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UNIDIR

Security in Space
The Next Generation

Conference Report
31 March–1 April 2008

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The Next Generation

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FOREWORD

Outer space is an essential resource for all of us, whether we come from developed or developing nations, and must be kept free from attack for the whole of humankind. Imagine now a world without satellite communications, without mobile phone networks, weather forecasting and environmental imaging and you are imagining a world that has not prevented a war in outer space.

With this in mind, as part of the efforts of the Conference on Disarmament to discuss the prevention of an arms race in outer space, UNIDIR has been holding annual meetings to discuss space security. The conference "Security in Space: The Next Generation" is the seventh such conference and these are the proceedings from that day and a half of intensive discussion with experts from all over the world on this urgent security issue.

UNIDIR's conferences since 2002 have each in turn had a different emphasis: connecting outer space and global security, detailing the nexus between security and the peaceful uses of outer space, preventing an arms race in outer space, building the architecture for sustainable space security, celebrating the Outer Space Treaty, and exploring cooperative approaches to space security.

The 2008 conference took a prospective approach, giving a voice to the new generation of scientists and political analysts looking at the issue of space security. Building on the theme of the "Next Generation", we also discussed the new technologies for space weaponization and for the prevention of weaponization, and the prospects of legal and other instruments that could be developed to increase security in outer space. In particular, participants discussed the draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects, newly tabled in February 2008 by China and Russia. Participants also looked at ways to build trust in space activities in the future, as well as thinking on how to move from confrontation to cooperation as a way to increase space security and improve access to outer space for peaceful activities. Confidence-building measures, solving technical issues such as debris, enhanced cooperation for peaceful uses and international legally binding instruments are important mechanisms by which to guarantee a secure and stable space environment, for the benefit of all.

On a personal note, I leave UNIDIR in mid-2008 and I am proud of the work UNIDIR has done to create ideas for peace and security since I became Director in 1997. I am particularly proud of this series of conferences and their proceedings. It has not been easy to create a safe space for discussion on what has proven to be a hotly contested issue in the Conference on Disarmament. Nobody wants a war in outer space, but steps to avoid such a catastrophe range from treaties to prevent weaponization and build trust, to arming even commercial satellites in order to defend against attack and thus preparing for worst-case scenarios. In creating an annual discussion in Geneva, bringing experts from academia, government, the commercial sector and the military, we have enabled the negotiators at the Conference on Disarmament to explore and understand the variety of problems and the range of solutions with respect to outer space security. In publishing the proceedings (the summary of which is published annually as an official document of the Conference on Disarmament), we are reaching out to a wider audience beyond Geneva. This year we have made a specific effort to involve the Next Generation, the voices of those who will inherit the effects of the decisions we make today. It is our hope that our wide-ranging, provocative discussions in Geneva will contribute to the global efforts to create a secure outer space for all.

Patricia Lewis
Director
UNIDIR

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UNIDIR would like to express its gratitude to the Governments of Canada, China and Russia, as well as to the Secure World Foundation and The Simons Foundation, for their financial, political and material support of this conference.

In Geneva, UNIDIR would like to thank Ambassador Marius Grinius, Geoff Gartshore and Gillian Frost of the Permanent Mission of Canada; Ambassador Wang Qun and Li Chijiang of the Permanent Mission of China; and Ambassador Valery Loshchinin, Victor Vasiliev, Valery Semin and Alexey Petrenko of the Permanent Mission of the Russian Federation. We are also indebted to Cynda Collins Arsenault of the Secure World Foundation, as well as to Jennifer Allen Simons of The Simons Foundation for her unswerving support for this series of conferences.

Anita Blétry, Nicolas Gérard, Jason Powers and Kerstin Vignard followed the proceedings through the production phase.

ABOUT THE SPEAKERS

Samuel BLACK

Samuel Black is a Research Associate with the Henry L. Stimson Center. He previously worked as a Research Assistant for the Center for Defense Information. He received his MPP in 2008 and BA in 2006, both from the University of Maryland.

Einar BJORGO

Einar Bjorgo is Head of Humanitarian Rapid Mapping for the UN Institute for Training and Research Operational Satellite Applications Programme.

Gérard BRACHET

Gérard Brachet chaired the United Nations Committee on the Peaceful Uses of Outer Space during the period June 2006–June 2008. He is a member of the International Academy of Astronautics since 1992 and chaired its Commission Five: Space Policy, Regulations and Economics in 2006 and 2007. He is also Vice President of the Air and Space Academy/Académie de l'Air et de l'Espace, of which he chairs the Space Committee.

Nancy GALLAGHER

Nancy Gallagher is Associate Director for Research at the Center for International and Security Studies at Maryland and Senior Research Scholar at the University of Maryland's School of Public Policy. She was the Executive Director of the Clinton administration's Comprehensive Test Ban Treaty Task Force. She is the author of *The Politics of Verification* and numerous other academic and policy-oriented works on cooperative security.

Theresa HITCHENS

Theresa Hitchens is Director of the Center for Defense Information, and leads its Space Security Project, in cooperation with the Secure World Foundation. Editor of *Defense News* from 1998 to 2000, Hitchens has had a long career in journalism, with a focus on military, defense industry and NATO affairs. She also was director of research at the British American Security Information Council. Hitchens serves on the editorial board of *The Bulletin of the Atomic Scientists*, and is a member of Women in International Security and the International Institute for Strategic Studies.

Alexander KARL

Alexander Karl holds a degree in astronautical engineering from the Aachen University of Applied Sciences. He worked at the Max Planck Institute for Radioastronomy on a scientific subsystem for the Herschel satellite. He then went on to pursue a Master in Space Exploration and Development Systems from the Politecnico di Torino, Italy. Karl is the Co-Chairperson of the Space Generation Advisory Council since March 2007 and has been involved with the organization since 2005.

David KOPLOW

David Koplow has been a professor of law at the Georgetown University Law Center in Washington, DC, since 1981. His primary fields for teaching and scholarship involve public international law and national security law, with a particular emphasis on arms control, non-proliferation and anti-terrorism. He served as Attorney-Advisor and as Special Assistant to the Director of the US Arms Control and Disarmament Agency from 1978 to 1981, and as Deputy General Counsel for International Affairs at the US Department of Defense from 1997 to 1999.

Garold LARSON

Garold Larson, a career Foreign Service Officer with the US Department of State, is Deputy Permanent Representative of the US Mission to the Conference on Disarmament. Since his entry into the Foreign Service in 1984, he has served in Copenhagen, Dhahran, London, Washington, Paris, and Sarajevo. His most recent posting was as Economic Counselor, then Deputy Chief of Mission, in Budapest. Larson holds the rank of lieutenant colonel in the US Air Force Reserves, with more than 4,000 flying hours and the rating of Command Pilot.

Andrey MAKAROV

Andrey Makarov is a specialist in the field of space military activities and space security in the General Directorate of International Military Cooperation of the Russian Ministry of Defence. Since 1980, he has held various posts in the Strategic Missile Forces and Space Forces.

Makarov is a 1985 graduate of the Missile Forces School of Kharkov, and holds the rank of colonel.

Geraint MORGAN

Geraint Morgan is an analytical chemist with over 15 years of experience in the application and development of mass spectrometer systems for terrestrial and space flight applications. He was Project Scientist for the Ptolemy instrument onboard the current ESA Rosetta Mission and Project Scientist/System Engineer for the Gas Analysis Package onboard the Beagle 2 Mission. Morgan was Research Director for the Wellcome Trust project to investigate the translation of space technology to terrestrial issues.

Francesco PISANO

Francesco Pisano is Head of Institutional Affairs for the UN Institute for Training and Research Operational Satellite Applications Programme.

Tommaso SGOBBA

Tommaso Sgobba is Head of the Product Assurance and Safety Office, Research Operations Department, ESA Directorate of Human Spaceflight, Microgravity and Exploration. He also chairs the ISS Payload Safety Review Panel at ESA, and the ATV Re-entry Safety Review Panel. Sgobba is President and co-founder of the International Association for the Advancement of Space Safety, and Vice-President and co-founder of the International Space Safety Foundation based in California. He holds an MS in Aeronautical Engineering from the Polytechnic of Turin, where he was Professor of Space System Safety from 1999–2001.

Yvette STEVENS

Yvette Stevens recently retired from the United Nations, where she served as Assistant Emergency Relief Coordinator and Director of the Office for the Coordination of Humanitarian Affairs in Geneva from 2004 to 2006. An engineer by training, Stevens studied at the Moscow Power Engineering Institute and at the Imperial College of Science and Technology, University of London. Before her last assignment, she was the Director at the United Nations Office of the Special Adviser on Africa in New York, having served as the Special Coordinator for Africa and the Least Developed Countries in the United Nations Department of Economic and Social Affairs from 1999 to 2003.

Victor VASILIEV

Victor Vasiliev is Deputy Permanent Representative of the Russian Federation to the United Nations Office and other International Organizations in Geneva. After graduating in 1989 from the Moscow State Institute of International Relations he joined the diplomatic service. Vasiliev has participated as a member of the Soviet/Russian delegations at various international forums, including the NPT 1995–2005 Review Conferences, sessions of the UN General Assembly First Committee, Disarmament Commission, etc. He was part of the UN Group of Governmental Experts on Verification in All its Aspects in 2005–2006.

WANG Daxue

Wang Daxue is Deputy Division Director, Department of Arms Control and Disarmament, Chinese Ministry of Foreign Affairs.

Jessica WEST

Jessica West is Program Manager for the Space Security Index at Project Ploughshares. She joined Project Ploughshares in 2006 as a Program Associate responsible for nuclear weapons and space weaponization. She has experience researching conflict and security issues at the Canadian International Development Agency and has worked as a Program Manager for the Stabilization and Reconstruction Task Force at the Department of Foreign Affairs and International Trade Canada.

Maureen WILLIAMS

Maureen Williams is Chair of the Space Law Committee of the International Law Association and permanent observer to the Committee on the Peaceful Uses of Outer Space since 1996. She is also Professor (Chair) of Public International Law, since 1993, at the University of Buenos Aires and at Belgrano University, and Head of Research Projects on international law/space law at the National Science Council of Argentina. Williams is a member of the Royal Institute of International Affairs (London), legal adviser to the Argentine Space Agency, and member of the Board of Directors of the International Institute of Space Law (International Astronautical Federation).

Pearl WILLIAMS

Pearl Williams is Senior Policy Advisor responsible for space security in the Non-Proliferation and Disarmament Division (Chemical/Biological, Conventional, Remote Sensing), Foreign Affairs and International Trade Canada. She is a career Foreign Service Officer who has had postings to Bern, New York, Brasilia and, most recently, Accra.

Ray WILLIAMSON

Ray Williamson is Executive Director of the Secure World Foundation. Between December 1995 and April 2008, he was Research Professor of Space Policy and International Affairs in the Space Policy Institute, The George Washington University. He is also a member of the International Academy of Astronautics, serving on Commission Five: Space Policies, Law and Economics, and a member of the editorial board of the Space Policy Journal. He was recently Vice-Chairman of the US National Oceanic and Atmospheric Administration's Advisory Committee on Commercial Remote Sensing.

CONFERENCE SUMMARY

The conference "Security in Space: the Next Generation" is the latest in a series of annual conferences held by UNIDIR on the issue of space security, the peaceful uses of outer space and the prevention of an arms race in outer space (PAROS).

The purpose of this conference series is, in line with UNIDIR's mandate, to promote informed participation by all States in disarmament efforts and to assist delegations to the Conference on Disarmament (CD) to prepare for possible substantive discussions under agenda item 3, PAROS. Since beginning in 2002, these conferences have received the financial and material support of a number of Member States, showing the broad political support for these discussions.

This year's conference focused on three main issue areas:

- a historical overview of outer space diplomacy and possible future developments, including the Outer Space Treaty (OST) and PAROS within the CD;
- the status and challenges to space security, including a discussion of approaches on how to improve space security; and
- the creation of an environment promoting space security through creative thinking and transparency and confidence-building measures (TCBMs).

In February 2008, the Governments of the People's Republic of China and the Russian Federation tabled in the CD a draft treaty on preventing the placement of weapons in space. The draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects (PPWT) is the result of many years of consultations and expert discussions and aims to contribute to the CD's work on PAROS. Following a highly successful conference in 2007 marking the fiftieth anniversary of the launch of the first artificial satellite, Sputnik, and the fortieth anniversary of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (the Outer Space Treaty), UNIDIR's intent for its 2008 conference on security in outer space was to address the next generation of treaties and technologies and invite the next generation of space-users.

The conference convened in Geneva on 31 March–1 April 2008, organized by UNIDIR, with financial and material support from the Governments of Canada, the People's Republic of China and the Russian Federation, as well as from the Secure World Foundation and The Simons Foundation. Representatives from UN Member States and Observers, from non-governmental organizations and civil society, as well as speakers from Argentina, Canada, China, France, Germany, Italy, Norway, Russia, Sierra Leone, the United Kingdom and the United States brought the total number of participants to over 150.

The following is a summary report of the conference. The keynote speakers are identified along with summaries of their presentations. The Chatham House Rule applied in the ensuing discussions.

Sergei Ordzhonikidze, Director-General of the United Nations Office at Geneva and Secretary-General of the CD, opened the conference. Remarking on the title of the conference, he expressed concern not only for the next generation, but as well for the current generation and how an interruption in the uses of space could harm our daily lives due to the increased dependency on space-dependent technologies, such as cellular phones, satellite television, global positioning systems and so forth. The space age goes hand-in-hand with globalization and thus our aim should be building trust and confidence among countries in order to ensure security in outer space. Fortunately, space cooperation has grown since the end of the Cold War. Indeed, as an example, nationals of the United States, Russia, Canada, Europe, Japan and soon South Korea have lived and worked together on the International Space Station.

Since 1957, hundreds of satellites have been launched into space, many for commercial reasons. However, the security of the space environment has yet not been adequately addressed. For instance, orbital debris is a serious threat due to the potential for collision; despite debris mitigation guidelines, such as those of the Committee on the Peaceful Uses of Outer Space (COPUOS), the problem remains overwhelming and a great threat to space assets.

Another threat that we need to address is weapons placed in space and weapons designed to attack space-based assets, for example anti-satellite weapons (ASATs). Indeed, it is imperative that an arms race in outer space be avoided. Substantive discussions have been taking place in the CD and in the UN General Assembly and much has been achieved as a result. Ordzhonikidze gave the example of the draft PPWT, tabled by China and Russia, as a supportive approach that has now to be negotiated. Because space belongs to all, humanity needs a collective, universal approach to achieve space security.

SESSION I
PROVIDING SPACE SECURITY FOR THE NEXT GENERATION

Alexander Karl of the Space Generation Advisory Council presented a roadmap containing visions and recommendations for the safeguarding of outer space, of the long-term viability of the use of space and of the use of space by new actors. First, a better strategy is needed for addressing space debris—more than the voluntary international guidelines negotiated at COPUOS—as well as improvements to the resolution of debris tracking systems. Second, traffic management should be available and applied to all in space, as a logical consequence of an increase in the numbers of satellites, in order to avoid collisions and to guarantee safe access. Third, space governance, in connection with lunar governance and property rights, requires a broader, more integrated approach. Finally, a way must be found to prevent conflict in space and to prohibit ASAT tests. Progress in treaty negotiations could be made through the creation of a new working group on space traffic, and the introduction of property rights should be considered as a way to prevent conflict.

In looking at how not to repeat historical mistakes, Wang Daxue of the Chinese Ministry of Foreign Affairs reminded the conference that it took several decades of Cold War arms racing for the powers to realize that a nuclear war could never be won and should never be fought. Humanity paid a high price for them to reach this conclusion and we should not repeat the past in regard to space. To achieve strategic and military superiority in space, a state would need to develop a dedicated space weapons programme. This would include planning for space war and therefore would stimulate an arms race. China’s support for and introduction of the PPWT is thus aimed at reducing the possibility of an attack from space or a war in space.

The PPWT is in the interest of all states—a legally binding instrument increases security for all. The UN Charter already prohibits the threat of the use of force and so the CD could build on this to create a new international legal instrument, the PPWT. Arms control cannot rely only on political undertakings—a treaty is needed and the CD should successfully negotiate it. The human race relies on space security, and a weapon-free space environment, for its development. A PPWT should, therefore, be of the utmost importance.

Turning to the uses of space for humanity, Geraint Morgan of The Open University's Planetary and Space Sciences Research Institute (PSSRI) described how space technology can be applied to challenges faced on Earth. PSSRI developed a gas analysis instrument that was sent on the Beagle II mission to Mars. The development of the technology for this instrument—which was funded by the Wellcome Trust because of the applicability of space technology to clinical and medical research—has had an important scientific impact on the health of the next generation. In 2003, for example, 1.7 million people died from tuberculosis. The research carried out by PSSRI has enabled a new form of diagnosis for this disease, which is far faster than conventional methods. Such work thus demonstrates the type of benefits we can expect from space technology for human health—another critical reason for providing for space security for the next generation.

The UN Millennium Development Goals, as well as Hyogo Framework of Action, provide a useful approach to space development for the next generation. Yvette Stevens, former UN Assistant Emergency Relief Coordinator, pointed out that communications satellites have the capability to reach out to remote places and provide people with knowledge and information for education, not only for military needs. Remote-sensing satellites are a persistent and accurate means for observing the surface of the Earth and, in addition, are more cost effective than are other means, such as aircraft or ground-based surveys. Such technologies, combined with global satellite navigation systems, provide powerful tools for monitoring the environment and crises such as natural disasters or refugee flows in conflict. Space-based assets can thus both help to protect the environment and to mitigate risks during disasters. Environmental degradation can be monitored through satellites and action and assistance can be taken earlier than would otherwise be the case. As an example of how satellites can assist humanitarian responses to disasters, following the 2005 South Asian earthquake, satellite maps were used to find open roads and enable humanitarian workers to reach the effected locations. Road blocks were easily seen and clearance equipment was thus sent to the places where they were most needed. There was a reduction in guesswork and thus more effective use of donor aid—and more people were assisted as a result. Due to global climate change, more natural disasters will occur, such as flooding of low-lying island states and regions, such as river deltas. Satellites have great potential for enhancing disaster response and management and therefore for risk reduction. Thus the next generation must fully incorporate the use of space to ensure that the Millennium Development Goals are met, especially in developing countries.

In presenting the annual Space Security Index, Jessica West of Project Ploughshares Canada discussed the current and future requirements for providing space security. Key measures would include an annual assessment, TCBMs, as well as the development of a global policy to ensure free access to space. The goal of space security should be to secure and sustain freedom in space for all. Key challenges include protecting the operating environment, particularly with respect to preventing space debris to mitigate the risk of collision, given the growing number and diversity of actors in space as well as the proliferation of technologies.

Space debris is an indiscriminate threat for all space-faring nations and all space users. The largest increase in debris occurred in 2007 with the destruction of a Chinese satellite. More actors in space will mean increased debris—it should be remembered that the international guidelines agreed by COPUOS are only voluntary. There is still only a limited ability to monitor the space environment. Currently, the United States, Russia, France, China and Ukraine have the capability to monitor space debris. However, objects smaller than 10cm cannot yet be tracked. An increase in the number of actors in space will have the potential to create more fear, threats and misperception, but at the same time to allow increased cooperation and economic development. In order to reduce fear, there should be more international cooperation and transparency, particularly involving all sectors as civil, military and commercial space assets are, or soon will be, indistinguishable.

Another threat is the development of ballistic missiles and anti-ballistic missile systems. Technologies developed for missile defences have many potential threat applications to space-based assets. Currently there is no space-to-Earth strike capability. However, over time, the combination of dependence on space by a growing number of actors increases the likelihood of space weaponization. An international space security proposal is most certainly the challenge of this generation and the next.

Following the presentations by the panellists, the ensuing discussion focused broadly on four issues:

- space debris;
- awareness-raising;
- satellites for disaster prevention and response; and
- treaties compared to TCBMs.

Discussion centred on the need for guidelines to mitigate space debris, potential actions to reduce debris and the need for transparency regarding the issue. Transparency especially seems to be an important component of addressing this challenge. It would not reduce debris, but would assist in our reaction to it. Few states have the ability to identify and track the debris that threatens space assets, and even the most advanced technology needs to be improved. Still, a primary concern is that such information has national security implications.

