.

Furthermore, there are a number of technical approaches that could increase the security of space-based assets without resorting to the deployment of weapons. These include: hardening and shielding power sources and vulnerable equipment both to protect against EMP and certain levels of kinetic impact; building in redundancy, ensuring that there are back-up facilities and replacements to avoid a whole system being crippled if one or a few parts of it are disabled; and increasing situational awareness, manoeuvrability and stealth/concealment capabilities.

INTERNATIONAL APPROACHES

Placing weapons in space is not the inevitable outcome of the use of space for commercial purposes. Many of the perceived vulnerabilities of space assets can be addressed in other ways. At present, no one but the United States has the capability, intention and resources to pose a significant risk to space-based assets. In addition, no State with the technological potential to pose a future threat to US (or other) space assets (for example, the Russian Federation, China, France/European Union, India) is prioritizing financial or technical resources to developing weapons capable of threatening space assets, and all of these are more interested in building or maintaining cooperative (if sometimes uneasy) alliances with the hyper-Power. If US military developments in space continue their drive towards weaponization, however, other Governments may feel under pressure to devote political, financial and technological resources to counter or offset US space-based superiority. Before such expensive and dangerous military responses become necessary, a number of Governments and NGOs are exploring legal, political and diplomatic ways to address space security and weapons.

When considering what is desirable and feasible, three considerations are important: the current legal situation and what is already being addressed; realistic political possibilities in the near future; and what would need to be done to create the political conditions for addressing space security more effectively. Possible approaches fall into five broad categories: confidence-building measures; utilizing existing legal instruments; partial measures; national and regional approaches; and comprehensive approaches, including treaty negotiations. In examining these options below, I make the argument for the international community to undertake a comprehensive approach that would incorporate most of these elements. Comprehensively addressing space weaponization and security issues would not preclude partial, interim steps or agreements reached without full multilateral negotiations, but there needs to be the clear, overarching goal of creating a legally binding space security regime and embedding an unequivocal taboo on the deployment or use of weapons in and from space.

Confidence-Building Measures

Space security has been the subject of United Nations resolutions for more than 40 years. General Assembly resolution 1721[25] of 20 December 1961 established many of the foundational principles of space arms control that were later to be enshrined in the 1967 Outer Space Streaty (OST). It stressed that exploration and peaceful uses should be open to all, and that international law should apply to space and celestial bodies. It advocated the registration of space launches and international cooperation on issues such as communication and meteorology.[26] The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), attached to the General Assembly's Fourth Committee, has long been able to discuss the problems associated with space traffic control and debris, but is hampered by an interpretation of its mandate that precludes any addressing of arms control or disarmament questions. Employing the well-known "ping-pong" tactic, the United States and others insisted that any disarmament-related issues were the purview of the Conference on Disarmament (CD), where they could then be blocked.

Transparency measures under consideration, in conjunction with wider efforts to control ballistic missile proliferation, include notification of launches, providing pre- and post-launch information, and the licensing of activities. The idea of starting the process of addressing space security by looking at transparency, confidence-building measures and international cooperation to track and mitigate debris and overcrowding in space appears attractive because it is thought possible to bypass the space hawks' objections and draw the United States into such discussions. If the United States were prepared to engage and if (a bigger if, this) the talks could be effectively managed, they would be intrinsically valuable. However, as long as the CD and COPUOS maintain a rigid division of labour, it will be difficult—if not impossible—to move from such confidence-building measures into the kind of cooperative arms control that is urgently required. There would be a danger that under such circumstances substantive talks on space debris and traffic control would be time-consuming and could be manipulated to divert attention from measures to prevent the first testing and deployment of space weapons.

Strengthening Existing Legislation

There are already a number of international instruments with jurisdiction over space activities. The most important is the OST, which provides a basic framework for space activities. Enshrining the principles of peaceful use and exploration, and that outer space should be available for the benefit of all (not subject to national appropriation by sovereignty claims), the OST has 102 parties, including China, France, India, Israel, Pakistan, the Russian Federation, the United Kingdom and the United States.[27] It prohibits the stationing of WMD, including nuclear weapons, in space orbit or on celestial bodies. It does not cover the transit of nuclear weapons (on ballistic missiles) through space or prohibit nuclear weapons launched from Earth into space for the purposes of destroying incoming missiles.[28] It also says nothing about ASATs or the placement of conventionally armed weapons in space. Other relevant treaties include the 1963 Partial Test Ban Treaty (PTBT), which banned nuclear testing in outer space, and the Moon Agreement of 1979, which confirmed many of the provisions of the OST, with specific reference to the Moon. Though prohibiting the threat or use of force on the Moon or the use of the Moon to commit hostile acts in relation to the Earth or space assets, the Moon Agreement does not address placing conventional weapons in orbit around the Moon.[29]