Questions were raised concerning the level of awareness that is exhibited in relation to space issues. Currently, the general public, sometimes even scientists, tend to be relatively uninformed about the state of space security, and furthermore seem to have little interest. This was made clear in the lack of public response to the destruction of the Chinese and American satellites. Steps must be taken to better educate the public regarding the potential and dangers of a compromised space environment, perhaps by emphasizing the dependence of our daily lives on space technologies. The media should play an important role to this end. However, it is also necessary to remain on guard against the spreading of misinformation.

Many satellite applications provide valuable information for identifying and responding to crises on Earth. However, the utility is limited by lack of means to translate this information into action. There needs to be a focus on developing mechanisms for communicating and applying this information on the ground. Moreover, these same applications could be of even greater use in disaster prevention. The monitoring of high-risk areas would enable advance warning of a potential crisis, and thus allow for preventive measures to be taken.

The question was raised as to whether a treaty would be more beneficial than TCBMs in promoting space security, and into which path we should put our energy. On the one hand, TCBMs are much easier to agree and keep updated. They can also show parties the benefits that an eventual treaty could provide. On the other hand, a treaty is a legally binding instrument, states are accountable to their obligations and, in case of a dispute, the International Court of Justice can have jurisdiction to mediate. In addition, it is more difficult to withdraw from a treaty because in most cases a treaty becomes part of national law. The opinion was expressed that most states would prefer a legally binding instrument in order to feel more secure concerning others' commitments and are willing to negotiate a treaty within the CD. However, as there is not yet consensus to negotiate a treaty on outer space security—such as the PPWT—TCBMs may be a more realistic option for near-term positive action.

SESSION II
BUILDING TRUST IN THE FUTURE

In looking at one of the keys to confidence building, Samuel Black of the Henry L. Stimson Center discussed how to prevent harmful interference activities in space, proposing an international agreement on space security with the aim of increasing stability in space activities. A no-harmful-interference clause would be an indispensable provision in any agreement on outer space security. A code of conduct could be more advantageous with respect to existing problems than would a treaty in that it would be quicker to negotiate and implement. This is particularly true in regard to the United States, as a treaty might fail to be ratified as happened with the Comprehensive Nuclear-Test-Ban Treaty. Thus, a code of conduct would be more politically viable. In addition, focusing on behaviour and actions avoids the difficulty of ascertaining intentions of spacefaring countries and avoids the difficulties of defining what qualifies as a space weapon.

Garold Larson of the Permanent Mission of the United States to the Conference on Disarmament made it clear that the United States strongly supports the peaceful use of outer space and is fully committed to the 1967 Outer Space Treaty. Fundamentally important to the United States is the increasing problem of persistent space debris and possible collisions between debris and functioning satellites. The United States has been working in cooperation with other states to address this problem, for example through the Inter-Agency Space Debris Coordination Committee (IADC) in producing its Space Debris Mitigation Guidelines, which laid the foundation for those endorsed in 2007 by COPUOS and the General Assembly.

The United States strongly supports involving private sector satellite operators in the dialogue on collision avoidance and space debris mitigation, given the experience such operators have developed in coordination and cooperation among themselves. Scientists and engineers from a wide range of government and commercial organizations have an increasing interest in sharing space situational awareness, and an expert dialogue would lead to clear guidelines and the comprehensive coordination of action. However, deliberations take time and so the United States proposes that bilateral agreements on transparency measures should also be undertaken in parallel. One suggestion in this regard would be to install or expand hotlines between capitals to facilitate direct communication regarding space incidents. Another measure could be regular exchanges of senior space officers and their staffs, as well as operations officers. Such exchanges can help to build trust and understanding, two key elements of cooperation and effective crisis management.

Andrey Makarov of the Russian Ministry of Defence addressed TCBMs, which are integral to the international legal framework. They are recognized by the United Nations as a mechanism to promote understanding and to lessen tensions. They can assist in strengthening international peace and security, and in helping to prevent war. However, they must not take the place of disarmament efforts, distract attention from such, nor substitute for the implementation of agreements that have been reached. Still, they may be developed independently to promote favourable conditions for agreement, or be used as parallel measures to strengthen agreements.

TCBMs are recognized as important for regulating space activities. Again, such measures must strengthen international peace and security, but to be effective they must respect national security concerns. They must as well account for differing capabilities of actors, as these differences in the realm of space activities are extreme. For many states, the time has come to proceed with negotiations on a treaty banning the placement of weapons in space. But national concerns make this a difficult step. TCBMs can and should be considered as being easy first steps to strengthening space security, and laying the foundation for stronger legally binding agreements.

For this reasons, TCBMs and a treaty banning weaponization should be pursued in parallel.

Following the presentations by the panellists, the ensuing discussion focused broadly on two issues:

- codes of conduct; and
- information sharing.

The question was raised about the difference between legally binding and politically binding in relation to the proposals for a code of conduct in outer space. The discussion centred around the sense that a politically binding instrument would receive greater support currently and is not dependent on ratification processes, thus perhaps would be easier to obtain.

Interest was expressed as to whether the commercial owners of satellites are willing to share information about assets in space. The answer was that this information is already available, because of the obligation to register every space object with the UN Secretariat. This information is accessible to all and experts are able to quickly ascertain the purposes of the satellites listed according to their orbits and types.

SESSION III
FROM CONFRONTATION TO COOPERATION

Nancy Gallagher of the University of Maryland discussed how the end of the Cold War and increasing dependence on space started a debate in the 1990s about the proper approach to the use of space. For most space actors, the assumption is that space is an environment where cooperation is and must be the norm, and where the management of debris, traffic, resources and so forth could be accomplished through informal tools, such as codes of conduct. For an important minority of space actors, the environment is one of increasing competition, wherein the security of space assets and uses is assured through dominance of that environment.

Which of these approaches will provide the better route to space security? One way to evaluate this is to examine the results achieved by the minority of actors that seek space dominance. How much have proponents of space dominance achieved to this end? Vast amounts of money have been spent on developing the capabilities that would enable control of the space environment. Yet, none of these actors are anywhere close to realizing this goal. Incremental progress has been made in terms of existing technologies, but none have been able to achieve decisive advances in space technology. Rather, the real development has been in terms of intentions and policies. In pursuing dominance, these actors undermine the potential for cooperation in space affairs.

This leads to a second question: if these actors continue to seek dominance of the environment, have they the potential to achieve it, and thereby achieve security of space? This does not seem to be the case. By manoeuvring to maintain freedom of action in space, these actors undermine legal and political protections of space assets and actors. Furthermore, developments in capabilities spur other actors to do likewise. The result would be a space environment in which it would be more dangerous, and contentious, to operate than it is now.

The conclusion is that seeking dominance of space is a self-defeating route to space security. This minority of actors would be best advised to pursue negotiated strategies to achieving security in space that would address the interests of all and apply common expectations and rules to all actors.

The security of the space environment faces many challenges. Maureen Williams of the Space Law Committee of the International Law Association pointed out that foremost among these is orbital debris. We know of some 12,000 particles of 10cm or greater in size. Many thousands more are of a size smaller than this, and these cannot be tracked using current technology. Given the great velocity of these particles (some 8km/sec in low Earth orbit), even very small pieces of debris have the potential to cause catastrophic damage to space assets.

Unfortunately, this issue, and the consequent obligations of space actors, are not adequately addressed by the Outer Space Treaty. Article 9 states that if a party has reason to believe that its activities might cause damage to the environment or harmful contamination, they should take the necessary measures to avoid that. But the article does not specify when contamination is considered harmful, or if all contamination is considered harmful. Neither does it specify measures that should be taken. Does this apply to future activities? Does this apply to abandoned or inactive assets that nevertheless fill valuable orbital slots? Article 9 also states that in these cases actors should engage in consultations, yet no time limit is defined. Great damage can take place while consultations proceed. In any case, the article is vague and insufficient.

Thus the Space Law Committee of the International Law Association continues to elaborate its Draft International Instrument on the Protection of the Environment from Damage Caused by Space Debris. This instrument posits that cooperation in space activities is an obligation for all actors. There is also the obligation to inform (not simply to exchange information, but rather to be proactive and provide anything of possible relevance). The instrument also provides for a dispute settlement mechanism, in order to pave the way for compulsory jurisdiction. To correct the weaknesses of the Outer Space Treaty, the instrument limits such consultations to 12 months.

Tommaso Sgobba of the International Association for the Advancement of Space Safety argued that, in terms of ensuring space security, the true problem that we face is not the lack of a treaty governing military space activities, but rather the lack of a civilian regulator for space activities. While a treaty would address possible future threats, there are very real, current threats that must be faced now. For example, orbital debris is a safety concern, and only peripherally a strategic concern. Would a treaty on military space activities prevent debris? No. Even if the COPUOS guidelines on debris mitigation were mandatory, the threat would remain. The problem of orbital debris does not need to be mitigated, it needs to be resolved.

The space age is rooted in a military heritage. For this reason, the space age has been driven by the primacy of the "mission", rather than of its safety. As the number of space actors continues to grow, and activities become more commercial, the traditional distinctions between public and private, and domestic and international are blurring. In terms of investment, 80% of space activities are now civilian. Space actors must move beyond the military heritage and mindset, and resist applying models that are more relevant to the past than to the future.

It is imperative that we move beyond general principles concerning space and define the rules and standards that will enable us to progress into a new space age, one that stresses the civil regulation of activities. As a specific example, the International Association for the Advancement of Space Safety proposes that the mandate of the International Civil Aviation Organization be expanded to include Earth orbit—not only are we seeing the development of hybrid aircraft/spacecraft, but the management of air traffic relies on orbital space assets.

Gérard Brachet, Chairman of the United Nations Committee on the Peaceful Uses of Outer Space, related how for 50 years, space systems have contributed to peace and economic development through their three main areas of application—defence and security, the support of everyday activities, and scientific research. But over the next 50 years, our use of space cannot be guaranteed. The reason is simple, and that is the multiplication of actors, both governmental and private.

More discipline will be needed in space activities. From the beginning of the space age to the end of 2007, there were 4,457 space launches. Currently there are 660 operational satellites. These account for only 5% of the approximately 12,500 objects being tracked that are 10cm or larger in size. The rest is junk. And between 10cm and 1cm, there are perhaps 300,000 objects, and several million pieces in the millimetre range. The debris situation is thus a real and pressing concern. And, it must be remembered, this situation has resulted without any deployment of space weapons (although ground-based weapons can target space assets, thus posing a serious threat to near-Earth space). Space security is fragile and, in the long term, an open question.

The question is what can be done to guarantee long-term, sustainable access? The work by the IADC on debris mitigation was most useful and fed into the guidelines put forth by COPUOS and adopted by the General Assembly. Hopefully this can be a step towards developing a regime addressing the issue. Can COPUOS address the issue of long-term sustainability in a like manner, that being a bottom-up approach based on operational analysis? It is hoped so, and working groups have been organized to this end, bringing together spacefaring nations and commercial operators. Hopefully outputs from these groups can be incorporated into the COPUOS agenda, and be put forward as best practice guidelines.

Working to preserve the long-term, sustainable use of space is an issue that must be engaged now. The benefits of doing so will be shared by all stakeholders. Because all space operators must share the same environment, it is imperative that a common approach to sustainable use be found.

Following the presentations by the panellists, the ensuing discussion focused broadly on two issues:

- space debris; and
- space activities and actors.

At this very moment there is no practical, economical way to clean up debris in space. There are guidelines requiring that low Earth orbit satellites should re-enter the atmosphere naturally within 25 years, and that satellites in geostationary orbits should be decommissioned in a graveyard orbit after their useful lives. Compliance with these guidelines is encouraging and increasing, and it is good to see that voluntary rules are having an impact on actual behaviour. Nevertheless, a parked satellite is still clutter, so efforts and resources must be expended to develop economical methods for cleaning orbital debris.

Widespread frustration with the lack of progress to regulate activities in space was strongly evident within the discussion. Hope was expressed that changes in political approaches over the coming years could overcome such obstacles and negotiations could begin in the CD. It was also noted that spacefaring nations are not the only actors involved in discussions on regulations and ways forward. Many states, while not technically spacefaring, do operate or have involvement in the operation of space assets. Representatives from such states are prominent in the bodies negotiating space issues.

SESSION IV
TREATIES AND AGREEMENTS: THE NEW GENERATION

Victor Vasiliev of the Russian Mission to the Conference on Disarmament discussed how a treaty prohibiting the placement of weapons in space is essential. The weaponization of that environment could bring about grave and unexpected challenges, as did the development of nuclear weapons. For this reason, Russia and China have put forth the draft PPWT. The rationale behind this initiative is that modern space law does not prohibit the placement of weapons in space, unless they are weapons of mass destruction. However, given the global reach that space weapons would have, as well as the high possibility of their use, the placement of such weapons—or even the threat of their use—would generate fear and mistrust. In this sense, the impact of space weapons makes them similar to weapons of mass destruction.

But why a treaty, rather than other more simple forms of control? Without such a binding agreement, it will be difficult to predict future developments in the strategic situation both in space and on Earth. The international situation would be destabilized by the use or threat of use of space weapons, and it is likely that arms racing would result. This is compounded by the fact that, unlike weapons of mass destruction, space weapons could be used selectively and discriminately, thus making this likely. An arms race to achieve superiority in space would only result in all kinds of symmetrical and asymmetrical responses, and thus the climate of cooperation and confidence in space activities would be destroyed.

The PPWT seeks to avoid this potential situation by keeping weapons out of orbit. But it must also be remembered that space assets can be targeted with ground-based systems, thus the PPWT's additional focus on prohibiting the threat or use of force against such assets. We should not be distracted in negotiating what hardware to concern ourselves with, but rather with the behaviours that must be regulated or prohibited. The CD has discussed the basic elements of a treaty for over five years. There are no real arguments against a PPWT, so it is time to focus on substantive discussions.

Theresa Hitchens of the Center for Defense Information reminded participants that the work done towards a PPWT has been important in keeping space weaponization an important topic of deliberations. However, in regard to the draft text put forward by China and Russia, the language raises questions of viability.

It is not clear that the PPWT definitively addresses the development, testing and use of terrestrial ASAT weapon systems. The proliferation of such systems is a serious concern, and is in the interest of no one. Furthermore, such technology is difficult to restrict (for example because so many technologies are dual-use). But it is possible that an agreement could be reached to ban the testing and use of such systems. This would have the advantage of being easily verifiable, as we could concentrate on observed behaviour rather than technology.

There are also difficulties with Article 3 of the draft PPWT, concerning the threat or use of force. The concept of threat is a matter of perception.

Could stated national policies, if considered adversarial, be considered a threat? Could continued research into ASAT technologies, even without testing, be considered a threat? What of missile defences or laser tracking stations? It would be very difficult to define what should be considered a threat, yet a failure to do so would severely weaken a PPWT. The same applies to defining what is considered the use of force.

The language of the draft PPWT also faces the difficulty of how to define what is or is not a weapon. Again, a primary issue is that of dual-use technologies. For example, proposed systems to clear space debris could just as well be used against operational assets. There could be a process created for classifying space assets, although this would be politically contentious. In any case, the PPWT makes no reference to such a process. It would be critical to adequately define what is a space weapon. Without such a definition, there would be no way to develop a verification regime for the PPWT, which at the moment it is lacking.

Despite these shortcomings, the PPWT is a worthy goal. Yet, to be effective it must be given more clarity. The current language may not prevent deployment of space weapons, and could in itself cause continuing conflict over compliance issues. But the work being done is nevertheless valuable. All members of the CD should work towards the goals of this treaty, considering as well near-term alternatives such as TCBMs, codes of conduct and a space weapons test ban.

David Koplow of Georgetown University spoke about how, in terms of securing the space environment, we commonly speak of two possible methods: one being treaty law, and the other being non-law mechanisms such as TCBMs or rules of the road. But a third possible method is present in customary international law. This is as strong and reliable as treaty law, but yet is not as definite, in that it is unwritten. Customary international law is based on the long-term, widespread behaviour of states, as well as an ingrained acceptance that such expressed behaviours are obligatory. It can be argued that there exists customary international law restricting the testing of ASAT weapons.

For example, we could say that there is a rejection of the destruction of space assets in combat. There have been many conflicts during the space age, but never have space assets been aggressed in such a manner. As for testing, such was undertaken on occasion during the Cold War. And in the last 20 years, there have been perhaps three ASAT weapon tests. The pattern seems to be that states accept that they must refrain from such activities. However, there does not yet seem to be an acceptance that use or testing is illegal or illegitimate, so no norm could be said to exist.

But in regard to the law of armed conflict, it can be argued that ASATs would fail the tests of discrimination and proportionality. The debris created in the destruction of space assets is persistent and poses a serious threat to all space activities. In regard to protection of the environment, it is accepted that states will not damage the environment in the territory of other states or beyond territorial borders. This arguably should extend to space as well. Thus, the production of debris again should make ASAT use and testing not legally acceptable.

Customary international law was applied in the case of chemical weapons. A norm against them had emerged, which enabled the agreement of a treaty prohibiting them. Thus, even states not party to the Chemical Weapons Convention are bound by the norm against the use of such weapons. Perhaps the same approach could be applied in regard to space weapons.

Following the presentations by the panellists, the ensuing discussion focused broadly on two issues:

- customary international law; and
- treaty negotiations.

Questions where raised vis-à-vis whether we should consider customary international law as effective in the case of nuclear weapons. Furthermore, doubts were raised as to the fact that for customary law to be established repeating patterns are required and therefore time is required to establish customary international law. In addition, it is difficult for customary international law to deal with future threats.

However, the weak reaction of other countries, for example to ASAT tests in the past, means that such tests are not illegal today. The quickest way to create a legal norm is an immediate response to actions that are considered illegitimate and this reaction, over time, will brand them as illegal. An example of customary international law would be the acceptance of satellites in orbit or their overflight. When Sputnik was launched in 1957, no one knew if satellite overflights were legal and, indeed, many experts declared the contrary. Rules in space became accepted as a result of practice—that is, it became customary international law.

However, it was stated, customary international law does not replace a treaty, quite the opposite. But, in the absence of a treaty, the customary practice would allow agreement on certain activities quickly and inclusively.

The proposed PPWT generated a great deal of interest. One suggestion was to use more general language in the treaty—more of a framework treaty—whereas the opposite view, calling for more specificity, was also put forward. In support of generality, a concern was raised that defining a weapon in space would be senseless because in the environment of space just about anything could be a weapon. In addition, the assumption that if weapons in space were to be forbidden they would not be developed—whether or not they were deployed—was questioned. There are a number of examples of treaties prohibiting the deployment of weapons that do not curb their development entirely. In response, those in favour of a PPWT pointed out that the financial costs of space technology are sharply higher than most other weapon systems and therefore it would not make much sense to develop them if they cannot be deployed—of course, the same criticism could be made of any arms control treaty.

SESSION V
NEXT GENERATION, NEXT STEPS

Pearl Williams of Foreign Affairs and International Trade Canada noted that, since the beginning of the space age, there have been significant developments in space exploration and space-based applications. For example, we have become increasingly dependent on space as part of our collective infrastructure—from global communications and navigation links, to the collection of environmental and natural resources management information. Other developments in the space arena have included a greater expansion in the number of space actors, not only in terms of states, but of commercial actors too. For such reasons, there is a growing appreciation of the need for a rules-based operating environment in order to safeguard space exploration and its benefits for all. But we face shortcomings in regard to rules. What can be done? What structures could be put in place to contribute positively to preserving space as a global resource for the coming generations?

The CD is the pre-eminent body dealing with disarmament issues, and among these the issue of PAROS. But the CD has been deadlocked for years. Nevertheless, forward movement is possible, for example in pursuing discussions on the draft PPWT. Likewise, we need to address the fact that many of the technologies used to access the benefits of space fall into the category of "dual-use". This affords the opportunity for COPUOS and its subcommittees to play a central role in responding to the challenges and opportunities posed by the international community's increased reliance on outer space. But at the same time we must move beyond the increasingly misleading distinction between what is a peaceful use and what is not. Moreover, we need to broaden our concept of space security, not only addressing military concerns, but civilian and commercial as well. As we move forward in our efforts to preserve the secure and sustainable access to space, it is critical that we do not overlook the awareness-raising that will contribute to creating a better understanding among our fellow citizens.

Space applications (such as communications and Earth observation) are greatly affected by space security, as noted by Francesco Pisano and Einar Bjorgo of the United Nations Institute for Training and Research. As the number of space actors grows, this raises challenges for space security. This is problematic, as greater security means greater accessibility and potential for space applications.

From the perspective of the United Nations, space security is not simply a goal in itself. The application of space technologies has much promise for helping the United Nations to achieve its broader goals. From monitoring and managing crisis situations, to responding to changes in climate, to providing maps and aiding logistics to operators in the field, the United Nations has become a user and a provider of the benefits of space applications.

To maintain this ability, the United Nations must be user-driven in its pursuit of these technologies and, more than that, must always be guided by the needs of the beneficiaries of these technologies—all the people of the world. The work in which the United Nations utilizes or makes available these capabilities is of such importance that it should look toward developing an independent capacity. Space security must be confronted head on, for a threat to that environment is a threat to the United Nations' primary goals.

Ray Williamson of the Secure World Foundation stated that today we face many space security challenges, including orbital crowding, debris, effects of space weather, and of course the possible use of space weapons. The challenges must not be underestimated. For example, assets in a Sun synchronous orbit bunch together in the polar segment of the orbit. In July 2007, a US–Canadian satellite in such a situation had to be moved from its standard orbit to avoid a possible collision with an Iranian satellite. This reinforces the growing recognition of the need for international, cooperative approaches to traffic management and space situational awareness. This is a question of resources, and they must be provided for this. Then there is the ultimate issue of the development and use of space weapons. Military solutions to this issue are pursued, such as active and passive defences. However, we must not forget that there are diplomatic solutions as well. Instead of continuing discussions about the best approach to these security issues, we must move beyond and apply a broad range of activities in seeking solutions.

The session concluded with a brief assessment of the next generation of steps that must be taken to preserve and protect space activities. Many proposals have been made, and much understanding has been gained, but there seems to be resistance in moving forward in a concrete fashion. There will be many opportunities in the coming years to make these concrete steps, and we must be prepared to take them.

WELCOMING REMARKS

Sergei Ordzhonikidze

It is my great pleasure to welcome you to the Palais des Nations and to continue the tradition of opening this annual conference on space security and the prevention of an arms race in outer space, organized by the United Nations Institute for Disarmament Research. This year's conference—the seventh in the series—is entitled "Security in Space: The Next Generation". But, this should not lead us to believe that reinforcing security in outer space is a futuristic project; it is very much an immediate concern for our generation.

As space technologies advance and our dependence on outer space deepens, the issue of space security has taken on crucial importance for us all. We have become ever more reliant on space science and technology, such as cell phones, satellite television and global positioning systems—so much so that any interruption of the use of outer space would disrupt our daily lives.

Space exploration stimulates creative thinking among visionary pioneers, and it is a source of scientific knowledge fundamental to our existence, often in areas we may not initially associate with outer space. As an example, the use of existing space technology can play a central role in supporting disaster management by providing accurate and timely information for decision-making and re-establishing communication in case of disasters. Space science and space technology and their applications, in areas such as telemedicine, tele-education and environmental protection, can contribute significantly to development. As we mark the midpoint toward the realization of the Millennium Development Goals, we must keep in mind these benefits of space activities for economic growth and sustainable development.

Ever since the beginning of the space age, the development and spread of space technologies have been key components of globalization, spurring international cooperation. As an ever-larger number of players enter into space activities, it has become critically important to ensure the security and integrity of outer space.

One of the most effective ways to enhance space security is to build trust and confidence among spacefaring states by promoting international partnerships and cooperation. Such cooperation in outer space has been accelerated in the wake of the Cold War. Today, Americans and Russians, along with Europeans, Japanese, Canadians and many others have worked—and lived—together on the International Space Station.

Outer space also provides numerous business and commercial opportunities. Hundreds of satellites have been put into orbit, providing a sweeping set of new services, ranging from international communications and weather forecasting, to broadcasting and Internet services. Today, the commercial space sector generates over a hundred billion dollars every year in direct revenue. This rapid expansion of the private space sector has also contributed to greater international cooperation, which, in turn, has helped to nurture mutual trust and build confidence between and among states engaged in space activities.

However, after half a century of expansion in space activities, there is widespread and growing concern about the security of the space environment. As a result of the exponentially increasing amount of debris, experts worry that speeding fragments of orbital debris might spark a cascade of collisions, threatening to destroy satellites and spacecraft. In this context, it is encouraging that the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) adopted the Space Debris Mitigation Guidelines last year. But this does not directly reduce the existing danger. As the Chairman of COPUOS reported in this Council Chamber last month, there are about 13,000 pieces of space debris large enough to be tracked.

Most notably, there is serious concern that outer space will not be used exclusively for peaceful purposes, but could be turned into an arena for military confrontation and competition. As we are all aware, modern international law does not prohibit deployment in outer space of weapons other than weapons of mass destruction. As an illustration, the 1967 Outer Space Treaty does not deal with conventional weapons. However, such weapons—if deployed in outer space—would have the capability, as well as the global reach, to destroy space objects of any kind. It is important to note that such weapons would obviously cause tensions among states and disrupt the currently effective cooperation in peaceful uses of outer space.

Similarly, the Outer Space Treaty bans military activities on the Moon and other celestial bodies, but it is silent about such activities in outer space. These gaps in the international legal framework must be closed if we are to avoid military competition or conflict in outer space.

There are worrying signs that strategic planners are seeking greater use of outer space for military purposes, including the development of space weapons. Tests and use of anti-satellite weapons reinforce such concerns, underlining the urgency with which to address the issue of space security. Such exercises have implications for security in outer space, not only from the perspective of military capabilities, but also with respect to the resulting debris.

If we do not prevent an arms race in outer space, international security will be damaged, and—as a result of this—strategic stability will be endangered. We cannot afford delay in preventing an arms race in outer space.

As you know, the General Assembly has reiterated that the Conference on Disarmament, as the sole multilateral disarmament negotiating forum, has the primary role in the negotiation of a multilateral agreement, or agreements, on the prevention of an arms race in outer space in all its aspects. As Secretary-General of the Conference on Disarmament and Personal Representative of the Secretary-General to the Conference, I would like to update you on the progress made in the discussions regarding the prevention of the arms race in outer space, also known as PAROS in the disarmament community.

Although the Conference has not been able to engage formally in substantive work on this issue for the past decade, no one disagrees as to the need to address the challenges facing space security. This was demonstrated during the Conference's informal discussions on PAROS earlier in the year, continuing last year's in-depth debate on transparency and confidence-building measures and elements for a new treaty prohibiting an arms race in outer space.

On 12 February 2008, Russian Foreign Minister Sergey Lavrov tabled a Chinese–Russian draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects. There was considerable interest among the membership in discussing the provisions of this draft treaty. As you all know, the draft treaty has been submitted with a research mandate. This approach is supported by the Conference on Disarmament member states. Thus, the Conference—after carefully considering all types of proposals—should start negotiations on the treaty.

Moreover, the Conference had an opportunity to interact with COPUOS, when its current Chairman, Gérard Brachet, briefed Conference members on the work of the Committee at the informal meeting held on 22 February 2008 in this chamber.

It is my sincere hope that the Conference on Disarmament will reach agreement quickly on its priorities and begin substantive work on the issue of outer space, including consideration of the draft treaty, without delay.

Next month, the United Nations flag will make a historic trip to the International Space Station. This is a symbolic reminder that outer space belongs to the human family, and that our exploration and use of outer space should be guided by the shared values and principles underpinning our organization. As the international community, it is our collective responsibility to find a universal approach to space security.

I trust that your exchanges here will make a valuable contribution to the ongoing debates on this vital issue.

SESSION I

PROVIDING SPACE SECURITY FOR THE NEXT GENERATION

SPACE GENERATION ADVISORY COUNCIL

Alexander Karl

The Space Generation Advisory Council (SGAC) is a non-governmental organization and a network for students and young professionals interested in outer space. We have permanent observer status at the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and represent the views of youth on space matters. We are honoured and thankful to have the privilege to speak here at this conference about the younger generation's perspective on space security.

Let me now give you a short introduction to the organization. The idea of having a global network of youth on space issues is already over 20 years old. But it was not until the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space in 1999, when the United Nations recommended in the Vienna Declaration on Space and Human Development that a youth advisory council be set up to give youth input on space matters. Thus the Space Generation Advisory Council in Support of the United Nations Programme on Space Applications—our full name—was founded. Initially run fully by volunteers, we now have two paid employees. One of those, our Executive Officer, is located in Vienna, sharing an office with the European Space Policy Institute to allow close contact with COPUOS and the United Nations Office for Outer Space Affairs and other entities.

Further, SGAC participates in and contributes to UN workshops, mainly in developing countries, through our global membership base, and also presents youth issues at various conferences and symposiums. We have working relations with the United Nations Educational, Scientific and Cultural Organization relating to education and outreach programmes. Furthermore, SGAC makes regular statements and technical presentations during COPUOS Subcommittee meetings as well as the general session in order to represent the views and opinions of youth to the United Nations.

During the foundation of the SGAC, our Declaration of the Space Generation was written to express our visions on outer space as we are its future stakeholders. Allow me to quote:

> We, the Space Generation, representing the worldwide vision of youth, commit ourselves to ensure the future of humankind. … In leaving the Earth's cradle in the quest for understanding our place in the Universe, we are entrusted by the next generations with the sustainable development of the planet for our peaceful future. We, the Space Generation, regardless of culture, language and creed must ensure that space exploration will improve the quality of life for the benefit of all humankind. We express the hope and the conviction that our common future ought to proceed *ethically*, with an *understanding* of the long-term consequences of our actions and with *all humanity* walking forward together as one.[1]

Further, in 2003 SGAC set the following aim in its strategy document: "Advancing human development through the peaceful uses of outer space".

Since 2007 we have been actively collecting contributions toward the formulation of a multi-disciplinary vision of youth for the next 50 years of space activities. Our members, coming from all kinds of backgrounds and regions, agreed on the following three themes: ensuring the survival of humanity, outer space for the benefit of all humanity and of our environment, and advancing the frontiers of science and technology.

The bottom line is that SGAC visions and recommendations have consistently pushed for developing outer space in a way that safeguards it for all of humanity. Safeguarding outer space means to ensure the long-term viability for all humanity to use outer space for peaceful purposes. The consequences are that outer space should be kept free from any activities that are against the spirit of the peaceful purposes enshrined in the Outer Space Treaty, inhibit the use of outer space by other actors, or in any other way destroy the finite resources or usability of the space environment.

In contemplating space security for the future, SGAC has identified four key issues that need to be addressed in the short term in order to provide long-term security.

The first issue is space debris. SGAC is very concerned about the rising amount of space debris as it is an increasing hazard to spacecraft and astronauts. The greatest threat is fragmentation events due to exploding rocket stages or collisions among debris as they potentially create exponentially more debris. In the long run this will inhibit the sustainable access to outer space and its use as a resource for all parties to explore and utilize in a peaceful way for many generations to come. Essential for a long-term solution is an effective mitigation strategy. Within COPUOS, Debris Mitigation Guidelines were suggested and adopted by the member states. However, these guidelines are voluntary and not legally binding. Closely linked with the mitigation of space debris is surveillance capability. Greater resolution is needed for tracking objects that have the potential to disable a spacecraft, specifically all objects larger than 1cm, while currently only objects larger than 10cm can be tracked in low Earth orbit. Greater resolution would be necessary to complement the mitigation guidelines to provide a long-term solution to space debris. Further, international cooperation to share relevant data would be beneficial to all actors involved.

Secondly, space traffic management is a logical step from space debris mitigation, as it would also allow a comprehensive collision-avoidance infrastructure. While currently not much can be done about debris–debris collisions, active spacecraft are able to make collision-avoidance manoeuvres if an impending impact is predicted in time. With ever increasing numbers of space actors as well as objects in Earth orbit, space traffic management is a logical consequence, not only to avoid collisions but also to guarantee for all humankind an unimpeded and more efficient use of space resources—the question is not if, but when, it will be implemented. It must be clear to all space actors that having a space traffic management system in place would reduce the loss of working satellites, sustain the use of space resources, and provide an asset for maintaining the security of outer space for the coming years.

Thirdly, while not immediately related to space security in the short term, further clarifications in the space law regime are needed to solve issues that will arise in the long term as there is a general lack of basic law on space conduct. In the future we might see conflict over land and resources not on Earth, not necessarily solely among states but possibly involving commercial and private companies as well. Our generation strongly supports initiatives that aim at an accelerated development of space technologies within the private and commercial sector for the peaceful uses of outer space for all humanity, such as the Google Lunar X Prize, which offers up to $30 million to the first team that can land a privately built rover on the Moon before the end of 2014 and send back high-resolution video. Initiatives like this will eventually lead to a larger number of non-state space actors. Resulting from that, even if the technology was invented in a peaceful environment for peaceful purposes, it cannot be ruled out, and it appears rather likely, that certain issues related to security might arise in an environment that is not sufficiently legally covered, and thus should be dealt with in time. This, as an example for other new advances, was not perceived 40 years ago when the first space treaties were drafted, and needs to be addressed in a civilized manner within international space law to ensure sustainable access to and utilization of outer space and its resources for all humanity.

The final key point is conflict avoidance. Space weapons and aggressive acts, such as anti-satellite activities, should be prohibited. Of special concern are space weapons generally, due to their negative influence on the space security situation, and kinetic anti-satellite weapons especially, as their use creates large amounts of debris. As mentioned earlier, space debris is a serious concern as it might prohibit future generations from accessing and utilizing outer space in a sustainable manner. Kinetic space weapons are threatening everything our generation wants to do in the space environment. The recent tests conducted within the last 15 months triggered an intense reaction among the young generation who remain very concerned about these developments. They even lead to the establishment of a working group by concerned youth and the subject continues to be discussed and carefully analysed. The results of their findings will be presented at a later opportunity.

Summarizing, these are very common issues, as you can see by the presentation titles of my fellow speakers today and tomorrow. Deriving from the above-mentioned points, SGAC recommends the following:

- create a treaty through COPUOS to make space debris mitigation legally binding and increase the resolution of surveillance capabilities and encourage the sharing of relevant data;
- initiate a working group on space traffic management as well as address a framework for rules of the road, possibly through an Inter-Agency Space Debris Coordination Committee Working Group and then further to COPUOS;

- avoid conflict by prohibiting weapons and aggressive acts in outer space; and
- address several open issues regarding space governance (for example, lunar governance and property rights).

These issues should be addressed as soon as possible as we cannot afford to wait much longer as reality will progress beyond the current laws. This would make it difficult to address the issues then.

SGAC is already very involved with these issues as they influence our ability to access and utilize outer space. We have internal working groups on space debris, anti-satellite weapons and space traffic management. Further, SGAC was a partner for the Space Security Index and also, while not being directly involved, helped initiate the International Space University's Space Traffic Management activities. We are willing and able to discuss and contribute further to the open issues at hand related to space security and we would be interested and glad in providing our advice.

Note

1 Space Generation Advisory Council, *Declaration of the Space Generation*, <www.spacegeneration.org/node/144>.

SECURITY IN OUTER SPACE: DO NOT DUPLICATE HISTORICAL MISTAKES

Wang Daxue

The use of outer space has all along been driven by forces from two directions: one is the impetus of outer space weaponization, and the other is the efforts toward the prevention of an arms race in outer space (PAROS). This conference, focusing on examining the risks facing outer space while exploring the possible approaches to enhance space cooperation and avoid space conflicts, will certainly make a positive contribution to the international efforts in preventing the weaponization of and an arms race in outer space.

Today, I would like to start with looking back on the decades of history of the nuclear arms race and nuclear arms control, to explore with you the importance and urgency of making multilateral efforts in outer space.

After several decades of nuclear arms racing dominating the Cold War, the two superpowers finally realized in October 1985 that a nuclear war cannot be won and must never be fought. However, a high price had already been paid before reaching such a conclusion. To obtain strategic advantage over the other side, both superpowers tried their best to expand their nuclear arsenals, putting all human beings under the shadow of nuclear war.

Unfortunately, it seems that the past scene is about to replay. Just as nuclear weapons are regarded as a strategic tool for pursuing security, outer space has been attached too many strategic and security considerations by some states, as a domain for establishing strategic and military superiority. Space capabilities have been regarded as a tool for promoting security and diplomatic objectives. Accordingly, doctrines, plans, and even weapon programmes on space war have been initiated or developed by some states. On the contrary, the PAROS agenda in the Conference on Disarmament has come to a stalemate. It is worrying that there is an immediate risk that in outer space we may repeat this vicious circle of armament, disarmament, and counterproliferation.

For its devastating power, the danger of nuclear weapons is easy to be understood for the public, and decision makers are usually prudent toward the use of nuclear weapons. Different from the situation of nuclear weapons, people have no experience of outer space weaponization, and thus often take it as fiction of the far future. In the meanwhile, the decision makers of some states think much of the strategic and military value of outer space. They believe that outer space can be dominated and controlled to deter other states from obtaining similar capabilities. Even if other states have acquired certain capabilities, these capabilities can be denied or eliminated. Some people think a space war could be conducted in a humanitarian way with fewer concerns of human life and devastation. Some even think prompt attack from outer space is a means of reducing risks of war and costs. It seems that "space war can be won and can be fought".

If compared with nuclear war, would space war be an exception? The answer is negative. No state should attempt to control outer space, at least not forever, because space technology cannot be monopolized. Space war is by no means safer, nor does it have fewer humanitarian concerns compared with other types of military conflict. Space assets are regarded as an extension of a state's sovereignty, and attack against space assets will be regarded as the infringement on sovereignty. Space weaponization may combine land, sea, air and outer space together—the four dimensions of the battlefield.

It is my view that the following benchmarks should be observed in order to maintain outer space security.

NO STRATEGIC AND MILITARY COMPETITION IN OUTER SPACE

Outer space should only be used for peaceful purposes given its extremely important value for mankind and its vulnerability to damage. The Outer Space Treaty stipulates that the exploration and use of outer space shall be carried out for the benefit and interests of all. It is very hard to say that strategic and military competition in outer space is in conformity with the spirit of the treaty. It should be avoided to attach too much importance to security and strategic missions to outer space or try to establish strategic and military superiority in outer space; we must refrain from using space capabilities as a tool to promote a state's national policy.

NO PURSUIT OF SPACE DETERRENCE

Nuclear deterrence policy results in a spiralling increase in nuclear weapons and a horrible balance of mutually assured destruction. If outer space is understood in light of this, if all states treat space issues with the same strategic logic, space deterrence will be introduced. Space deterrence will not only lead to weapon development, but also to a posture of space offence and defence. The situation will inevitably be contrary to mutual trust among major powers, bringing about arms races and accidental conflicts.

NO DEPLOYMENT OF WEAPONS IN OUTER SPACE

As a substantial step toward outer space weaponization, the deployment of weapons in outer space constitutes a threat to space assets and terrestrial objectives of other states, and will stimulate them to develop their countermeasures. Prohibiting the deployment of weapons in outer space should be the bottom line of peaceful use. Luckily enough, there is no weapon in outer space so far, which is the last hope of keeping outer space a sanctuary free of weapons for ever.

ILLEGALIZE THE USE OF FORCE FROM OR AGAINST OUTER SPACE

The UN charter prohibits the threat or use of force in international relations. Logically, the threat or use of force against or from outer space should also be covered. Nevertheless, this is merely a general request for member states in dealing with international relations at peace time. To preserve the prospect of peaceful uses of outer space, no use of force from or against outer space should be codified into the law of military conflicts.

China has always been of the view that, to avoid taking the old path of arms control where control comes after development, the fundamental way of preventing the weaponization of outer space and maintaining lasting peace and security there is to negotiate a legally binding international instrument.

China, together with Russia and some other states, have made tremendous efforts in this regard. Since 2002, we have submitted a number of working papers elaborating our views on definition, verification and scope of a future outer space legal instrument. In February 2008, China and Russia submitted to the Conference on Disarmament the draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects. This effort has been welcomed by the majority of the members. We are of the view that the draft treaty has laid the ground for the Conference to carry out substantive work on PAROS.