Important prohibitions on deploying and testing anti-ballistic missile (ABM) systems in space and on interfering with national technical means (NTM) operated for verification purposes were enshrined in the 1972 ABM Treaty, deemed void following US withdrawal in June 2002.[30] The principle of non-interference with NTM was also enshrined in the 1987 Intermediate Nuclear Forces (INF) Treaty and the 1991 Strategic Arms Reduction Treaty (START I).[31] START I also prohibited the production, testing and deployment of "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" and contained transparency and confidence-building provisions. It reinforced the provisions of the 1988 Ballistic Missile Launch Notification Agreement, providing for advance launch notification of ballistic missiles used as boosters to put objects into the upper atmosphere or space.[32]

George Bunn and John Rhinelander, legal advisers to earlier US Administrations, have argued that the OST created an "overall rule [that] space shall be preserved for peaceful purposes for all countries".[33] They argue that OST parties would have the right under the treaty to request consultations if another party planned to test or deploy in space a laser or kinetic kill vehicle capable of being used as an ASAT, a description that would cover the space-based component of the Bush Administration's multi-layered missile defence architecture. Endorsing that OST parties should make use of this provision and request formal consultations with the United States, Jonathan Dean also proposed that nations could pass a resolution in the General Assembly to request the International Court of Justice (ICJ) to give an advisory opinion on whether testing or orbiting space weapons of any kind would be contrary to the core rule and objective of the OST that space be maintained for peaceful purposes. On the grounds that the testing or use of space weapons would jeopardize national technical means of verification, enshrined in several treaties and agreements, and the commercial uses of space, he also suggests that legal action could be taken to prevent such threats, utilizing international and US courts, as appropriate.[34]

Partial Measures

Assessing that the current situation is equally detrimental to the interests of commercial and military space users, advocates of space weapons for missile defence and arms controllers, and that the alternative to compromising around some middle ground would be no agreement at all (and a victory for the space hawks), some arms controllers are exploring partial measures.

The Eisenhower Institute has suggested that certain space assets like the Global Positioning System (GPS) and other navigation satellites, telecommunication and weather satellites could be declared "global utilities" and given special legal status.[35] Recalling earlier discussions, particularly during the 1980s debates over Ronald Reagan's Strategic Defence Initiative (SDI), a number of governmental and non-governmental representatives have pushed for reconsideration of a multilateral ban on ASAT weapons, at least as a first step.

Another proposal builds on an earlier Bunn proposal to distinguish between weapons in low and high orbit. With the aim of getting the support of key actors among the inevitable weaponizers and militarization realists, James Clay Moltz argued the case for prohibiting the use, testing or deployment of weapons or interceptors of any sort above 500 miles and prohibiting the stationing of weapons in LEO. His proposal would permit the testing (and presumably use) of ground-based, sea-based and air-based interceptors in LEO against ballistic missiles but not against satellites or other space-based objects (while recognizing that implementation of this would have to rely on taboo-building and confidence, since verification techniques would be unable to distinguish between permitted ABM interceptors and banned ASAT purposes).[36] While such a compromise would be unlikely to satisfy the space hawks, it allows key elements of the Bush Administration's missile defence plans, while clear barriers would prevent space-based lasers or kinetic kill weapons, and might therefore head off the escalation to higher levels of space weaponization that many fear as the most threatening and destabilizing facet of the missile defence project.

The Stimson Centre's "space assurance" concept takes another approach, starting from the premise that cooperative international measures are necessary to ensure the continuation of space commerce and exploration and would be highly advantageous to US military operations. Accordingly, the Stimson Centre favours licensing and controlling particular kinds of space-related activities through consultation, negotiation, or by means of unilateral national action.[37]

These are interesting initiatives to gain attention from moderates in the Bush Administration, but there is a risk that partial approaches may buy off public concern, making it more difficult to build the necessary political momentum to ensure that negotiations actually go ahead.[38] It is also important to note that though there are indications that some in the Bush Administration might be willing to consider a ban on ASAT weapons and uses, this is no longer a viable option for other key States, notably China. US use of force-support assets in space means that such a ban would be dismissed as a mechanism to protect US military capabilities while denying others the right to defend themselves against space-supported attacks. If pursued on its own, an ASAT ban would be regarded as discriminatory and unenforceable. To be viable, it would need to be coupled with a ban on space weapons testing and deployment.