Actually, to negotiate and conclude a new legal instrument on outer space enjoys extensive political support. The UN General Assembly has, for over 20 years, adopted resolutions on PAROS by an overwhelming majority of votes, calling for the Conference on Disarmament to play a primary role in the negotiation of a multilateral agreement on the prevention of such an arms race, which shows that a new international legal instrument is in line with the desire of the majority of states, represents the common aspiration of the international community, and serves the long-term and fundamental interests of all.

We have also noticed that transparency and confidence-building measures in outer space, such as a code of conduct or rules of the road, have been called for by some states and institutions. We do recognize that these measures can lessen misunderstandings, prevent conflicts, facilitate trust and promote cooperation in the peaceful uses of outer space. To a certain extent, they can safeguard outer space and promote the goal of PAROS. However, we have to understand that these measures are not legally binding, and rely only on good will. History tells us that arms control and the containment of wars cannot rely solely on good political will.

It is not proper to judge which one is better than the other, transparency and confidence-building measures or a legal instrument. They serve different purposes and have different roles to play. However, in order to solve space security issues fundamentally, a treaty will be the ultimate choice, and the focus should be on preventing the weaponization of outer space. We are of the view to negotiate and conclude a legally binding treaty with proper compliance measures will be helpful to increase the predictability of national activities in outer space, and this would be a transparency and confidence-building measure on a higher level.

The Council Chamber, where we are now, makes our efforts closer to the work in the Conference on Disarmament. The Conference has accumulated rich experience in working on legal instruments on outer space. The Conference has included PAROS in its agenda since 1982, and has established ad hoc committees for 10 years, holding profound discussions on issues including definition, principles, existing treaties, and transparency and confidence-building measures. It is our hope and belief that our discussions today will serve as food for thought for breaking the deadlock in work on PAROS, and will certainly improve future discussions and possible negotiations on the issue.

As humankind's reliance on outer space increases rapidly, the task of preventing the weaponization of outer space and maintaining space security is getting more urgent each day. China is ready to work with all parties, to preserve a safe and clean outer space, free from weapons and warfare, for our future generations.

DOWN TO EARTH: A SOLUTION TO A GLOBAL PROBLEM?

Geraint Morgan

The influence of space technology is pervasive in every day life. As, Vladimir Putkov stated at the last UNIDIR outer space conference, “People no longer can do without telecommunications, navigation and the information provided by remote sensing based on space systems”.

I would like to talk to you about our work in translating technology, that was originally developed to search for life in our solar system, to the provision of a potential solution for one of the greatest healthcare challenges facing the human race at present—the early detection and subsequent treatment of tuberculosis (TB).

Let me start by explaining a bit about the Planetary and Space Sciences Research Institute, better known as PSSRI, the largest planetary sciences group in the United Kingdom. We are based at The Open University, in Milton Keynes, just north of London. The Open University is one of the largest universities in Europe, with over 220,000 distance-learning undergraduates registered—that is 5% of the United Kingdom’s undergraduate population.

The institute is home to over 60 multi-disciplinary staff and we are very fortunate to be housed in a state-of-the art building with world class laboratory and clean room facilities. Indeed, some of our instruments are unique in the United Kingdom—one example is the CAMECA NanoSIMS 50L mass spectrometer, which cost £2 million and is currently being used to analyse interstellar dust samples returned by the US National Aeronautics and Space Administration’s Stardust mission. As the above project would suggest, the group specializes in developing instrumentation for the analysis of extra-terrestrial samples in the laboratory; instruments are also developed for *in situ* analysis on space missions.

We have been involved in providing instruments, or support, to over 10 missions so far, from Prof. Colin Pillinger’s analysis of the Apollo XI samples to having experiments on the most recent Space Shuttle mission.

Other missions in which the group has had significant involvement include Giotto, Cassini–Huygens, Stardust, Genesis and Flying Stones. The mission of most relevance to this presentation is the European Space Agency's Rosetta mission. Launched on 2 March 2004, it is currently on a four billion mile, 10-year journey around the solar system, chasing comet Churyumov Gerasimenko. In March 2014, at a distance 3.5 times the distance the Earth is from the Sun, we hope to catch up with the comet. The orbiter craft will then spend six months mapping and analysing the chemical composition of the nucleus before depositing the Philae lander for the first ever soft landing on a cometary nucleus.

We have an instrument on the Philae lander and we intend, with the help of Italian, German and French systems, to analyse the composition of the comet, to answer fundamental questions such as did water on Earth come from a cometary impact early in history? Did the building blocks of life arrive at the same time?

The instrument we have built to conduct these analyses is known as Ptolemy. Ptolemy is a miniature Gas Chromatograph–Isotope Ratio-Mass Spectrometer that weighs just over 4kg and is about the same size as a shoe box. Ptolemy was developed in partnership with our colleagues at the Rutherford Appleton Laboratory, with approximately £7 million of funding from the Science and Technology Facilities Council.

However, the mission we are most famous for is the Beagle 2 Mars lander. The *raison d'être* for the Beagle 2 mission was this instrument—the Gas Analysis Package. The package was a miniaturized version of the instruments used in the laboratory to analyse meteorites and was designed to determine whether conditions were ever conducive to life on Mars.

Unfortunately, all contact with Beagle 2 was lost. We have no telemetry from Beagle 2 after it was released from the Express Orbiter on 19 December 2003 and we cannot therefore be certain of the exact nature of the failure. One consolation was that the Mars Express Orbiter went on to have a highly successful mission and has been sending back fantastic scientific data ever since.

The development of the Gas Analysis Package instrument was mainly funded by the Wellcome Trust, the world's largest medical research charity. Prof. Pillinger had persuaded them that the technology being developed to search for life on Mars could have a number of potential applications for global healthcare. With Prof. Pillinger involved with the inevitable postmortem of the Beagle 2 mission, I took over as the Research Director for this the second phase of the project. The remit was: “Explore all possible opportunities to investigate technology transfer to clinical or medical applications”.

Initial investigations concentrated on the rapidly developing area of breath analysis for the diagnosis of medical conditions. At the time, it was concluded that the field was still too immature for an instrument to be designed for any specific disease. It was at this point that the Trust indicated that they would be highly interested in a rapid diagnostic test for TB.

Tuberculosis is an airborne disease caused by *Mycobacterium tuberculosis*. The disease is rapidly spread by being in close contact with an infected person who is coughing or sneezing. The global scale of the problem is illustrated by figures released by the World Health Organization for 2003. They estimated the following number of cases:

- latent TB (non-active): 2 billion;
- prevalence (existing cases): 14.6 million;
- incidence (new cases): 8.8 million; and
- mortality (deaths): 1.7 million.

In addition, the World Health Organization’s Stop TB Department has reported that there has been a significant increase in the incidence rates of TB since 1990, especially in the developing world. The increases in sub-Saharan Africa have been particularly pronounced, for example the reported incidence rate in Swaziland in 2005 was 1,262 cases per 100,000 people.

A major contributing factor for the rise in the incidence of TB in sub-Saharan Africa is co-infection with HIV. TB is now the most common cause of death in Africa among those infected with HIV, and it has been reported that in Southern Africa about half of all deaths from TB are being diagnosed during autopsy, not while the patient was alive.

TB diagnosis in resource-poor settings relies primarily on smear microscopy. This is a highly inaccurate technique and requires an operator to make a decision on the presence of the bacteria. It is estimated that smear microscopy will only diagnose 3 out of every 10 TB-positive patients presenting themselves at a clinic—the remainder must undergo a process that can result in them having to return up to 10 times before being diagnosed. The gold-standard method for the diagnosis of TB is the preparation of a culture, followed by microscopy. Unfortunately, as TB grows so slowly this can take up to six weeks. In addition, because of the infrastructure required, it is only available in a few laboratories in each country in the developing world. It is clear that there is a need for a rapid and sensitive diagnostic technique that is appropriate for use in resource-poor settings.

Preliminary work, during the original Wellcome Trust project, suggested that a gas chromatograph–mass spectrometer-based technique could provide such a solution. As a result, I was invited to put together a consortium to bid for a Strategic Translation Award from the Trust. The consortium included Prof. Pillinger and Prof. Wright from The Open University; Dr. Elizabeth Corbett and Dr. Ruth McNerney from the London School of Hygiene and Tropical Medicine, and Dr. Conrad Bessant from Cranfield University.

Dr. Corbett is a clinical epidemiologist practicing at the Biomedical Research Training Institute in Harare. Dr. McNerney is a microbiologist based in London specializing in evaluating diagnostic tests for TB. Dr. Bessant is a bioinformatics specialist and will produce the algorithm that will determine the disease state from the compounds present. The Open University will provide the analytical chemistry for the diagnostic test and will also develop and build the gas chromatograph–mass spectrometer system.

The application was successful, and as a result the project has been funded for a period two years. The project started on 1 February 2008. The first 12 months has been split into two parallel phases. The first will concentrate on the development, optimization and validation of a suitable sampling and analytical technique. The second will produce several versions of the instrument. The ultimate goal of both phases is the development of an instrument and methodology that can be used at the Biomedical Research Training Institute, for a 12-month performance evaluation trial. It is during this trial that the sensitivity and selectivity of the newly developed process will compared, in the field, with the existing diagnostic tests available.

I would like to finish the presentation with a quotation from Dr. Ted Bianco, Director of Technology Transfer at the Wellcome Trust:

> Combining their expertise in mass spectrometry with the experience of doctors working in Southern Africa is a potent mix of talent. If you can build instruments rugged enough to look for life elsewhere in the Solar System, you should be able to crack the problem of detecting TB bacteria in the lung of a patient.

The Wellcome Trust has recognized the potential that space technology can have in providing new solutions to existing global healthcare issues. It also recognizes the importance of the interaction of the end-users with the technology developers. If this project is successful, I would hope that it opens the way to the funding of the translation of other space technologies to the global healthcare arena.

SPACE SECURITY: THE NEED TO SAFEGUARD OUTER SPACE FOR THE NEXT GENERATION

Yvette Stevens

INTRODUCTION

The use of space applications, such as for remote sensing, communications and global positioning systems, has increasingly facilitated the activities aimed at the achievement of UN goals and targets, and there is great potential for their more widespread use. In fact, it can be argued that many of these goals cannot be reached in the near future without the use of space applications. As their usefulness becomes more and more appreciated, it is clear that concern in safeguarding space technology becomes paramount, not only to the scientific and military communities, but to humanitarian workers and development practitioners.

I will here review current uses of space applications of relevance to the implementation of Agenda 21,[1] the Hyogo Framework for Action[2] as well as to meeting the Millennium Development Goals,[3] three mutually dependent areas of UN work. In addition, I will examine their existing and potential uses in meeting these goals, and highlight the challenges of the next generation. Furthermore, I will describe in brief established UN programmes and initiatives set up to promulgate space applications. Finally, I will examine the risks to space technology that would hamper their applications and hence their use in addressing the universally declared problems facing the planet.

SPACE TECHNOLOGY AND ITS APPLICATIONS

Satellite remote sensing can be used to monitor land surface, oceans and the atmosphere. Most of these satellites provide global coverage hence provide the possibility of observing global phenomena. They represent a fast, repetitive, consistent, accurate and cost-effective means of observing global phenomena from outer space.

Perhaps the most widespread civilian use of space technology is in telecommunications. Communications satellites can reach people in remote places and, together with ground-based networks, provide access to the World Wide Web. They are thus potential sources of information, not only for urban dwellers, but for rural and remote areas.

Global Navigation Satellite Systems are based on a constellation of Earth-orbiting spacecraft. Suitable receiver equipment combines the signals from at least four spacecraft, yielding the time and three space coordinates, enabling it to determine its location, speed and direction. When used in conjunction with remote sensing and Global Information Systems, satellite navigation has wide potential applications in many fields. These could include location-based services and emergency calls; road, rail and air transport; maritime, inland motorway and fisheries navigation, site surveying, civil protection, emergency management and humanitarian aid; dangerous goods; livestock transport and feedstock management; agriculture, parcel measurement, geodesy and cadastral survey; energy, oil and gas and biogas production; search and rescue services; as well as a wide range of other applications, including in logistics, the environment, science and the maintenance of public order.

A combination of these Earth-observation systems is indispensable to the achievement of the Millennium Development Goals and other UN goals.

USE OF SPACE TECHNOLOGY IN THE ACHIEVEMENT OF UN GOALS

It has now become increasingly clear that unless drastic measures are taken to address current and potential problems facing the world, future generations will suffer severely. To address this and other concerns, the United Nations has developed, over the years, a number of goals, which could lead to addressing the major problems facing mankind and provide safeguards for the next generation. Many of these are interrelated and, for the purpose of this chapter, three sets of goals are included. These are:

- protecting the Earth's environment and natural resources management (Agenda 21);
- disaster risk reduction (Hyogo Framework for Action: Building the Resilience of Nations); and
- the Millennium Development Goals.

PROTECTING THE EARTH'S ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT (AGENDA 21)

The environmental goals, as elaborated in Agenda 21, are:

- protection of the atmosphere;
- planning and management of land resources;
- combating deforestation;
- combating drought and desertification;
- sustainable mountain development;
- promoting sustainable agriculture and rural development;
- conservation of biological diversity;
- management of biotechnology;
- protection of oceans and seas;
- management and protection of fresh water resources; and
- management of toxic chemicals, hazardous, solid and radioactive wastes.

Satellite applications for protecting the environment and natural resources management include the monitoring of land cover and land use; monitoring environmental degradation (particularly useful in remote and difficult-to-access areas, and for areas undergoing rapid environmental change); measuring the environmental impact of disasters and wars and assessing impacts of pollution, from depletion of the ozone layer to tracing oil spills and photochemical smog.

DISASTER RISK REDUCTION (HYOGO FRAMEWORK FOR ACTION)

The priorities of the Hyogo Framework for Action are:

- ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation;
- identify, assess and monitor disaster risks and enhance early warning;
- use knowledge, innovation and education to build a culture of safety and resilience at all levels;
- reduce the underlying risk factors; and

- strengthen disaster preparedness for effective response at all levels.

As the incidence of disasters caused by natural hazards increases, the use of satellite applications in disaster risk reduction is receiving more and more attention. First and foremost, through the use of satellite communications it is now possible to spread information and launch campaigns on disaster risk reduction to the most remote areas. In addition, Disaster Early Warning Systems, which depend on Earth observation systems, are more systematically used to forecast disasters well in advance, thus allowing for better response to save life and livelihoods.

After a disaster has struck, satellite imagery is used for search and rescue operations, as well as to assess the damage caused. Planning the logistics to reach populations in the most remote locations following a disaster is often complicated and satellite imagery has been invaluable in situations such as the Himalayas following the 2005 Pakistan earthquake. Space information is also important in the recovery phase after a disaster, in identifying the requirements and in planning recovery activities.

In the case of slow-onset disasters such as droughts, satellite technology provides the environmental and agricultural indicators that are essential in mapping risks and in preparing adequately for any impending disaster.

THE MILLENNIUM DEVELOPMENT GOALS

The Millennium Development Goals (MDGs), which were adopted following the Millennium Summit in 2000, wrap up all of the development targets that were reached at various United Nations Global Conferences in the 1990s. These eight goals are:

- eradicate extreme poverty and hunger;
- achieve universal primary education;
- promote gender equality and empower women;
- reduce child mortality;
- improve maternal health;
- combat HIV/AIDS, malaria and other diseases;
- ensure environmental sustainability; and
- develop a Global Partnership for Development.

In addition to the satellite applications given above, a particular reference needs to be made to a number of crucial applications that are currently utilized, or which hold the promise of facilitating the achievements of the MDGs.

Agriculture plays a crucial role in the eradication of poverty and hunger in the world. Satellite technology has been used to monitor and forecast weather for farmers and to monitoring crop development to help predict agricultural outputs in advance. Such information is crucial in assessing vulnerability and managing food security. Satellite imagery can also assist in identifying areas at risk from natural phenomena, locusts for example, thus providing valuable information that can be used in undertaking remedial action.

In the fields of education and health, satellite communications can be used to reach the most remote areas for distance education, as well as for monitoring public health and providing tele-health services.

SOME UN PROGRAMMES AND ACTIVITIES TO PROMOTE THE USE OF SATELLITE APPLICATIONS

United Nations entities such as the Food and Agricultural Organization (FAO), the United Nations Environment Programme (UNEP) and the World Food Programme (WFP) have for some time now worked with governments and non-governmental actors to strengthen information systems to mange disasters. One example of this is the FAO/UNEP Global Land Cover Network, which provides reliable baseline land-cover data.

The World Meteorological Organization (WMO) Space Programme coordinates environmental satellite matters and activities throughout all WMO Programmes and provides guidance on the potential of remote-sensing techniques in meteorology, hydrology and related disciplines and applications.

The United Nations Institute for Training and Research (UNITAR) Operational Satellite Applications Programme (UNOSAT), created in 2001 and implemented in cooperation with the UN Office for Project Services (UNOPS) and the European Organization of High Energy Physics (CERN), is a people-centred programme that delivers integrated satellite-based solutions for human security, peace and socio-economic development, in keeping with the mandate given to UNITAR by the UN General Assembly since 1965, and relying on the flexibility and result-oriented management capability of UNOPS. UNOSAT has in recent years played a key role in responding to major disasters, such as the Indian Ocean tsunami and the Pakistan earthquake.

Under the UN Programme on Space Applications, the United Nations Office for Space Affairs (UNOOSA) aims at providing the expertise required to ensure the full use of the potential of space technology, particularly in developing countries. It conducts international workshops, training courses and pilot projects on topics that include remote sensing, satellite navigation, satellite meteorology, tele-education and basic space sciences for the benefit of developing nations.

In 2006, the UN General Assembly agreed on the establishment of the UN Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER). This programme focuses on the need to ensure access to and use of such solutions during all phases of a disaster, including the risk-reduction phase which will significantly contribute to reducing loss of lives, livelihoods and property.

The UN-SPIDER programme hopes to achieve this by being a gateway to space information for disaster management support, by serving as a bridge to connect the disaster management and space communities and by being a facilitator of capacity-building and institutional strengthening, in particular for developing countries. UN-SPIDER will be implemented as an open network of providers of space-based solutions to support disaster management activities.

UNOOSA also serves as the Secretariat for the International Committee on Global Navigation Satellite Systems**,** an international forum established in 2006 (with recognition from the UN General Assembly) to discuss cooperation on Global Navigation Satellite Systems and to promote the applications of such systems to maximize their benefits to people around the world.

CHALLENGES OF THE NEXT GENERATION

Although there has been some progress in reaching the MDGs, a lot more needs to be done. Repeated conferences and reviews have noted that the goals are not going to be met within the set timeframes. For instance, the Secretary-General's Report on Africa to the 2007 General Assembly[4] notes, at the mid-point of the 2015 target, "the unfortunate reality that most African countries are off track in meeting most, if not all, of the Millennium Development Goals". It is clear that, while the reasons for this are varied, increasing the access to space applications could help in removing some obstacles.

The task is made even more difficult as a result of a number of challenges that are now apparent. Population growth in poor countries as well as the impacts of climate change (competition for increasingly scarce resources, more frequent and severe droughts and floods in some parts of the world, as well as increasing sea levels threatening small islands) are all bound to make the tasks of meeting these goals more difficult. No efforts should thus be spared in using all the tools at the disposal of the international community to the fullest to safeguard the planet for the next generation.

It is clear that space technology is vital to address the challenges of the next generation, and should be promoted to ensure its contribution to the achievements of United Nations goals.

RISKS FACING SPACE APPLICATIONS

A number of threats to the existence of space systems have been identified. First and foremost is the proliferation of space objects. The total number of space objects registered in accordance with the Registration Convention of 1974 is 12,400, of which 6,000 are still orbiting the Earth. As the number of space objects increases, there would be threats from collision unless basic "rules of the road" are instituted.

In addition, there are risks from space debris. Space debris includes the objects in orbit created by humans, that no longer serve any useful purpose. They consist of everything from entire spent rocket stages and defunct satellites to explosion fragments, paint flakes, dust, and slag from solid rocket motors, coolant released by nuclear-powered satellites as well as needles and other small particles. There are more than 600,000 objects larger than 1cm in orbit (according to the European Space Agency Meteoroid and Space Debris Terrestrial Environment Reference, the MASTER-2005 model). Once again, there is the risk of collision with orbiting satellites and there have been a number of near misses over the years. There is a need to more comprehensively address the problem of space debris to avoid serious damage to satellites.