National and Regional Approaches

Although few parliaments have yet begun to pay attention to space security as an issue, it is beginning to be linked with rising international concern about missile defence. The European Parliament has issued periodic reports on Europe and space. By contrast with the US emphasis on the military uses of space, the most recent European Parliament report emphasized that space activities should only be for peaceful purposes, including scientific knowledge, with "benefits for research, industry and society as a whole", including the European Space Agency (ESA) and a future satellite system for global environment monitoring.[39] The report also identified "protection and management of the space environment" as a major policy goal and warned that the European Union could be taking its first step towards the militarization of space with the GALILEO navigation/location system, intelligence-gathering and the Global Monitoring for Environment and Security (GMES) initiative. The European Union's emphasis on social and economic benefits and on managing the environment is reinforced by France, Europe's leading spacefaring nation and a prime mover behind ESA.[40] Among US allies in Europe, France has been more keen than most to challenge Washington over missile defence and space policy, and has in the past advocated greater action on PAROS in the CD than the United States is willing to contemplate.

Britain, like France, has an active space programme, with significant investment in space-based telecommunications, remote sensing, surveillance and intelligence-gathering. Reflecting its close military collaboration with the United States, however, the United Kingdom has been reluctant for PAROS to be made a CD priority, although it traditionally votes in favour of the annual United Nations General Assembly resolutions on prevention of an arms race in outer space.[41] The British Ministry of Defence (MoD) has expressed concerns about space debris, and has noted—but without expressing explicit concern—that space could become part of a potential "future battlespace" in which the use of directed energy weapons "seems likely to increase".[42] The United Kingdom is more dependent on US military space programmes than other European Union countries. Although officials privately express concern about the implications of the Bush Administration's ambitious and apparently open-ended plans for missile defence and the weaponization of space, the United Kingdom already hosts two US facilities that are crucial for missile defence and the US National Security Agency, at Fylingdales and Menwith

Hill in Yorkshire, and the current Government would be unlikely to take an independent or critical stance unless the issue became domestically politicized at a much higher level than at present.

Within the United States itself, a Democrat Representative, Dennis Kucinich of Ohio, put forward a Space Preservation Bill in the House of Representatives in January 2002. In essence, the bill calls on the United States to ban all research, development, testing and deployment of space-based weapons. If passed, it would also require the United States to enter into negotiations towards an international treaty to ban weapons in space.[43] This initiative, which has also given rise to an NGO-sponsored Space Preservation Treaty, can be a useful tool to stimulate public and political debate, but it is unlikely to become a viable basis for negotiations or real legislative action. Nevertheless, there may be some political merit in other parliaments introducing similar initiatives to stimulate national debate and public and political mobilization around space security issues.

Comprehensive Approaches

The most effective comprehensive approach for addressing both US and international security concerns would require three interrelated components:[44]

- A ban on the testing, deployment and use of all kinds of intentional weapons in space. This is needed to extend and strengthen the 1967 Outer Space Treaty's prohibitions on weapons of mass destruction in space so that directed energy (laser) and kinetic kill weapons are also banned, as well as any other potential offensive innovations that military researchers or planners might dream up;
- A ban on the testing, deployment and use of terrestrially based anti-satellite weapons, adding land, air and sea-based ASAT weapons to the ban on space-based ones covered in the previous point; and
- A code of conduct for the peace-supporting, non-offensive and non-aggressive uses of space. The code of conduct/rules of the road could include regulations relating to space debris and space traffic control, missile launch notification, and other transparency and confidence-building measures, with mechanisms for reviewing and updating provisions as and when appropriate.

An obvious and fundamental problem for treaty negotiations is how a "weapon in space" can be defined or distinguished from the military components in space of terrestrially based weapons. Suggestions for basing the ban on "purpose" rather than "technology" need to be explored further. Verification questions abound. Such objections do not undermine or invalidate the concept of either a space security treaty or a set of interconnecting agreements covering these three essential and interrelated components, but they do point to the need for legal and technical experts to get together with diplomats and government officials to work out the needs and parameters of a space security architecture.

With the advent of the United States' most recent push to develop missile defences, there has been renewed pressure from many States for the CD to address issues relating to the potential weaponization of space under its PAROS agenda item. Some States, notably China and the Russian Federation, have intensified their demands for the CD to undertake negotiations to prevent the weaponization of space. In June 2002, China and the Russian Federation, together with Belarus, Indonesia, Syria, Viet Nam and Zimbabwe, co-sponsored a working paper on *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*.[45] Consisting of 13 articles, the working paper was laid out as a draft treaty with the object of stimulating the early start of substantive discussions in the CD on the issue of PAROS.[46]

The preamble stated that "only a treaty-based prohibition of the deployment of weapons in outer space and the prevention of the threat or use of force against outer space objects can eliminate the emerging threat of an arms race in outer space and ensure the security for outer space assets of all countries which is an essential condition for the maintenance of world peace".

The draft treaty's scope comprises three elements: "Not to place in orbit around the Earth any objects carrying any kinds of weapons, not to install such weapons on celestial bodies, or not to station such weapons in outer space in any other manner. Not to resort to the threat or use of force against outer space objects. Not to assist or encourage other States, groups of States, international organizations to participate in activities prohibited by this Treaty."

The Chinese-Russian initiative is partly a political tactic, and partly a genuine attempt to stimulate discussion about what a space security treaty might look like. Like the Kucinich bill, it is important to recognize that such drafts are only sketched, intended to provoke discussion rather than be a technical or legal basis for negotiations. They can play a very valuable role, providing their supporters recognize their mobilizing function and do not become stuck on the minutiae of specific language formulations or become narrow-mindedly exclusive about their particular approach.[47]

CONCLUSION

As the Russian Federation's Permanent Representative in Geneva, Leonid Skotnikov, underlined when presenting the Chinese-Russian draft treaty to the CD, "urgent measures should be taken today to prevent the deployment of weapons in outer space, so that we are not forced later on to waste a colossal amount of time and effort on its deweaponization".[48] If we ignore the issue now, it is possible that—as with the "Star Wars" plans of earlier decades—it might go away or collapse under the weight of its own technological, military or financial contradictions. Or, alternatively, it could be quietly and efficiently embedded and promoted within the bureaucracies and military industries, as appears to be the strategy Donald Rumsfeld has chosen, as he proceeds to implement the recommendations of the Space Commission.

As outer space grows in commercial and military importance, there are current threats and vulnerabilities that need to be addressed now, but coherent international approaches are hampered by weapons-driven approaches on defence and security and short-sighted attitudes towards arms control. Although the conditions have not yet developed for negotiations on a comprehensive treaty to be viable, it could be very useful to consider initial measures on launch notification, space debris and elements of a code of conduct for sustainable space activities. If addressed as confidence-building means related to the wider context of space security and non-weaponization, rather than treated as sufficient ends in themselves, such negotiations would be a way to engage the United States and other spacefarers in a dialogue about ways of sharing outer space to enhance international security and reap greater long-term benefits for all.

The levels of issue salience and civil-society engagement are still quite low. To raise consciousness there needs to be greater understanding of the foreseeable consequences. It is not sufficient to assert that the weaponization of space would create even more debris with unpredictable consequences for the Earth, human security or future space activities. More research needs to be undertaken on a range of technical, strategic, environmental, economic and security implications and to assess the likely architecture (numbers and types of weapons) if one or more countries were to deploy space-based directed energy or kinetic kill weapons or an ASAT array. The debate risks becoming bogged down, however, if it focuses too much on the arguments for or against certain types of weapons or technologies.

Advocates of a space weapons ban need to frame the issue in terms of future security and focus on the following strategies:

- **Forge alliances** within the military, political and industrial sectors, especially in the United States, using technical expertise and cognitive strategies aimed at diminishing support for space weaponization and shaping interests in the direction of identifying both US security needs and international security as best served through creating a space sanctuary or security regime;
- **Strengthen** the advocates of a space weapons ban both within and outside the United States by encouraging knowledge-sharing and the development of a coherent, objective and multi-layered approach. The objective of space security needs to be promoted in terms of a non-weaponized architecture, with a code of conduct regulating space activities to enhance the security of space assets and current and future non-offensive uses and activities;
- **Unify** as large a group of States as possible behind a coherent concept for a space security treaty, preferably through building a strong partnership of Governments and civil society experts, advocates and activists;
- **Maximize** the effective engagement of global civil society around achievable goals and viable strategies.