Furthermore, there is the question of the weaponization of outer space. This could lead to an arms race in outer space that would threaten satellites with civilian applications. Finally, deliberate attacks on satellites could also pose a threat.

For the humanitarian and development communities that are increasingly dependent on the use of space technology to achieve the MDGs, any threats to space systems that would adversely affect their use are most undesirable.

CONCLUDING REMARKS

I would like to note that "security" should be defined in a broader context to include not only military security, but human security, which would imply consideration of global goals for improving the standard of living on Earth—this should guide future activities in outer space.

I have presented the case for appreciating the current and potential uses of space applications in addressing problems on Earth. Any action which hampers the ability to exploit the vast resources provided by space technology would impede the achievements of global goals.

Notes

1 Agenda 21, the Rio Declaration on Environment and Development, and the Statement of principles for the Sustainable Management of Forests were adopted by more than 178 governments at the United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil, 3–14 June 1992.

[2] The World Conference on Disaster Reduction was held on 18–22 January 2005 in Kobe, Hyogo, Japan, and adopted the present Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters. The conference provided a unique opportunity to promote a strategic and systematic approach to reducing vulnerabilities and risks to hazards. It underscored the need for, and identified ways of, building the resilience of nations and communities to disasters.

[3] The Millennium Development Goals are eight goals that 189 UN Member States have agreed to try to achieve by the year 2015. The Millennium Development Goals derive from earlier international development goals, and were officially established at the Millennium Summit in 2000, where 189 world leaders adopted the United Nations Millennium Declaration.

[4] General Assembly, *New Partnership for Africa's Development: fifth consolidated report on progress in implementation and international support, Report of the Secretary-General*, UN document A/62/203, 3 August 2007.

NEXT GENERATION SPACE SECURITY CHALLENGES

Jessica West

INTRODUCTION

As the sustainable use of outer space becomes increasingly critical to security issues on Earth, including national, international, human, environmental and economic security, policy leaders must act to ensure that this environment remains safe and usable for the next generation. In order to do so, it is necessary to understand the types of challenges that will face the international community in outer space in the near future.

The following analysis of next-generation space security challenges is based on research contained in the Space Security Index series of publications. The Space Security Index provides an annual assessment of the status of space security based on objective and evidence-based analysis to promote transparency and confidence in space activities, and to support the development of policies that ensure secure access to space for all.[1]

The definition of space security developed by the Space Security Index is the secure and sustainable access to space and freedom from space-based threats. This is very much an environmental approach to space security that has as its goal the common security of all actors in the space environment. Because outer space is a particular, and particularly sensitive, environment, it presents unique governance challenges to the international community. Based on current trends, the most significant challenges in the future will involve:

- sustainability of the operating environment;
- the increase in space actors; and
- the proliferation of space technologies.

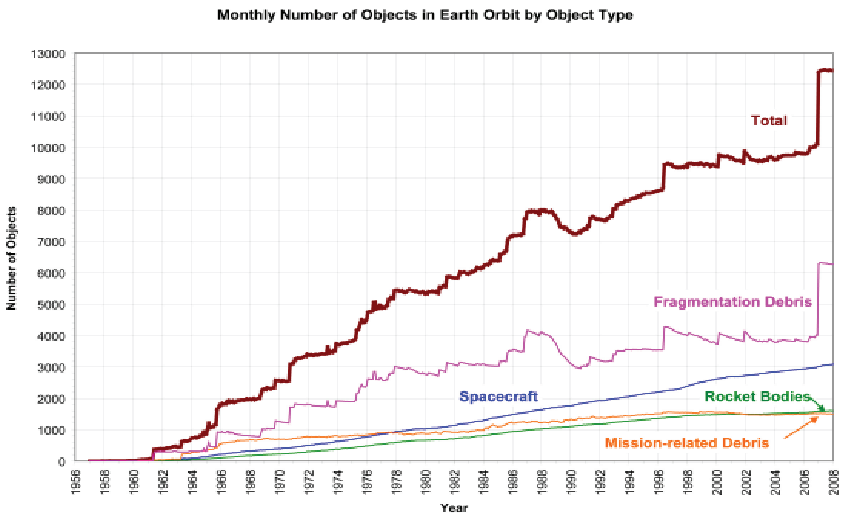
These types of challenges are interconnected and in many ways reinforce one another, demanding a holistic approach to managing the security of outer space.

OPERATING IN OUTER SPACE: THE CHALLENGE OF DEBRIS

Space debris poses a serious challenge to operating in the space environment because it is largely unavoidable (particularly in popular orbits), it is indiscriminate and it is long term. Prevention is currently the only form of mitigation available.

The challenge of space debris is particularly highlighted by events in 2007, which produced one of the largest yearly increases in space debris ever (see Chart 1). Most of this debris was caused by the intentional destruction of an obsolete Chinese weather satellite, Fengyun-1C, by a kinetic intercept vehicle on 11 January 2008. As of 1 February 2008, 2,317 pieces of debris from the event were identified and catalogued by the US Space Surveillance Network (SSN).[2] It is estimated that some 150,000 pieces of debris to small to be tracked were generated.[3] As a result of this event, the amount of debris in low Earth orbit has increased by approximately 20%, raising the number of close approaches to operational satellites. According to the US Air Force, the number of close approaches to the approximately 400 operational US satellites has doubled to almost 200 per week,[4] although the definition of a close approach is not clear.

Chart 1. Growth in on-orbit population by category



This is a summary of all objects in Earth orbit officially catalogued by the US Space Surveillance Network. "Fragmentation debris" includes satellite break-up debris and anomalous event debris while "mission-related debris" includes all objects dispensed, separated or released as part of the planned mission.

Source: National Aeronautics and Space Administration, Orbital Debris Quarterly News*, vol. 12, no. 1, January 2008, <http://orbitaldebris.jsc.nasa.gov/newsletter/pdfs/ODQNv12i1.pdf>.*

In addition to the Chinese satellite intercept, there were several other incidents during 2007 that contributed to the worst year ever for new debris creation. These events are summarized in Table 1.

Table 1. 2007 debris event summary

Parent object	State	Date	Estimated number of pieces*	Catalogued number of pieces**	Lifespan of pieces
FY-1C	China	11 January	2,600	2,300	long
Beidou	China	2 February	70–100	0	long
Aux Motor	Russia	14 February	60+	0	long
CBERS-1	China/Brazil	18 February	100	66	short
Briz-M	Russia	19 February	1,000+	0	long
H2-A	Japan	28 July	14	14	short
UARS	United States	10 November	4	4	short
Delta IV	United States	11 November	25+	0	short

* *according to the US SSN*
** *as of 1 February 2008*
Data compiled from the public satellite catalogue Space Track*, <www.space-track.org>.*

While steps are currently being taken to mitigate the production of new space debris, including the adoption of debris mitigation guidelines by the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) in June 2007, these are non-binding guidelines that Member

States have pledged to implement within national licensing or other applicable mechanisms “to the greatest extent feasible”. The threat of rising debris levels will continue to be posed through growth in the number of space actors and space missions in the future, the potential use of kinetic-force technologies against objects in space, and the process of debris collision and fragmentation that occurs naturally in the space environment.

OPERATING IN OUTER SPACE: LIMITED MONITORING

Space surveillance capabilities are vital to the mitigation of environmental hazards such as space debris, as well for creating greater transparency and confidence in space activities. There is no international space surveillance mechanism or catalogue of objects, but several states have developed discrete capabilities. The United States possesses the most advanced surveillance system, which tracks over 17,000 objects larger than 10cm in diameter. Russia maintains a space surveillance capacity through its early-warning radars, and France and Germany have national capabilities through the Grande Réseau Adapté à la Veille Spatiale system and the Forschungsgesellschaft für Angewandte Naturwissenschaften Tracking and Imaging Radar, respectively. Canada, China, Japan, Ukraine and the United Kingdom are all developing independent space surveillance capabilities. Details of these systems as indicated through public sources are given in Table 2.

The capabilities that have been developed to date are limited in terms of the size of objects that can be observed in outer space at different altitudes, and in terms of the international availability of the data. The next generation will require both better space situational awareness capabilities, and better sharing. This is due both to the inevitable growth of space debris, as well as the need for greater transparency of space activities, which are naturally marked by a degree of uncertainty. This uncertainty increases risks to space security as more actors with more advanced capabilities enter outer space, challenging both abilities to monitor space traffic, and potentially creating an environment of fear and mistrust.

Table 2. Worldwide space situational awareness capabilities

Actor	Optical sensors	Radar sensors	Orbital sensors	Global coverage	Central tasking	Catalogue	Public data
Amateur observers	■			□	□	□	■
Bolivia*	■						
Canada	■						
China	■	■					
European Union	■	■		(□)	(□)	(□)	
France	■	■					
Georgia*	■						
Germany		■					
Japan	■	■					
India	■						
Norway		■					
Russia	■	■				□	
South Africa	■						
Spain*	■						
Switzerland	■						
Tajikistan*	■						
Ukraine	■						
United Kingdom	■	■					
United States	■	■	□	□	■	■	□
Uzbekistan*	■						

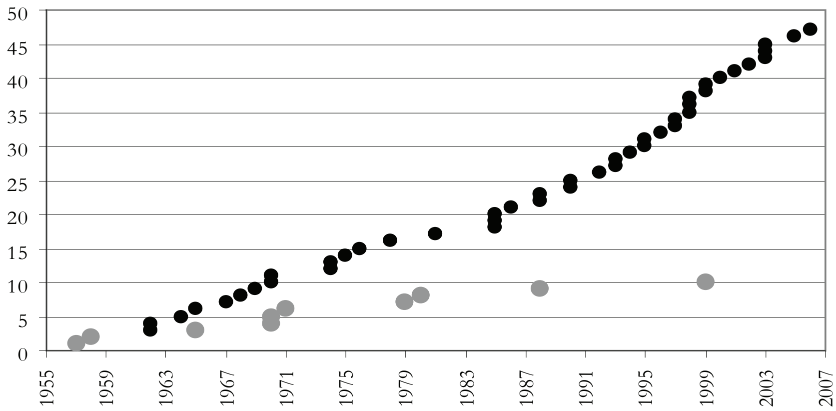
Key: ■ = full capability; □ = some capability; (□) = under development
* *part of the International Scientific Optical Network*

Source: analysis by Brian Weeden, technical consultant, Secure World Foundation.

INCREASE IN SPACE ACTORS

Linked to the operational challenges of the space environment are the number and diversity of space actors, which continue to grow as the social, economic and security benefits that space access provides are sought. Chart 2 indicates the growing number of national actors accessing outer space.

Chart 2. Growth in the number of national actors accessing space



● = *first independent launch*
● = *deployment of first satellite*

Source: Jonathan's Space Report, "Satellite Catalogue and Launch Catalogue", <http://planet4589.org/space/log/satcat.txt>; Encyclopedia Austronautica, "Chronology 2004", <http://www.astronautix.com/chrono/20041.htm>.

Not only are more national actors gaining access to outer space, particularly developing countries, but new private actors with a range of interests are also emerging. As companies such as SpaceX and Bigelow Aerospace seek to revolutionize access to outer space by drastically reducing costs and providing access to private individuals, the number and type of users of outer space will continue to grow. Even among traditional civil, military, and commercial space actors, the use of outer space is both growing and diversifying. In 2007, the number of satellites launched by each actor was on par with one another at roughly 35 spacecraft each, and there is a notable overlap of users for different spacecraft, blurring this standard classification of space actors.

Increasingly, the growing number and diversity of actors in outer space will strain both the availability of resources and the current international legal and regulatory regime for outer space. Both radio frequencies and orbital slots, the building blocks of operating in outer space, are limited resources, currently managed by the International Telecommunications Union (ITU). The distribution of these resources on a first-come, first-served basis may be contentious in the future, with one concern being the growing military use of space resources, which is not regulated by the ITU. Moreover, the current legal regime is based extensively on the premise of states as actors, which has already generated some challenges regarding registration and liability issues, but will prove more problematic in the future as private actors increasingly access outer space. The need for a set of common and consistent rules and procedures for operating in outer space, or a system of space traffic management that includes all actors, will also become more apparent in the future as the use of outer space increases.

Finally, as space access spreads, so does access to and development of space technologies, some of which could be used to threaten the security of space operations.

PROLIFERATION OF SPACE TECHNOLOGIES: GROUND-BASED CAPABILITIES

One of the greatest technological challenges to the security of outer space in the future will continue to come from ground-based capabilities, particularly the horizontal and vertical proliferation of missile technologies. For example, medium- and long-range ballistic missiles can be modified to threaten space objects in low Earth orbit, as demonstrated by the Chinese missile intercept on 11 January 2007. Similarly, the spread of anti-ballistic missile defences is also of concern due to the potential of use against space objects, illustrated by the intercept of US-193 with a modified Standard Missile 3 used by the Aegis Ballistic Missile Defense System on 21 February 2008. Not only can longer range missiles and anti-missile systems directly threaten spacecraft in low orbits, but they also pose a risk to the operating environment through the creation of debris.

Although the spread of missile and anti-missile capabilities is predominantly driven by security concerns on Earth and not necessarily linked to space capabilities, it has the potential to threaten the security of space operations. Managing this threat in the future will require initiatives not only aimed at enhancing the security of outer space, but also to address the driving security concerns on Earth.

PROLIFERATION OF SPACE TECHNOLOGIES: SPACE-BASED CAPABILITIES

Another technological source of insecurity in the future is likely to come from the research and development of advanced, space-based technologies that could threaten secure and sustainable use of outer space. Examples of such technologies include, but are not limited to, microsatellite and smaller spacecraft capabilities, manoeuvrability and docking capabilities, and laser communication. These technologies are not by their nature threatening, and none are currently linked to dedicated anti-satellite systems, but they have the potential to serve a variety of purposes that can be difficult to verify once based in outer space. Not only could these technologies be used to physically threaten satellites, but due to their dual-use abilities, they can cause perceptions and *misperceptions* of insecurity in outer space, which can lead to very real consequences. The challenge for the future will be to create systems or mechanisms of verification, trust and transparency, particularly in light of the growing number and diversity of actors in outer space and the current obstacles to reliable monitoring of that environment. Otherwise it will be difficult to verify the purpose of space-based capabilities and to keep perceptual sources of insecurity and consequent reactions from spiralling out of control.

PROLIFERATION OF SPACE TECHNOLOGIES: SPACE-TO-EARTH STRIKE

There are currently no space-to-Earth strike capabilities. The United States continues to explore advanced technologies that could enable such a capability through programmes such as the Near Field Infrared Experiment and other missile defence initiatives, but there are no currently no programmes or policies in place to pursue such a capability. Nonetheless, the potential for space-to-Earth strike systems will continue to pose a challenge to the international community in the future, particularly as advanced space-based technologies continue to be developed, which may lead to hedging strategies. Moreover, while some enabling technologies for space-based strike are discrete and include significant technological barriers, many are advanced technologies associated with other space applications and have been developed for a variety of purposes by several different actors (see Table 3).

This means that if one actor were to pursue a space-based strike capability, others could follow. The dynamic nature of space technology makes it difficult to control or to dominate, allowing for an escalation of capabilities in outer space. Like the risks posed by the ground-based and space-based systems discussed above, the challenge of space-based strike is not simply one of technology spread, but is inherently linked to transparency, confidence and unresolved security issues both in outer space and on Earth.

SPACE SECURITY: NEXT-GENERATION RESPONSES

Analysis of current trends in space security indicates that the challenges of tomorrow will have behavioural, perceptual, organizational and technological roots. Moreover, these challenges are interconnected and in many ways serve to reinforce one another, and they are deeply entrenched in other security issues on Earth.

These characteristics suggest that a variety of tools will be needed that will also work together to create broad security in outer space, and also address related security challenges on Earth, such as missile and ballistic missile defence, and nuclear capabilities. Current proposals for space security address a range of these challenges together, but not independently. It is important to consider the relationships between them and how they might work with one another to create a holistic governance regime for outer space. The question to be answered is not which tool is most needed, most practical or most attainable, but what can be done today to address each of these challenges in the future. This is a question of political will.

Table 3. Advanced space-based warfare enabling capabilities

Capability	Conventional			Nuclear	Directed energy	
	Interceptors	Hypervelocity rod bundle	Munitions delivery	Munitions delivery	Lasers	Neutral particle beams
Precision positional maneuverability	■	■	■	■		
High-g thrusters	■					
Large Δv thrusters	■	■	■	■		
Global positioning	■	■	■	■	■	■
Missile homing sensors	■				■	
Global missile tracking	▲				▲	▲
Global missile early warning	▲				▲	▲
Launch-on-demand	■	■	■	■	■	■
Microsatellite construction	■					
High-power laser systems					■	
High-power generation					■	■
Large-aperture deployable optics					■	
Precision attitude control					■	■
Precision re-entry technology		■	■	■		
Nuclear weapons				■		

Key: ■ = required; ▲ = needed but not necessarily on the primary craft(s)

Notes

[1] This research has been made possible through a partnership with the Secure World Foundation and support from the Government of Canada.

[2] Data compiled from Space Track, at <www.space-track.org>.

[3] Orbital Debris Quarterly of the NASA Orbital Debris Program Office, available at <http://orbitaldebris.jsc.nasa.gov/newsletter/pdfs/ODQNv12i1.pdf>.

[4] Kevin Whitelaw, "The problem of space debris", *U.S. News & World Report*, 4 December 2007.

SESSION II

BUILDING TRUST IN THE FUTURE

NO HARMFUL INTERFERENCE WITH SPACE OBJECTS: THE KEY TO CONFIDENCE-BUILDING

Samuel Black

INTRODUCTION

There is a consensus that the use of outer space is essential to preserving the economic, commercial and military interests of advanced industrial nations, and that any harmful interference with satellites poses a threat to these interests. Opinions diverge on the means with which to secure the use of outer space over the long term. I will show that the advancement of an international norm against harmful interference with space objects, supported by a hedging strategy in the event of non-compliance by other nations, offers the best likelihood that satellites can continue to support the needs of citizens and their governments. Furthermore, I argue that a provision banning harmful interference with satellites might best be imbedded in a code of conduct for responsible spacefaring nations. Indeed, a code of conduct that includes other essential provisions, such as those establishing debris mitigation and space traffic management protocols, could be vitiated if nations test and use mechanisms that result in harmful interference with space objects. The alternative to a code of conduct is including a provision banning harmful interference with space objects in a more formal legal instrument. I will use the terms “ban”, “prohibit” and others to refer to the no-harmful-interference provision. In all cases this should be taken to mean, unless specified otherwise, a pledge not to interfere in a harmful manner with space objects. Whether this pledge takes the form of a politically or legally binding agreement would be a decision left to interested nations, though I will discuss the merits of these options.

The next section examines the precedent for embedding such a provision in an international agreement. This is followed by a discussion of the need for a ban on harmful interference with space objects in a code of conduct for responsible spacefaring nations, including how the lack of a ban could threaten the success of the code as a whole. The fourth section explains why advanced spacefaring nations will still retain the means to respond effectively if another state breaks its pledge not to engage in harmful interference. The fifth section compares the relative merits of legally and politically binding instruments as tools for building a norm against harmful interference with space objects.

HARMFUL INTERFERENCE PRECEDENTS

A provision limiting harmful interference would not be without precedent. The agreement most directly comparable to a ban on harmful interference with space objects is the 1975 Incidents at Sea Agreement between the United States and the Soviet Union. The agreement provided for the implementation of a wide variety of specific procedures so as to avoid dangerous close-quarters incidents at sea. That both navies retained the ability to respond forcefully when attacked actually enhanced the strength of the agreement. It also ensured that both had incentives to ensure strict adherence to the procedures by stressing the consequences of a failure to abide by the terms laid out by the agreement. This diplomatic agreement enhanced international security by limiting freedom of military action in a way that reduced the chances of unintentional escalation to a general nuclear war. In the years before the agreement was negotiated there were a number of incidents which posed a risk of unintentional escalation. They forced the realization that without some diplomatic limitations on military operations, the risk of escalation was dangerously high. A ban on harmful interference with space objects would be perfectly analogous to avoiding incidents at sea if, in addition to creating political crises, incidents at sea made the oceans themselves more dangerous to traverse.