There is nothing wrong with motivating public action through images that make people afraid, if the threats and risks underlying the fears are well founded. In the case of space weaponization or war, the dangers cannot be predicted and must not be underestimated. Future exploration and the peaceful uses of space could be irrevocably damaged. Life on Earth could be harmed in unpredictable and far-reaching ways. It is time to create new partnerships between Governments, industry, space users and explorers, and informed, concerned citizens, to get this message across to the wider public and their political representatives.

Notes

1 This paper has benefited greatly from my discussions in several countries with scholars, activists and military officials too numerous (or sensitive) to mention, but I would like to express particular appreciation to Theresa Hitchens, Bruce DeBlois, John Pike and Yu Xiaoling for challenging and stimulating my thinking on space security.

2 Paul Wolfowitz, US Deputy Secretary of Defense, in a speech to the Frontiers of Freedom organization, used this term in the following quotation: "... while we have demonstrated that hit-to-kill works, as we look ahead we need to think about areas that would provide higher leverage. Nowhere is that more true than in space. Space offers attractive options not only for missile defence but for a broad range of interrelated civil and military missions. It truly is the ultimate high ground. We are exploring concepts and technologies for space-based intercepts." "Transcript—Wolfowitz Outlines Missile Defense Successes, Way Ahead", US State Department (Washington File), 25 October 2002, at <http://usembassy.state.gov/tokyo/wwwhsec20021028b3.html>.

3 *Report of the Commission to Assess United States National Security Space Management and Organization*, Washington D.C. (Public Law 106-65), 11 January 2001, available at <http://www.space.gov/docs/fullreport.pdf>, known as the 2001 Space Commission.

4 Available at <http://www.ostp.gov/NSTC/html/fs/fs-5.html>.

5 Available at <http://www.fas.org/spp/military/docops/defense/ d310010p.htm>.

6 Available at <http://www.fas.org/spp/military/docops/usspac/visbook.pdf>.

7 Available at <http://www.fas.org/spp/military/docops/usspac/lrp/toc.htm>.

8 Available at <http://www.spacecom.af.mil/hqafspc/Library/AFSPCPAOffice/2000smp.html>.

[9] Available at <http://www.space.gov/docs/fullreport.pdf>.

[10] Available at <http://www.defenselink.mil/news/Jun2001/d20010621transrep.pdf>.

[11] Available at <http://www.defenselink.mil/pubs/qdr2001.pdf>. In 2002, USSPACECOM was folded into US Strategic Command (StratCom), following Department of Defense reorganization. This integration of USSPACECOM as part of the Pentagon's core military mission was one of the recommendations of the 2001 Space Commission (see note 3), now being implemented.

[12] USSPACECOM, *Vision for 2020*, February 1997, at <http://www.fas.org/spp/military/docops/usspac/visbook.pdf>.

[13] *Report of the Commission...*, p. 12. This echoes USSPACECOM's *Long Range Plan*, which stated: "At present, the notion of weapons in space is not consistent with US national policy. Planning for this possibility is the purpose of this plan should our civilian leadership later decide that the application of force from space is in our national interest." USSPACECOM, 1998, *Long Range Plan*, March, p. 8, available at <http://www.fas.org/spp/military/docops/usspac/lrp/toc.htm>.

[14] *Long Range Plan*, Executive Summary.

[15] *Report of the Commission...*, pp. 7-10.

[16] The quotation is from the statement of Hu Xiaodi, Ambassador of China to the CD on 27 June 2002. See CD/PV.907 of 27 June 2002.

[17] Eric Javits, Ambassador of the United States of America to the CD on 27 June 2002. See CD/PV.907 of 27 June 2002.

[18] This characterization is based on Lt. Col. Hays' typology of four approaches to space weaponization: "space hawks", keen to pursue weaponization at all costs; "inevitable weaponizers", who argue from historical analogy and are sceptical of arms control; "militarization realists", who interpret history differently and believe that the US has little to gain and much to lose by weaponizing space; and "space doves", who advocate comprehensive arms control on the grounds that concepts such as space sanctuary and space security are more consistent with US national security than initiating an arms race in outer space. Lt. Col. Peter L. Hays, 2002, *United States Military Space: Into the Twenty-First Century*, Colorado, Institute for National Security Studies, September (INSS Occasional Paper No. 42), especially pp. 116-21. See also Lt. Col. Bruce M. DeBlois, Space Sanctuary: A Viable National Strategy, *Airpower Journal*, Vol. 12, No. 4 (Winter

1998), pp. 41-57, available at <http://www.airpower.maxwell.af.mil/airchronicles/apj/apj98/win98/deblois.pdf>.