Though there is no perfect analogy to be made between a ban on harmful interference with space objects and other threat reduction agreements, the precursors of an international norm against harmful interference with space objects can be identified, as this provision is embedded in international treaties and agreements as well as, by extension, customary international law. These precedents include specific provisions that ban harmful interference with space objects, provide for notification or consultations in the event of harmful interference, and list some of the specific actions that might constitute harmful interference. The Anti-Ballistic Missile Treaty, the Strategic Arms Limitation Talks, the Intermediate-Range Nuclear Forces Treaty, the Threshold Test Ban Treaty, the Peaceful Nuclear Explosions Treaty, the Strategic Arms Reduction Treaty, Conventional Forces in Europe Treaty, and the second Strategic Arms Reduction Treaty all contained measures that ban interference with "national technical means of verification", a euphemism that was commonly understood to refer to the satellites essential to monitoring treaty compliance. Similarly, the 1971 Agreement on Measures to Reduce the Risk of Outbreak of Nuclear War contained a provision requiring that the United States and the Soviet Union notify each other "in the event of signs of interference with these systems or with related communications facilities".

The Constitution of the International Telecommunication Union (ITU) created another powerful precedent for non-interference with space objects. Article 45 of the ITU constitution states that, "All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States …". Importantly, the next item in the constitution states that members are required to ensure that non-governmental providers and users of radio services or communications adhere to the non-interference clause as well. This document is particularly important because it established what might be the only legal precedent that specifically addresses harmful interference with satellites mounted by non-military and extra-governmental organizations.

The cornerstone of the existing international legal regime that governs activities in outer space, the Outer Space Treaty, also lays the basis for a ban on harmful interference with satellites. Article IX of the treaty links harmful interference with consultation measures:

> If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.

Finally, it is important to note that the provisions banning interference with satellites have existed for almost as long as satellites themselves. The earliest references to "national technical means" in international law are found in the Anti-Ballistic Missile Treaty and the Strategic Arms Limitation Treaty I interim agreement of 1972, while the reference to harmful interference in the Outer Space Treaty was enshrined in international law five years earlier. A mere 10 years after the space age began, states were already beginning to insist that satellites and other objects traversing outer space were not to be interfered with. This sentiment has only grown stronger over time.

THE INDISPENSABILITY OF THE NO-HARMFUL-INTERFERENCE PROVISION

It is the tension between the existence of myriad ways to interfere with satellites and the crucial role that satellites play that has placed this topic on the agenda. Recognizing that the United States' use of outer space is crucial to its national and economic security, domestic commentators have proposed policies that seek to resolve this tension satisfactorily. I cite these commentators and discuss the case of the United States only because it is that with which I am most familiar—but the arguments I make apply to other spacefaring nations as well. Most American commentators gravitate towards one of two options: military dominance or legal restraint. There is also a third option which does not constrain the ability to interfere or seek a treaty banning space weapons. It relies on a code of conduct built around the principle of non-interference with space objects. In fact, this principle would be an indispensable component of any of the three options: protection through freedom of military action, a space weapons treaty or a code of conduct.

Attempts to dominate outer space by any state, and certainly by the United States, will inevitably run afoul of the security dilemma. At its core, the security dilemma is the paradox often used to explain the motivation behind arms races. A state may decide to build up its military with the goal of improving its capabilities relative to those of its neighbours. Its leaders may see such a build-up as being a viable way of improving the state's security. However, when its neighbours see the state upgrading its military, they realize that their own capabilities are growing relatively less capable. Thus, when one state builds up its forces, it implicitly threatens its neighbours, leading them to build up their own militaries. This is a fear for space-based as well as terrestrial capabilities. Any attempt by a state to dominate outer space militarily would by definition make other countries that operate in outer space feel less secure. As a result of a state's pursuit of dominance, other actors face the spectre of a first-strike attack on their satellites. These actors would then be spurred to pursue parity or, more likely, asymmetric capabilities aimed at negating the competitor's advantage. The pursuit of anti-satellite weapons or other systems with the latent ability to interfere with space objects would be characteristic of an asymmetric strategy. That this very possibility may have motivated the pursuit of dominance in the first place is the essence of the security dilemma.

The international community has already seen evidence of the security dilemma as it pertains to outer space. In the political storm in Washington that followed China's destruction of its satellite Fengyun-1C in 2007, one did not have to look hard to find a "hawk" calling for an immediate response. The response advocated with the most frequency was an increase in the level of funding devoted to offensive counter-space programmes. China's reaction to the United States' destruction of its failed satellite USA-193, though it was ostensibly for the purpose of enhancing safety and was conducted with advance warning to the international community, will be a good indication of how sensitive states are to the implications of the security dilemma as it pertains to outer space.

A provision banning harmful interference with satellites would not resolve, but would help address, the security dilemma. By ensuring that any state that initiated harmful interference against satellites would be violating an established norm of international behaviour, the no-interference provision would be the foundation of the victim's effort to rally international support for its response, whatever that might be. In effect, pledges by spacefaring nations against harmful interference would serve a purpose similar to that of the articles of the UN Charter that prohibit and allow for responses to acts of aggression. The nations with the technical knowledge and resources necessary to operate in outer space also generally have the means to respond to harmful interference with their space assets. There is a consensus that nations have a right to defend themselves and their interests if attacked. An established norm against initiating the harmful interference that would constitute an attack would not impair the right of self-defence that is integral to national security and acknowledged in the UN Charter. The violation of an international norm against harmful interference would also make such a response more politically defensible, if a nation were to deem it necessary.

Pledges not to interfere with space objects may be broken, just as treaties may be broken. Major spacefaring nations have the means to respond in outer space or on the ground if international norms or treaty commitments are disregarded. Thus, it is unreasonable to expect states making a no-harmful-interference pledge to refrain from hedging against the possibility of a violation of the norm. Indeed, hedging strategies can serve as a deterrent, reducing the likelihood of interference directed against space objects. But such a pledge would preclude spacefaring nations from carrying out tests of harmful interference. Thus, pledges against harmful interference with satellites would make a violation of this norm more objectionable and enhance the credibility of a retaliatory response, if one were deemed necessary. Both effects would ultimately serve to reduce the likelihood of any interference with satellites. Of course, this state of affairs—tit-for-tat strikes against satellites—would not be ideal. Surely, no nation desires (or should desire) a race to acquire anti-satellite weapons of any variety. My point is simply that given the nature of the security dilemma and the existence of technology with the latent capability to harm satellites, the world will be better off if there is a strengthened norm against interfering with satellites.

An early push towards a norm against harmful interference would also do a great deal to hasten a more complete code of conduct geared toward other aspects of space security. When building a norm against interfering with satellites, why not deal with other elements of space security as well? A holistic path towards securing outer space is much more likely to succeed than one that leaves issues outside of harmful interference unaddressed. For example, efforts to establish space traffic management protocols would reduce the probability of an accidental collision. However, an accidental collision could be just as harmful as intentional interference. Though its effects could be indistinguishable from those caused by a harmful interference event, an accidental collision could not be considered a violation of an agreement not to interfere with satellites. It is unclear why states would endeavour to prevent the consequences of one type of interference but not the other. Given the precedents against interfering with satellites, a norm against interference is a very attractive foundation for a more comprehensive agreement. It is also absolutely necessary for the other elements of a code of conduct to operate effectively or be meaningful at all.

The Henry L. Stimson Center, in collaboration with other non-governmental organizations, has developed a code of conduct governing the actions of responsible spacefaring nations.[1] Its key elements are as follows: non-interference with satellites, the prevention of activities resulting in persistent orbital debris, information exchanges and consultations concerning space activities in general, information exchanges and consultations regarding activities that might be construed as either interfering or debris-creating, the coordination of spectrum use (for example, radio frequencies) and orbital slot allocation, and space traffic management. None of these are sustainable in the long term without a ban on harmful interference with satellites. The prevention of activities that create orbital debris is an obvious case, particularly when considering that debris-creating direct-ascent kinetic energy anti-satellite weapons are currently experiencing an unfortunate renaissance and pose a serious threat to the existence and use of satellites. Some methods of physically interfering with satellites create debris, yet without a code against harmful interference, this debris would be treated the same as debris created by normal space operations—as unfortunate but largely unavoidable. The coordination of spectrum use and orbital slot allocation might likewise fall by the wayside without a ban on harmful interference. An incident that occurred late in 2006 serves to illustrate this point. The roots of the incident reach back to 1988, when Tonga registered a large number of slots in geostationary orbit. It lacked the capacity to use the slots itself, but leased them out to corporations to bring in revenue.[2] However, several of these slots became subject to international dispute. Indonesia, in an effort either to put pressure on Tonga to acquiesce to its claim over a particular slot or to deny Tonga the use of this slot, proceeded to jam the satellite in that slot.[3] Thus, jamming occurred because of a disagreement about the use of an orbital slot. Thankfully, ad hoc diplomatic intervention prevented further escalation. With an agreement banning harmful interference, a mechanism to resolve the dispute would already be in place. Without removing the option of escalating such a dispute by physically interfering with the satellite in question, belligerent states have no incentives to resolve these disputes peacefully. With no clear international stance on harmful interference with satellites not necessarily involved in treaty verification (and therefore considered to be national technical means), it will doubtless continue to occur.

Space traffic management, another major element of a code of conduct for operating in outer space, is also vulnerable to the instability inherent in the present state of affairs. Since it entails debris mitigation as well as collision avoidance, it seems clear that space traffic management would be vitiated without a non-interference provision, lest debris created innocently be subject to the mandates of the system while debris created wilfully remains perversely outside of it. Space traffic management also requires consultations, which would be difficult to maintain without a harmful interference ban. In fact, the possibility of instituting virtually any consultative measure seems very low without a ban on harmful interference. If there are no definite and pre-determined objectionable activities, what is there to consult about?

Establishing a space traffic management system, debris mitigation protocol or consultative mechanism without a strengthened international norm against harmful interference with satellites is analogous to having a nuclear hotline that is automatically turned off during crises. Times of international tension, particularly those caused by an incident in outer space, are times when a code of conduct would be subjected to its most difficult test. Without first banning harmful interference, a code of conduct for operating in outer space would be less reliable during crises, when nations rely on their satellites to a particularly great extent. As made clear in this section, a ban on harmful interference with satellites is vital to international security, even if there is no code of conduct governing space operations. Conversely, if the international community opts to pursue a code of conduct for outer space, it cannot hope to succeed without also considering a provision that deals with harmful interference.

LIMITING INTERFERENCE LIMITS TESTS BUT NOT LATENT CAPABILITIES

One of the most common arguments against a treaty or code of conduct governing activities in outer space is that an exclusive approach to protect satellites would capture military capabilities with other purposes. On the other hand, a narrow approach that focuses solely on “dedicated” anti-satellite capabilities would not be sufficiently protective of satellites, since many technologies have the capability to perform both benign and hostile missions. Furthermore, these critics argue, unscrupulous states will likely ignore the prohibition against developing and deploying the weapons that are banned, leaving the states that stand by the provisions of the agreement at a disadvantage. These arguments do not apply very persuasively to a ban on harmful interference.

The critics are right to recall that a key barrier to concluding space arms control agreements has been the difficulty in defining space weapons. As noted by former US Under Secretary of State for Arms Control Robert Joseph, "… negotiations [during the Carter administration] were stymied by questions of which so-called 'space weapons' capabilities should be limited—co-orbital interceptors, direct-ascent interceptors, ground-based, or just space-based directed-energy systems".[4] However, space weapons do not have to be defined in order to maintain a provision banning harmful interference. The prohibition of harmful interference with satellites is specifically designed to take into account the multi-purpose nature of space technology. Missile defence systems, satellites capable of shifting their orbits and even the Space Shuttle could be used to interfere with satellites. While some of these systems are considered more threatening than others, the fact remains that when negotiators seek to define space weapons, their definitions will always be too encompassing or too narrow, depending on the perspective of their respective states. Banning the act of interference rather than the existence of "weapons" bypasses this difficulty altogether. Doing so is not without precedent—weapons of mass destruction (WMDs) have been stockpiled for decades without being used. Though WMDs obviously have more horrific effects, and thus have not been used for somewhat different reasons, the analogy holds because the first use of a space weapon in military conflict, like the use of a WMD, is unlikely to be a singular event. The existence of weapons does not imply their eventual or inevitable use if the consequences of such use can be devastating for both combatants.

An additional benefit of seeking to define harmful interference rather than seeking to ban space weapons is that it eases the dilemmas associated with verification. As noted by numerous critics of space weapons treaties, it would be extremely difficult to verify the absence of space weapons from the arsenal of a potential adversary. This problem would be exacerbated by the existence of numerous dual-use technologies and weapons systems. However, parties to a code of conduct do not need to concern themselves with what constitutes a space weapon or engage in the seemingly hopeless task of agreeing on a common definition of one. Instead, they need only focus upon one application of multi-purpose technologies—their use to interfere harmfully with satellites and other space objects. Monitoring and verification of this singular application would be left to national technical means, as would the choice of a response in the event that purposeful, harmful interference occurs. Clarifying harmful interference and ensuring verification would take hard work by national authorities; attributing harmful interference could be difficult in some cases. None of these tasks would be anywhere near as difficult as deciding on and verifying a common definition of space weapons or dominating space militarily.

Nonetheless, states cannot be assured that others will honour their pledges. A hedging strategy, in which states actively research and field systems with dual-use capabilities, will surely continue during the negotiation and implementation of a code of conduct. Indeed, there is no feasible way of stopping this from happening. Spacefaring nations will therefore reserve the right and probably have the capability to pursue whichever avenues of research seem appealing—as long as in this pursuit they do not test these technologies in ways that interfere with space objects. Hedging strategies that respect a norm against harmful interference can serve as a deterrent against subsequent anti-satellite tests.

AGREEMENT FORMAT

To this point, I have assumed that a provision banning harmful interference with satellites would operate virtually identically as part of any code of conduct. Such a code could take the form of a legally binding treaty, an executive agreement (an instrument often used in the United States and that, under international law, has the standing of a treaty) or a politically binding agreement. In this section I lay out the relative benefits associated with each of these paths. Political compacts between states, such as the proliferation security initiative, do not have the standing under international law as treaties or, in the United States, as executive agreements. They oblige states involved to abide by certain rules, refrain from taking certain actions, or adhere to a set of best practices. A treaty in the United States requires the advice and consent of two thirds of the Senate. When approved, it becomes law. Treaties usually take considerable time to negotiate, especially if many parties are involved and if consensus is required for their completion.

While many states favour a treaty to deal with the problems posed by anti-satellite tests and space weapons, it is difficult to envision how a consensus might be reached in this regard, or how a treaty can be negotiated in a timely manner. There is far more flexibility available if a code of conduct for responsible spacefaring nations is negotiated in the form of an executive agreement. It could be negotiated in any one of several possible multilateral forums. It could be negotiated by a large number of countries, or it could initially be drafted by a core group of spacefaring nations. It could be negotiated under consensus rules, or if a small number of states oppose consensus, an agreement could be reached among like-minded states that could seek broader support later.

US law makes a peculiar distinction between treaties and executive agreements. Both are legally binding and thus, from the perspective of the international community, should be considered in the same way.[5] Executive agreements do not require the consent of 67 Senators, a very high hurdle for any agreement, regardless of its content. In rare instances, executive agreements are brought before both houses of Congress for their consent by a simple majority vote. The best known of these congressional–executive agreements is the 1972 Interim Agreement between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitation of Strategic Offensive Arms. It was submitted to Congress by President Nixon, where it won the support of all but two Senators and two members of the House of Representatives.[6] Thus, there is an avenue for executive agreements to gain legislative consent if doing so is deemed important, which it may be for reasons related to American domestic politics. Other executive agreements do not, however, require legislative voting or approval. A code of conduct for responsible spacefaring nations may well fall into this category. Since it would not obligate any state to reduce its armaments, it might not be subject to treaty ratification as per the conditions of the Arms Control and Disarmament Act of 1961.[7] Using the vehicle of an executive agreement would allow a code of conduct to avoid the peril of legislative purgatory, in which a treaty has been fully negotiated but languishes in the Senate, un-ratified, for years. Entry-into-force of the Comprehensive Test Ban Treaty has fallen victim to this—the treaty was submitted to the Senate during the Clinton administration and has yet to be ratified. Indeed, in 1999 the Senate voted to deny its advice and consent to the ratification of the treaty.[8]

A politically binding agreement may be even quicker to negotiate than either an executive agreement or a treaty. However, it would not be legally binding. This may be a rather severe disadvantage for those states that seek the security that may be provided by legally binding instruments. There may be ways to reassure such states that other signatories take their political commitment seriously. In the United States, for example, the president could issue an executive order (not to be confused with the executive agreements discussed above) which is binding on the conduct of federal agencies. Such signalling devices would not be binding on the United States vis-à-vis other signatories. As noted by the Congressional Research Service, "… [political] agreements may be considered morally binding by the parties, and the President may be making a type of national commitment when he enters one".[9] This notwithstanding, legally binding agreements are preferred to other agreements by many nations.

There is no treaty banning space weapons that is likely to be verifiable and have reassuring enforcement provisions. It is also likely that any treaty that is not verifiable and enforceable will be unattractive to several of the major spacefaring nations, including the United States. A code of conduct sets aside issues that are likely to bedevil treaty negotiators for a decade or more. In a code of conduct, verification and determination of compliance would be left to national authorities. One substantive task of negotiators would be to define precisely what constitutes "harmful interference". This task is far simpler than trying to reach agreed definitions of what a treaty regarding space weapons would seek to ban. Regardless of the precise definition of harmful interference, participating states can request consultations when they witness ambiguous events or events they perceive as interference. A refusal to comply with such requests would be a show of bad faith and would reinforce negative assessments. The dilemmas associated with enforcement will continue to exist regardless of the form in which a space security agreement appears. All potential agreements would require consultation measures, and at times these consultations may prove to be unsatisfactory. If signatories to a space security agreement violate their pledges, states that feel disadvantaged have the sovereign right to respond, including the right to withdraw from the agreement.

In the wake of the tests carried out by the Chinese and American governments, near-term actions are required to strengthen norms against harmful interference with space objects. The best option may be to employ a hybrid formulation consisting of a political agreement during the initial norm-building period, to be reinforced subsequently by the force of international law. An instrument negotiated in a forum which does not require consensus and that is considered by the US government to be an executive agreement would be attractive for the reasons outlined above. Agreement on a code of conduct that includes a no-harmful-interference provision would reinforce the norm-building process created by the network of other treaties that relate to outer space. Besides those setting the precedent for non-interference with satellites, there are also the Liability Convention, the Rescue Agreement, the Registration Convention and the Moon Agreement, all of which have been adopted by the UN General Assembly.[10] The existence of this body of existing law indicates that the norm against satellite interference is present, but in need of reinforcement.

CONCLUSION

My goal has been to convince the reader that a code of conduct accompanied by a ban on harmful interference with satellites would significantly enhance space security. I have further argued that, even in the absence any significant movement forward from the status quo, a measure preventing harmful interference would have significant benefits. I have explained how this proposal bypasses many of the common objections to formal arms control measures in outer space. By continuing the current efforts to improve space situational awareness, the strongest objections to a harmful-interference ban—those about the inability to verify the banned activity—will be rendered moot. It is my sincere hope that such a proposal will be seriously considered and advanced in the coming years.

Notes

1 For a copy of the draft code of conduct, see <www.stimson.org/pub.cfm?ID=575>.

2 Tonga initially registered the last 16 available slots in 1988 and then reduced its claim to seven slots following the receipt of numerous protests.

3 David Shiga, "Mysterious source jams satellite communications," *NewScientist.com*, 26 January 2006, <http://space.newscientist.com/article/dn11033-mysterious-source-jams-satellite-communications.html>.

4 Robert Joseph, "Remarks on the President's National Space Policy—Assuring America's Vital Interests", Center for Space and Defense Forum, 11 January 2007, <www.state.gov/t/us/rm/78679.htm>.

5 US Congressional Research Service, "Treaties and other International Agreements: The Role of the United States Senate", 2001.

[6] Christopher Stone, "Signaling Behavior, Congressional-Executive Agreements, and the SALT I Interim Agreement", *The George Washington International Law Review*, vol. 34, no. 2, 2002.

[7] US Congressional Research Service, "Treaties and other International Agreements: The Role of the United States Senate", 2001, p. 251.

[8] Ibid, p. 254.

[9] Ibid, p. 23.

[10] "United Nations Treaties and Principles on Space Law", UN Office for Outer Space Affairs, 2006, <www.unoosa.org/oosa/en/SpaceLaw/treaties.html>.

TRANSPARENCY AND CONFIDENCE-BUILDING MEASURES FOR OUTER SPACE

Garold Larson

I am grateful for the opportunity to provide the perspective of the United States on transparency and confidence-building measures (TCBMs) related to outer space.

In making these remarks, I should note that the United States is a strong supporter of pragmatic TCBMs that support the peaceful use of outer space. As Acting Deputy Assistant Secretary of State Donald Mahley noted in a speech earlier this year at the George Washington University in Washington, DC:

> It is universally acknowledged that defense and intelligence-related activities in pursuit of a country's national interests fall within the scope of, and are fully consistent with, the 1967 Outer Space Treaty's provisions regarding the peaceful uses of space. Moreover, Article 51 of the United Nations Charter states that '[n]othing in the ... Charter shall impair the inherent right of individual or collective self-defense.' The [United States] also will support its allies and friends in the protection of their space capabilities, with special emphasis for those satellites whose peaceful use supports U.S. national interests.

A FOUNDATION OF COMMON PRINCIPLES

For the United States and other responsible spacefaring nations, a foundation of common principles starts with the 1967 Outer Space Treaty, which is formally known as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. This foundation also includes the provisions of the 1968 Rescue and Return Agreement, the 1972 Liability Convention and the 1974 Registration Convention. These four "core" treaties, along with other elements of established international law activities in outer space, together with various non-binding instruments, provide a sound basis to respond to the emerging challenges of the twenty-first century.

Although the United States is determined to keep sufficient flexibility to protect its national security interests, we also recognize that some emerging challenges to space security may require new forms of international cooperation with allies, friends and other responsible spacefaring nations to preserve the most important of the mutually shared principles elaborated in these treaties—free access to, and use of, outer space by all nations for peaceful purposes.

This principle was first advanced by President Eisenhower in the late 1950s and formed the basis for key precepts of the Outer Space Treaty. The commitment to peaceful use and benefit for all is embedded firmly in the United States National Space Policy signed by President George W. Bush on 31 August 2006. That policy states explicitly that all activities of the United States Government would be consistent with applicable international law, including treaties to which the United States is a party, which includes the Outer Space Treaty. The importance of the Outer Space Treaty and international cooperation are also fundamental elements of the space policies of other responsible spacefaring nations.

BEST PRACTICE GUIDELINES

The United States and Europe have been leading supporters of international cooperation to preserve the space environment for future generations. Confronted with the fact of persistent debris after rocket explosions and anti-satellite tests during the early and mid-1980s, the United States and Europe began to consider the potential long-term hazards created by the accumulation of space debris. These discussions during the late 1980s and early 1990s soon expanded to include Japan and Russia. These expert exchanges also led to the formation of an Inter-Agency Space Debris Coordination Committee (IADC) in 1993 by the US National Aeronautics and Space Administration (NASA), the European Space Agency (ESA) and the civil space agencies of Russia and Japan.

Today, the IADC includes a total of nine national space agencies as well as the ESA. Its guidelines for orbital debris mitigation have provided a common basis for protecting the space environment from man-made debris. The

IADC's terms of reference also provide a useful framework for providing notifications of potential hazards from what are referred to as "high risk re-entry events".

The technical experts of IADC can take pride that their debris mitigation guidelines formed the basis for guidelines that were endorsed in 2007 by the UN Committee on the Peaceful Uses of Outer Space (COPUOS). Cooperation on debris mitigation also serves as an useful model for a new and promising set of "bottom-up" discussions on a broader set of best practice guidelines for safe space operations.

In this regard, the United States has been pleased to support a recent initiative to establish an informal working group that brings together experts from the public and private space sectors to explore additional measures to ensure the long-term sustainability of space activities. In particular, the United States is grateful for the leadership provided by Gérard Brachet, the current chairman of COPUOS, as well as the Government of France's sponsorship of an initial workshop on this topic last month in Paris.

Looking forward, the United States strongly believes that any consideration of best practice guidelines should include private sector satellite operators. Focused on the bottom line, commercial operators must both ensure uninterrupted service and protect their shareholders' investments. As a result, commercial operators have devoted considerable time and effort to develop cost-effective approaches for satellite control and for coordination with other commercial operators to avoid collisions and minimize harmful radio interference. Many of these measures can serve as the basis for improved information sharing between governments and the private sector.

ESTABLISHING A COMMON FRAME OF REFERENCE

Using commercial best practices as a baseline also can promote efforts to establish a common vernacular and reference framework for technical data exchanges on spaceflight safety. This may be particularly useful for many US aerospace engineers, who are noted for their ability to provide status reports that sometimes cite pounds of spacecraft weight and relative velocities of kilometers per second in the same sentence. Usually the "measurement bilingualism" works out fine. But sometimes it leads to a mishap like the

Mars Climate Orbiter, which crashed into the Martian atmosphere due to what investigators called "a failure to recognize and correct an error in a transfer of information" between industry spacecraft engineers in Colorado and a NASA mission navigation team in California.

When US engineering students examine this case study, they usually provide several explanations for why the mishap occurred. The thoughtful explanation they provide for the loss of the Mars Climate Orbiter is that it reflects the fact that scientists and engineers working in different organizations can and do have differing frames of reference. Such differences often encompass not only systems of measurement but also broader approaches to systems engineering and spacecraft operations.

During the first four decades of the space age, these differences had little effect. Satellites operated by various companies and governments were relatively few in number, and spacecraft operated by different nations were usually separated by fairly large distances. Although the United States and other governments did and do pay close attention to fight safety for the International Space Station and other human spaceflight missions, the question of how different nations' robotic spacecraft interacted with each other was not a major concern.

But as outer space becomes increasingly vital to economic prosperity and international security, there is increasing interest in exploring new approaches for collision avoidance and improved responses to purposeful interference incidents. There also has been increasing international interest in new approaches for shared space situational awareness.

In this regard, it is worth noting that civil society has provided a range of options for new approaches for international cooperation in spaceflight safety. In addition to commercial operators, academic institutions such as the International Space University and non-governmental organizations such as the International Academy of Astronautics have devoted considerable effort to initial studies that can serve as valuable catalysts for further discussion between government and industry experts.

Our past experience with expert discussions on space debris mitigation shows how dialogues between experts can help to educate non-technical policymakers and establish clear guidelines and standard practices for responsible operators to exchange information and coordinate their actions. As these groups develop consensus, the results can be forwarded to COPUOS for consideration.

ENHANCING TRANSPARENCY AND BUILDING CONFIDENCE IN INTENTIONS

Given the complexity of these topics, the deliberations may take some time. As a result, it is important that they not become distorted by parochial political agendas or unnecessarily duplicated by competing discussions in other venues. COPUOS scientific and technical subcommittee meetings should remain the key multilateral forum for considering general best practice guidelines regarding the peaceful use of outer space. Any consideration of outer space TCBMs in other bilateral and multilateral settings should take into full account what goes on in both civil society and at COPUOS.

With regard to TCBMs specifically relating to the use of outer space to maintain international peace and security, the United States also favours a bottom-up approach that begins with bilateral dialogues with foreign governments on space security issues. In particular, these discussions can explore measures that can increase transparency regarding national security space policies and strategies, thus reducing uncertainty over intentions. Bilateral discussions also could consider new measures that could decrease the risk of misinterpretation or miscalculation during, for example, a crisis or confrontation.

One such measure could be creating new or expanding established "hot lines" between capitals, allowing political and military leaders to communicate directly with each other regarding space incidents. Specific measures could include regular exchanges between senior space commanders and their staffs as well as launch and satellite operations officers.

US officers in Florida, Colorado and California look forward to welcoming their Russian counterparts, and to reciprocal future visits to launch centres and movement control centres in Russia. Such exchanges can help to build mutual understanding and enhance trust—two key prerequisites for enhanced cooperation and crisis management.

The United States trusts our record of cooperation with Russia will be considered as part of a broader examination of options for voluntary

TCBMs. In 2007, the United States sought to work with Russia to draft a UN General Assembly resolution supporting an expert study of options for voluntary TCBMs. Regrettably, we were unable to reach agreement with Russia for the Sixty-Second General Assembly on a resolution that did not tie pragmatic TCBMs to proposals for binding space arms control treaties. But the United States still hopes to continue working with Russia and other major spacefaring nations in ways that could build on our ongoing work with our friends in Europe on concrete proposals for voluntary TCBMs that can gain wide acceptance.

In particular, we have welcomed the opportunity for trans-Atlantic dialogue with the European Union regarding proposals for a set of TCBMs that focuses upon a pragmatic and incremental approach to space security. Our discussions with Europe over the past six months have already identified many opportunities for consensus; over the coming months we look forward to continued exchanges with the European Union and its member states as well as substantive discussions on TCBMs here at the Conference on Disarmament.

CONCLUSION

In summary, let me note that the United States looks forward to participating in exchanges with, and learning from, academic and non-governmental experts such as the participants in today's conference. As with our endeavours on Earth, our priority for outer space is pursuing peaceful uses within cooperative relationships, particularly with our oldest and closest friends and allies.

TRANSPARENCY AND CONFIDENCE-BUILDING MEASURES: THEIR PLACE AND ROLE IN SPACE SECURITY

Andrey Makarov

Transparency and confidence-building measures (TCBMs) are an integral part of the international legal and institutional framework supporting military threat reduction and confidence-building among nations.

TCBMs are being recognized and upheld by the United Nations as mechanisms that can offer the way to mutual understanding among parties, and reduce misunderstanding and tensions; they promote a favourable climate for effective and mutually acceptable paths to arms reduction and non-proliferation.

In its resolution 39/63E of 12 December 1984, the Commission on Disarmament decided on the confidence-building guidelines later endorsed by the General Assembly in resolution 43/78H. The guidelines stipulate:

> [General Considerations]
>
> 1.3.1.1 Confidence-building measures must be neither a substitute nor a precondition for disarmament measures nor divert attention from them. Yet their potential for creating favourable conditions for progress in this field should be fully utilized in all regions of the world, in so far as they may facilitate and do not impair in any way the adoption of disarmament measures. …
>
> 1.3.1.4 Confidence-building measures may be worked out and implemented independently in order to contribute to the creation of favourable conditions for the adoption of additional disarmament measures, or, no less important, as collateral measures in connection with specific measures of arms limitation and disarmament. …
>
> [Principles]

2.1.2 In particular, and as a prerequisite for enhancing confidence among States, the following principles enshrined in the Charter of the United Nations must be strictly observed:

(a) Refraining from the threat or use of force against the territorial integrity or political independence of any State;

(b) Non-intervention and non-interference in the internal affairs of States;

(c) Peaceful settlement of disputes;

(d) Sovereign equality of States and self-determination of peoples. …

[Objectives]

2.2.1 The ultimate goal of confidence-building measures is to strengthen international peace and security and to contribute to the prevention of all wars, in particular nuclear war. …

2.2.3 A major goal of confidence-building measures is the realization of universally recognized principles, particularly those contained in the Charter of the United Nations. …

2.2.5 A major objective is to reduce or even eliminate the causes of mistrust, fear, misunderstanding and miscalculation with regard to relevant military activities and intentions of other States, factors which may generate the perception of an impaired security and provide justification for the continuation of the global and regional arms build-up. …

2.2.6 A centrally important task of confidence-building measures is to reduce the dangers of misunderstanding or miscalculation of military activities, to help to prevent military confrontation as well as covert preparations for the commencement of a war, to reduce the risk of surprise attacks and of the outbreak of war by accident; and thereby, finally, to give effect and concrete expression to the solemn pledge of all nations to refrain from the threat or use of force in all its forms and to enhance security and stability. …

2.2.7 Given the enhanced awareness of the importance of compliance, confidence-building measures may serve the additional objective of facilitating verification of arms limitation and disarmament agreements.

> In addition, strict compliance with obligations and commitments in the field of disarmament and cooperation in the elaboration and implementation of adequate measures to ensure the verification of such compliance - satisfactory to all parties concerned and determined by the purposes, scope and nature of the relevant agreement - have a considerable confidence-building effect of their own.
>
> Confidence-building measures cannot, however, supersede verification measures, which are an important element in arms limitation and disarmament agreements. …
>
> [Implementation]
>
> 2.4.2 Since States must be able to examine and assess the implementation of, and to ensure compliance with, a confidence-building arrangement, it is indispensable that the details of the established confidence-building measures should be defined precisely and clearly. …
>
> 2.4.4 The implementation of confidence-building measures should take place in such a manner as to ensure the right of each State to undiminished security, guaranteeing that no individual State or group of States obtains advantages over others at any stage of the confidence-building process.[1]

I should like to make a special emphasis on the point that, despite the great importance and role of TCBMs, disarmament measures are essential, and only the disarmament can make a decisive contribution to the prevention of war.

Space activities have a particular place in defence capabilities of all states, and their military interests are one of the decisive factors for its enforcement. As the scope of their military and national security activities in outer space is increasing, several states are becoming more concerned about the risk of transforming outer space into another area of military confrontation.

The application of TCBMs in space activities is not a new issue—the world has long recognized them as an important element to regulate space activities. This has been recorded in General Assembly resolutions (45/55B, 47/51 and 48/74B) that reiterate the importance of confidence-building measures to prevent the arms race in outer space. The resolution on the prevention of an arms race in outer space, adopted every year, recognizes that specific proposals on TCBMs can become an integral part of an agreement or agreements to this end.

TCBMs are being applied in that or another form in international space law. These are:

- notification of UN Secretary-General, the general public and the international scientific community about the character, conduct, location and results of outer space activities (Outer Space Treaty of 1967);
- provision of data about launched space objects and terminated or modified Earth-orbiting objects (Registration Convention of 1975);
- cooperation in the joint resolution of emerging problems, and so forth.

The Secretary-General presented to the Forty-Eighth Session of the General Assembly in 1993 the report of the Group of Government Experts on the "Study on the application of confidence-building measures in outer space".[2] The report raised and addressed the following issues:

- the need for transparency and confidence-building in outer space;
- specific features of transparency and confidence-building in space activities;
- proposals regarding specific confidence-building measures in outer space; and
- proposals regarding new mechanisms of transparency and confidence-building in outer space.

Its main conclusions and recommendations were that:

- any space activity should be carried out in the interest of strengthening international peace and security;
- the main problems that raise the concern of the majority of states are related to the potential placement of weapons in outer space;
- transparency measures must be developed in such a way as to take into account the need for strengthening international confidence and protecting national security interests;

- in considering eventual confidence-building measures in outer space, the different capabilities of states should be taken into account;
- in the view of several states, the time has come to start large-scope negotiations with a view to an international agreement prohibiting the weaponization of outer space;
- relevant confident-building measures in outer space can become an important step towards the prevention of an arms race in outer space and the peaceful use of outer space by all states; and
- international cooperation in the exploration and use of outer space is one possible confidence-building measure.

TCBMs in space activities have their own specifics—they can be applied not only to military space activities but also to functions unrelated to defence capabilities or the national security of states.

By their nature, TCBMs in space activities have several dimensions. On the one hand they have individual value that contributes to better mutual understanding and reduces the risk of misunderstanding concerning the activities of other states in outer space, and promotes international cooperation. On the other hand they can be the main or an integral part of a verification mechanism in the framework of an international treaty prohibiting the deployment of weapons in outer space. At the same time, they create favourable prerequisites for the elaboration and signing of a treaty on the non-weaponization of outer space. Finally, the development and application of TCBMs is a relatively easy first step toward strengthening space security.

Since the beginning of the space era, a number of states have proposed various solutions to the prevention of an arms race in outer space and the establishment of a regime of confidence and predictability of space activities:

- The Canadian concept of PAXSAT-A, proposed in 1987–1988 to create a special space vehicle for obtaining data on other spacecraft. The main objective of such a spacecraft would be the detection of functional capabilities of satellites placed into orbit. The PAXSAT-A constellation provided for two or three space vehicles on a high-inclination orbit at an altitude of 500km to 2000km, one

spacecraft on a semi-synchronous orbit and one spacecraft on a geosynchronous orbit.
- In 1978 France launched a proposal to create an International Satellite Control Agency to manage compliance with disarmament agreements and observation of crisis situations.
- In 1988 France proposed another concept, the Satellite Imagery Agency. The creation of such an agency would promote control of compliance with the existing disarmament and arms control agreements and help prevent catastrophes and major natural disasters. Moreover this agency could serve as a centre for training satellite imagery analysts.
- In 1988 the Soviet Union made a proposal to create an International Remote Sensing Agency that would provide the international community with information on compliance with multilateral disarmament agreements and observation of the military situation in conflict areas, for the reduction of international tension. In the view of the Soviet Union, if the results of observations by national satellite systems had been made available to an international organization this would have become a major confidence-building measure.
- Another Canadian concept dealt with a PAXSAT-B space vehicle designed for verification of compliance with conventional arms control treaties in restricted areas.

In the recent years there has been a visible increase of interest towards TCBMs. Some states are applying them at their own initiative. For instance:

- since 2003 Russia is posting on the web information on scheduled launches and their mission for the international community;
- in 2004 Russia announced that it will not be the first to deploy weapons in outer space;
- in 2005 this initiative of the Russian Federation was endorsed by the member states of the Collective Security Treaty, who made similar statements;
- Norway provides notifications on scheduled launches of rocket probes from its range in the Arctic Ocean; and
- on 8 June 2006 the UK delegation made a statement at a plenary meeting of the Conference on Disarmament that the United Kingdom “has no intention to deploy weapons in outer space”.

The above-mentioned measures are not comprehensive neither by the scope of coverage of various space activities nor by participation of states in their implementation. In this connection, the UN General Assembly at its sixtieth and sixty-first sessions adopted the resolutions on transparency and confidence-building measures in space activities that contained a request to Member States to inform the Secretary-General about their views on the need for further development of international TCBMs in outer space aimed at promoting peace, security, international cooperation and prevention of an arms race in outer space, as well as their specific proposals regarding such measures.

The development of TCBMs should not detract us from the main objective—the prevention of an arms race in outer space.

There have been proposals made ranging from simple to complex—since reaching an understanding on a treaty prohibiting the placement of weapons in outer space may take much time, it would be appropriate to focus first on confidence measures, codes of conduct, and the review and promotion of best practices. However, with all their apparent logic, such proposals have a number of shortcomings.

First, unlike the treaty in question, it is not intended that they would have a legally binding character. Second, they do not address the issue of the prevention of an arms race in outer space, and thus outer space would remain open for weaponization. Third, the existing experience to-date shows that states can be "transparent" and "predictable", but do not necessarily comply with existing international space law, as it happened in 2007 and 2008 with the destruction of two satellites. Fourth, one cannot exclude that such an approach to addressing the problems in orbit would be promoted as the "best practice" and could in time become a precedent. Finally, work that only pursues TCBMs may detract our attention from the task of prevention of an arms race in outer space and substantially slow down the development of a treaty prohibiting the deployment of weapons in outer space—and this runs counter to the guidelines regarding confidence-building measures—"Confidence-building measures must be neither a substitute nor a precondition for disarmament measures nor divert attention from them".

It is obvious, however, that any proposals regarding the development and application of TCBMs in outer space deserve careful attention and profound review.

CONCLUSIONS

TCBMs are an integral part of the international legal framework of international security, prevention of armed conflict and progress in the field of disarmament.

They are closely related to the issue of prevention of an arms race in outer space.

They contribute to the progress toward reaching agreement on prohibiting the placement of weapons in outer space.

TCBMs, with all their importance and relevance for security in outer space, cannot substitute for comprehensive legal obligations on the prevention of an arms race in outer space.

The drafting of a treaty prohibiting the weaponization of outer space should go in parallel with the development of TCBMs.

They can play an independent role in ensuring space security and remain an integral part of the control mechanism of a treaty prohibiting the deployment of weapons in outer space.

In developing TCBMs we should take into account the need to strengthen international trust and protect the interests of national security, with due regard to differences in the space capabilities of states, and the measures should be clear to all and, no less importantly, be feasible.

TCBMs may be developed and applied bilaterally, multilaterally, regionally or globally.