19 Quoted in Peter Grier, "The New Nuclear 'Theology'", *The Christian Science Monitor*, 8 May 2001, at <http://www.csmonitor.com/durable/2001/05/08/fp1s2-csm.shtml>.

20 Space abounds with disagreements about definitions. For example, LEO is defined by some as 60-500km above the Earth and by others as between 100-1,500km above Earth. Geostationary Earth Orbit (GEO) is around 35,000km above the Earth's equator, where satellites proceed on circular, 24 hour orbits. In between is the Medium Earth Orbit (MEO).

21 If an adversary able to carry out a high-altitude nuclear detonation were reckless enough to defy such compelling technical and political deterrents and risk crossing the nuclear threshold in pursuit of its objectives, we might also reflect that perhaps it would be better if the demonstration target were commercial and military assets in space rather than a city full of people on Earth.

22 Sally Ride, Drell Lecture, Stanford Centre for International Security and Cooperation, 10 April 2002, quoted in Joel Primack, "Pelted by paint, downed by debris", *The Bulletin of the Atomic Scientists*, Vol. 58, No. 5, September/October 2002, p. 25, available at <http://www.thebulletin.org/issues/2002/so02/so02primack.html>.

23 Primack, loc. cit., pp. 24-25.

24 Ibid., p. 71.

25 Full text available at <http://www.oosa.unvienna.org/SpaceLaw/gares/html/gares_16_1721.html>.

26 In 1963, a further United Nations General Assembly resolution called for a ban on the deployment of nuclear weapons or other weapons of mass destruction in space. See General Assembly resolution 1884 of 17 October 1963. This was followed by a further resolution that paved the way for negotiation of the Outer Space Treaty. See General Assembly resolution 1962 of 13 December 1963, available at <http://www.oosa.unvienna.org/SpaceLaw/gares/html/gares_18_1962.html>.

27 The Outer Space Treaty is formally named the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. For a list of the States party to this Treaty, as of 2002, see *SIPRI Yearbook 2002: Armaments, Disarmament and International Security*, Oxford, Oxford University Press and Stockholm International Peace Research Institute,

pp. 765-766. A further 27 states have signed but not ratified. Treaty available at <http://www.oosa.unvienna.org/SpaceLaw/outersptxt.html>.

28 Early US missile defence interceptors in North Dakota carried nuclear warheads, permitted under the 1972 Anti-Ballistic Missile (ABM) Treaty. The still-deployed Russian system around Moscow (*Galosh*) is also equipped with nuclear interceptors.

29 The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the Moon Agreement) was signed in December 1979 and entered into force in 1984. Before this, there were a couple of agreements facilitating cooperation: the 1968 Astronauts Rescue Agreement; the 1972 Convention on International Liability for Damage Caused by Space Objects; and the 1975 Convention on Registration of Objects Launched into Outer Space (the Registration Convention). All available at <http://www.oosa.unvienna.org/SpaceLaw/treaties.html>.

30 It is important to note that Article V of the ABM Treaty prohibited space-based ABM systems, but has been interpreted as allowing space-based interceptors or lasers for theatre missile defence (TMD). This loophole was closed by the Helsinki agreements of 1997. The Helsinki agreements were not ratified by the Senate, and the demise of the ABM Treaty reopens this option. See Hays, op. cit., pp. 96-97.

31 This non-interference obligation was made multilateral in the Conventional Armed Forces in Europe (CFE) Treaty, which has 30 North Atlantic Treaty Organisation (NATO) and East European participants and is of unlimited duration. These points were made by Jonathan Dean in his presentation to the Conference on Outer Space and Global Security, organized by UNIDIR and the Simons Foundation of Canada at the United Nations Office at Geneva, 26-27 November 2002.

32 These provisions have been augmented by a US-Russian memorandum of understanding establishing a PLNS for most ballistic missile and space vehicle launches, signed on 16 December 2000. This would be operated as part of the US-Russian Joint Data Exchange Centre. Text available at <http://www.state.gov/t/ac/trty/4954.htm>.

33 George Bunn and John B. Rhinelander, "Outer Space Treaty May Ban Strike Weapons", *Arms Control Today,* Vol. 32, No. 5, June 2002, p. 24 (Letter to the Editor), at <http://www.armscontrol.org/act/2002_06/letterjune02.asp>.

34 Jonathan Dean, "Defences in Space: Treaty Issues", in James Clay Moltz (ed.), *Future Security in Space: Commercial, Military and Arms Control Trade-Offs*, Monterey Institute of International Studies, Occasional Paper No. 10, 2002, pp. 3-7, available at <http://cns.miis.edu/pubs/opapers/op10/op10.pdf>.

35 As noted by Jonathan Dean in his presentation to the Conference on Outer Space and Global Security, loc. cit.

36 James Clay Moltz, "Breaking the Deadlock on Space Arms Control", *Arms Control Today*, April 2002, pp. 3-9, available at <http://www.armscontrol.org/act/2002_04/moltzapril02.asp>.

37 Presentation by Michael Krepon, President of the Henry L. Stimson Centre, 8th ISODARCO Beijing Seminar on Arms Control, Beijing, 14-18 October 2002.

38 The 1963 PTBT, for example, put nuclear testing out of sight, underground, thereby defusing public concern despite the fact that nuclear testing continued to fuel the nuclear arms race for another three decades.

39 European Parliament, *Draft Report on Europe and Space: Turning a New Chapter, Committee on Industry, External Trade, Research and Energy*, 2001/2072(COS) (Rapporteur: Konstantinos Alyssandrakis), 3 October 2001.

40 Centre National d'Éudes Spatiales (CNES), *2001-2005 Strategic Plan*, available at <http://www.cnes.fr/enjeux/1frame_index_enjeux.htm>.

41 After making a joint statement that they had voted in favour of the PAROS resolution but did not consider it a very high priority in 1998, the United Kingdom and Germany have since ensured a common European Union statement to this effect. In recent years, the PAROS resolution receives a very high vote in favour, with none against and a handful of abstentions, which include Israel and the United States and a satellite of the United States, such as the Marshall Islands or Micronesia. For example, General Assembly resolution 57/57 of 22 November 2002 received 159 in favour, none against and 3 abstentions. Available at <http://disarmament.un.org/vote.nsf>.

42 United Kingdom Ministry of Defence, *The Future Strategic Context for Defence*, para. 81 in The Military Dimension, available at <http://www.mod.uk/issues/strategic_context>. For a wider discussion of United Kingdom space interests, see British National Space Centre (BNSC), *United Kingdom Space Strategy 1999-2000: New Frontiers*, available at <http://www.bnsc.gov.uk>.

43 Space Preservation Act of 2002, HR 3616, January 2002, available at <http://www.pnnd.org/us_space_preservation_bill.htm >.

44 For an early discussion of these concepts, see Rebecca Johnson, "Multilateral Approaches to Preventing the Weaponisation of Space", *Disarmament Diplomacy,* No. 56, April 2001, at <http://www.acronym.org.uk/dd/dd56/56rej.htm>.

45 CD/1679 of 28 June 2002. This was a follow-on from China's earlier working papers on PAROS. In order to bring the Russian Federation on board as a co-sponsor, China's position underwent some important shifts. In particular, its 2001 working paper entitled *Possible Elements of the Future International Legal Agreement on the Prevention of the Weaponisation of Outer Space* (CD/1645) had proposed that the scope should cover "weapons, weapon systems or their components that may be used for war fighting in outer space". This provision was clearly intended to prohibit orbital attack weapons and anti-satellite weapons, but appeared to rule out some of the existing force-support roles, which could be construed as components of weapons, and was very ambiguous on interference with military space assets by electronic means rather than physical force (for example, hacking or jamming), covered for civilian satellites under the 1932 International Telecommunication Union (ITU) Convention, as amended in 1992 and 1994.

46 Leonid A. Skotnikov, Permanent Representative of the Russian Federation to the CD, CD/PV.907, 27 June 2002.

47 If pushed to the exclusion of other approaches, a premature treaty or legislative initiative risks becoming counter-productive, even serving to focus and strengthen the opposition, thereby "inoculating" the issue against later, more pragmatically targeted campaigns to develop legislation that would enhance space security and prevent weaponization.

48 CD/PV.907.