The issue of TCBMs remain valid and require continuous attention and further development.

Notes

1 General Assembly, *Special Report of the Disarmament Commission to the General Assembly at its Third Special Session Devoted to Disarmament*, UN document A/S-15/3, 28 May 1988, pp. 28–33.

2 General Assembly, *Prevention of an Arms Race in Outer Space*, UN document A/48/305, 15 October 1993.

SESSION III

FROM CONFRONTATION TO COOPERATION

SAFEGUARDING OUTER SPACE: ON THE ROAD TO DEBRIS MITIGATION

Maureen Williams

INTRODUCTION

The International Law Association (ILA) was created in Brussels 135 years ago, in the wake of the Alabama Arbitration. Its headquarters are currently in London. Among its objectives are the study, clarification and development of international law, both public and private, and the furtherance of international understanding and respect for international law. These objectives are mainly pursued through the work of the ILA's international committees and the focal point of its activities is the series of biennial conferences which provide a forum for discussion and endorsement of the work of the committees. The ILA Space Law Committee was set up 50 years ago during the Fifty-eighth Conference of the Association (New York, 1958), following the launching of the first Sputnik, and its work continues, to date, without interruption.

The ILA Space Law Committee is a permanent observer to the UN Committee on the Peaceful Uses of Outer Space (COPUOS) and both its subcommittees, namely the Scientific and Technical and the Legal Subcommittees. Its officers are the author, as chair, and Stephan Hobe (Germany), as general rapporteur. The practice of the Committee includes cooperation with other international organizations and institutions, public and private, such as the United Nations International Law Commission and the International Institute of Space Law, the European Centre for Space Law, the British National Space Centre, the Brazilian National Space Agency, the Argentine National Space Agency and others.

Similarly, the ILA Space Law Committee takes into account the activities, conclusions and recommendations provided by other academic institutions such as the National Council for Scientific and Technical Research of Argentina—in the framework of which the author is conducting research projects on space law on both the national and international fronts—and, also in Argentina, the Universities of Buenos Aires and of Belgrano. Likewise, and among other examples, the ILA follows closely the progress and results of research projects carried out on the subject by Cologne University and its Institute of Air and Space Law, under the direction of Stephan Hobe. Most of the work of the ILA Committee is developed from a strong interdisciplinary approach.

Among recent contributions of the Association to the development of space law, mention should be made of:

- the *ILA International Instrument on the Protection of the Environment from Damage Caused by Space Debris*, Final Report to the Sixty-sixth ILA Conference, Buenos Aires, 1994;
- the *Revised Draft Convention on the Settlement of Disputes related to Space Activities*, Final Report to the Sixty-eighth ILA Conference, Taipei, 1998;
- the *Review of the UN Space Treaties in View of Commercial Space Activities, First Report*, Report to the Sixty-ninth ILA Conference, London, 2000;
- the *Review of the UN Space Treaties in view of Commercial Space Activities, Final Report*, Report to the Seventieth ILA Conference, New Delhi, 2002;
- the *Legal Aspects of the Privatisation and Commercialisation of Space Activities: Remote Sensing (RS) and National Space Legislation (NSL), First Report*, Report to the Seventy-first ILA Conference, Berlin, 2004; and
- the *Legal Aspects of the Privatisation and Commercialisation of Space Activities: Remote Sensing, National Space Legislation (with emphasis on Registration Issues), Second Report*, Report to the Seventy-second ILA Conference, Toronto, 2006.

The ILA Space Law Committee is presently working on remote sensing, national space legislation and registration issues, following up its second report on these questions adopted by the ILA Toronto Conference in 2006. Those results were reported to the Forty-sixth Session of the Legal Subcommittee during 25 March–5 April 2007, under the heading "Information on the activities of international intergovernmental and non-governmental organisations relating to space law" and, similarly, to the Forty-seventh Session of that body on 31 March–11 April 2008.[1] The ILA Committee keeps the legal aspects of space debris and dispute settlement mechanisms under permanent review, taking as basis the above-mentioned ILA instruments adopted at recent conferences.

Concerning remote sensing, the ILA Committee is currently updating its 2006 Toronto Report in view of recent developments on the subject, particularly because developing countries are increasingly becoming involved in remote sensing activities and, therefore, the very controversial Principle XII of the UN principles relating to remote sensing of the Earth from outer space,[2] on the right of access of the sensed state to information collected over its territory, is now less dramatic.

Nowadays it is a fact that a number of sensed states have become, at the same time, sensing states. The ILA is also pursuing its review of state practice on remote sensing to establish whether it reflects the observance of the UN principles. To which the controversy surrounding satellite data and its value as evidence in international litigation should be added.

As to national space legislation and registration issues, our next report—well underway at the moment—is discussing and comparing a number of domestic laws recently adopted on registration. This question, closely intertwined with remote sensing and space debris, indeed gives food for thought. Suffice it to recall that this issue, developed by the working group operating in the framework of the Legal Subcommittee, chaired by Dr. Kai-Uwe Schrogl—and on which our ILA Committee had been asked for comments and suggestions which are appended to the ILA's report to the subcommittee for 2007[3]—is now embodied in General Assembly resolution A/RES/62/101, adopted at the end of 2007.

Strongly related to these issues are the answers from Germany, Japan, Poland, Saudi Arabia and the United Kingdom and the Committee on Space Research to a note by the Secretariat[4] whereby governments were asked to submit information on space debris and national space legislation adopted pursuant to the Guidelines on Mitigation adopted by the Scientific and Technical Subcommittee in 2007 and which, on 21 December 2007, became the UN Space Debris Mitigation Guidelines.[5]

On dispute settlement it may be safely assumed, at this stage, that the ever-increasing private activities in outer space are diminishing the risk of state immunity clauses being brought up during dispute settlement procedures with the ensuing difficulties of such an attitude.

The results of the ILA Space Law Committee's work on the above-described topics will be reported by our committee to the forthcoming Seventy-third ILA Conference in Rio de Janeiro, Brazil, 17–22 August 2008. A panel is also envisaged on this occasion to discuss weaponization and space traffic management.

IDENTIFYING THE MAJOR THREATS TO SPACE SECURITY TODAY

The military use of outer space is not a topic specifically addressed by COPUOS, but no doubt the delegations are sensing that weapon deployment may affect the safety of outer space activities.

A common denominator to be drawn from the doctrine today concurs that space debris should be on the top of the list, followed by weaponization and natural near-Earth objects, such as asteroids and meteorites, and the risk of collisions with Earth.

Space debris is an increasing threat to security in outer space. In addition to active satellites—as well as abandoned or inactive satellites—orbiting the Earth, small particles originating from collisions between these objects, known as "second generation debris" imply an extremely serious risk of collision with active satellites, sometimes with untold consequences. These small particles because of their size cannot be detected from Earth at the present state of the art. They travel at very high speeds (roughly 8km per second) and there are currently tens of thousands of those pieces in outer space.

As to weaponization, it may be true to say that weapons of mass destruction have not, so far, been deployed in the space environment. Nevertheless, reconnaissance satellites and early warning satellites are constantly transmitting processed information which is then taken into account for decision-making.

Article IV of the 1967 Outer Space Treaty[6] contains somewhat obscure provisions concerning the demilitarization and denuclearization of outer space, the Moon and other celestial bodies. In fact this article has been the target of sharp criticism over the years. Moreover, this situation opens the door for interpretation with all the dangers and uncertainties involved thereby and which may run counter to the object and purpose of the treaty. Reminiscent of the wording of the 1959 Antarctic Treaty, the lack of clarity of Article IV becomes much more dangerous in the field of outer space: unlike the Antarctic Treaty, the Outer Space Treaty is unlimited both in time and scope.

Voices have been raised advocating the amendment of Article IV of the Outer Space Treaty. Other views consider that the treaty should remain untouched and any changes be introduced by means of a separate instrument, be it a protocol, code of behaviour, UN resolution or the like. The recent Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects, based on a working document on possible elements for a future treaty, submitted by the delegations of Russia and China to the Conference on Disarmament in 2002,[7] embodies some interesting provisions in spite of excluding anti-satellite weapons which are today a most serious risk to space security. According to Victor Vasiliev (see his presentation in this volume), even though weapons that are not weapons of mass destruction may be lawfully deployed in outer space, they constitute a potential danger for other space objects and may affect the infrastructure on Earth. It is therefore surprising that anti-satellite weapons are excluded from that draft treaty having in mind that they are real stumbling blocks toward the strengthening of international cooperation, let alone transparency and confidence-building measures.

Near-Earth objects, for their part, pose a real challenge from the legal standpoint. This question has been discussed for some time now at the Scientific and Technical Subcommittee of COPUOS. The information stemming therefrom will indeed prove useful to start thinking of a more precise legal framework to this growing risk to space security. Indeed the topic seems to be gaining momentum and a place on the agenda of academic institutions dealing with international space law.[8]

SPACE DEBRIS MITIGATION: THE LANDMARKS

What follows are some general comments and recent steps which highlight the road toward the adoption of national and international measures and mechanisms consistent with the objective of the UN Space Debris Mitigation Guidelines.

In turning the pages of history back to 1967 it is easily perceived that Article IX of the 1967 Space Treaty was at the root of the problem when providing:

> In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.

Even in those days the provisions established thereby were far from satisfactory. Suffice it to say that, behind the label of "consultations"—for which no deadline was mentioned—talks could go on and on and, in the meantime, serious—and possibly irreversible—damage be caused to the Earth or the space environment.[9] Likewise, "cooperation" and "mutual assistance" appear as very vague requirements, hard to determine in practice. Moreover, who is to decide whether contamination is, in fact, "harmful"? What does "adverse change" really mean? And when do "appropriate measures" become such? To top the obscurity underlying Article IX, the requirement for a state "having reason to believe" that its activity may cause damage and thus request consultation is left entirely to the discretion of that state—hence, it may have no "reasons to believe" but still the activity could entail harmful consequences.

The possibility of unilateral removal of inactive or abandoned satellites did not go unnoticed in the mind of international lawyers. Most of the doctrine concurred that any such procedure was not admissible and entailed a breach of international law. As Perek[10] had acutely observed, at the time space objects were considered most valuable particularly in light of Article VIII of the Outer Space Treaty, reading:

> A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall, upon request, furnish identifying data prior to their return.

In this international context, and with the intention of moving towards a more agile, complete and compulsory registration system, and considering the growing number of abandoned or inactive objects in outer space, Perek was proposing the following.

The first step would be that every launching state should publish a list of all its active space objects plus the inactive ones it intends to protect and then declare that only the listed objects would fall under Article VIII of the Outer Space Treaty. Therefore any other object belonging to that state would not be included in that article and could be removed by a state having the adequate technology.[11] Naturally, for this system to be effective it would be essential to review that list perpetually, which, by electronic means, posed no problem. However, this proposal was viewed by some as a kind of "policy document or mechanism" and, therefore, did not gain the necessary support.

At the Sixty-fourth ILA Conference, Queensland, 1990, the initial bases for a future instrument on space debris were identified. Accordingly, the Space Law Committee instructed its then rapporteur (the author) to begin the drafting of an international instrument on the subject, the pillars and guidelines of which were submitted to, and adopted by, the Sixty-fifth ILA Conference, held in Cairo in 1992. The following should be highlighted:

- a general obligation to cooperate;
- an obligation to negotiate in good faith;
- an obligation to ensure that space activities cause no harm to persons, objects or the environment of other states, or to the environment in areas beyond national jurisdiction;
- an obligation to inform and exchange information, to consult, to prevent, control and reduce contamination, pollution and space debris, as well as inactive satellites precluding the use of orbital facilities by active systems; and
- an obligation to make every effort to settle disputes promptly and in an amicable manner, by peaceful means, with special accent on the need to avoid situations which may lead to disputes.

Some brief comments and recommendations concerning those pillars, designed for space debris mitigation at the time, follow:[12]

- in the first place, for drafting an international instrument on the matter, it was essential to agree on some definition or description of what should be understood by contamination, pollution and space debris and establish the scope and implications of the proposed instrument in the widest possible terms;
- the general obligation to cooperate (first pillar) should be interpreted broadly, in a way consistent with the 1989 Ottawa Declaration of the Meeting of Experts on the Protection of the Atmosphere;[13]
- the obligation to negotiate in good faith should be interpreted as one where talks are conducted with the main target of reaching effective solutions and where any unjustified breaking-off of negotiations is seen as bad faith;
- the obligation to exchange information should be equally interpreted as one to inform in cases where a given activity of uncertain consequences is to be carried out;
- the obligation to consult should be binding upon states and refusal to hold consultations should be seen as bad faith;
- dispute settlement is a key issue for the effectiveness of the rules embodied in the proposed instrument. The draft should include an optional clause on dispute settlement to allow states to waive the

condition of "common agreement". The clause could be drafted along the lines of the one included in the annex to the Convention on the Settlement of Disputes related to Space Activities (Sixty-first ILA Conference, Paris, 1984).[14] Also to be borne in mind is the optional clause appearing as an Annex to the 1985 Vienna Convention on the Protection of the Ozone Layer, dealing with dispute settlement;

- the possibility ought to be examined of setting up a panel of experts to report on scientific and technical aspects whenever the review of the instrument on space debris is called for or when amendments are proposed; and
- to avoid controversies going on indefinitely it appears necessary to establish with precision at what stage a given dispute should be referred to arbitration or adjudication.

Most of these pillars and subsequent recommendations were embodied in the Buenos Aires International Instrument on the Protection of the Environment from Damage caused by Space Debris, the text of which is appended as an annex to this chapter.[15] The Buenos Aires Instrument was introduced to COPUOS and its Legal Subcommittee in 1995 and explained thereto by then chair of the ILA Space Law Committee Karl-Heinz Böckstiegel. In the following years the instrument began to be quoted in the various circles involved with space law and to gain support from the doctrine. It is frequently mentioned and recommended as a basis, or starting point, for discussing space debris on the intergovernmental level, namely at the Legal Subcommittee of COPUOS. As noted before, the ILA Space Law Committee has kept this instrument under permanent review considering that, so far, it should be kept in its present reading.

THE NEW SCENARIOS: ADOPTION OF THE UN GUIDELINES

In 1999 COPUOS published a Technical Report on Space Debris[16] evaluating the state of the art on the matter. The general opinion then was that the space debris environment posed a serious risk and that prompt implementation of mitigation measures was necessary to safeguard the space environment for future generations.

A short reference will be made to some of the main conclusions and common denominators stemming from the doctrine and relevant UN documents considered by the ILA Space Law Committee in 2007.

As expressed at the outset, for the specific topic of space debris, the ILA Committee took as reference a number of research projects on the matter developed by the present writer in the framework of the University of Buenos Aires and the National Council for Scientific and Technical Research of Argentina. Likewise, the University of Cologne and its Air and Space Law Institute have been showing interesting progress on legal aspects of space debris. In 1988 this institute—whose director at the time was Karl-Heinz Böckstiegel—organized an international colloquium in cooperation with the International Institute of Space Law and the Space Law Committee of the International Law Association.[17] Also of great importance were the different views and recommendations of the members of the ILA Space Law Committee, based on their experience and dedication to these subjects, thus enabling the conduction of our objectives in a realistic manner. The emerging conclusions led the ILA to take up this subject for future work and discussion at its biennial conferences, which, as previously explained, resulted in an international instrument addressing the various legal implications of this topic.

The latest doctrine considered by the ILA was also drawn from other international and regional institutions—private and public—addressing the subject. On the governmental level, as said earlier, special attention was given, among others, to the various UN documents on the matter and the 2004 European Code of Conduct for Space Debris Mitigation.

On the private level 2007 was marked by a number of meetings which created further awareness on the need to give a more precise meaning to the general principles of the Outer Space Treaty and other sources of international law applicable to the mitigation of space debris. On 8–9 October 2007 a meeting convened under the heading Civil Society and Outer Space Forum 2007 took place at the Vienna International Centre with strong emphasis on security in outer space. This forum brought together a considerable number of non-governmental organizations involved, in one way or another, in outer space activities and their regulation. The author was assigned the topic Registration and the Mitigation of Space Debris on a panel addressing "Safeguarding Space" together with Patricia Lewis, then Director of UNIDIR, Ray Williamson, Executive Director of the Secure World

Foundation, and Rebecca Johnson, director of The Acronym Institute for Disarmament Diplomacy. The panel was chaired by Serge Plattard, former Secretary-General of the European Space Policy Institute who opened the session by stressing that outer space was a common heritage of great strategic value, essential for the long-term sustainability of the living planet. All speakers agreed on the importance of increasing space security through collaboration and collective trust which would lead, in turn, to transparency and confidence-building measures thus paving the way for a future legal regime on the subject. As to space debris in particular the panel concurred on the need to engage a wider audience in order to create awareness on this ever-growing threat.[18]

On 3–4 December 2007, the chair of the ILA Space Law Committee, together with a number of specialists representing the different legal systems of the world, were invited by the UN Outer Space Affairs Office in Vienna to participate in a UN Expert Meeting on Promoting Education in Space Law. The purpose was to elaborate a Space Law Education Curriculum and develop the syllabi of the general curricula (various modules) for the UN-affiliated Regional Centres. With a view to creating further awareness on the risks to the Earth and space environments implied by space debris, the legal aspects of the topic are one of the priorities in this context.

The outcome of these activities encouraged the ILA which, year after year, has advocated the inclusion of legal aspects of space debris on the agenda of the Legal Subcommittee of COPUOS. The matter had been brought up during the presentation made by the Space Law Committee to the Legal Subcommittee at its Forty-sixth session, 26 March–5 April 2007,[19] as well as in 2008 in the ILA Report to the Forty-seventh session of the Legal Subcommittee.[20]

Consequently, during 2007 the ILA directed its attention to the UN Scientific and Technical Subcommittee of COPUOS, particularly to the Guidelines on Space Debris Mitigation that had been adopted by that UN Subcommittee at the end of its forty-fourth session in February 2007.[21] As indicated in the subcommittee's report,[22] space debris mitigation measures can be divided into two broad categories, namely those that curtail the generation of potentially harmful space debris in the near term, and those that limit their generation over the long term. The former involves the curtailment of the production of mission-related space debris and the avoidance of break-ups. The latter concerns end-of-life procedures that remove decommissioned spacecraft and launch vehicle orbital stages from regions populated by operational spacecraft.

Briefly, the seven guidelines considered—and subsequently adopted—by the Scientific and Technical Subcommittee of COPUOS for the launch, mission and disposal phases of spacecraft and launch vehicle orbital stages were as follows:

- limit debris released during normal operations;
- minimize the potential for break-ups during operational phases;
- limit the probability of accidental collision in orbit;
- avoid intentional destruction and other harmful activities;
- minimize potential for post-mission break-ups resulting from stored energy;
- limit the long-term presence of spacecraft and launch vehicle orbital stages in the low Earth orbit region after the end of their mission; and
- limit the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit region after the end of their mission.

The fact that the guidelines reached the status of UN Guidelines on Space Debris Mitigation in 2007, plus the response given by a number of states concerning domestic measures taken in accordance with those guidelines, was a strong indication that the topic would be included on the agenda of the Legal Subcommittee of COPUOS in the near term.

This objective, towards which the International Law Association and its Space Law Committee have been concentrating since the early 1990s, is reflecting to a large extent the general opinion of the doctrine today.

STATE OF THE ART

The latest progress is reflected by the fact that the Legal Subcommittee of COPUOS at its forty-seventh session, 31 March–11 April 2008, included a proposal entitled “General exchange of information on national mechanisms relating to space debris mitigation measures” to be considered at its forty-eighth session in 2009 as a single item for discussion.[23]

ANNEX

Buenos Aires International Instrument on the Protection of the Environment from Damage Caused by Space Debris

Article 1: Definitions

For the purposes of this Instrument:

(a) "Contamination/pollution" means a human modification of the environment by the introduction of undesirable elements or by the undesirable use of those elements.

(b) "Contamination/pollution" will be considered as synonyms and are inclusive of all harmful elements other than space debris.

(c) "Space debris" means man-made objects in outer space, other than active or otherwise useful satellites, when no change can reasonably be expected in these conditions in the foreseeable future.

Space debris may result, *inter alia*, from:

Routine space operations including spent stages of rockets and space vehicles, and hardware released during normal manoeuvres.

Orbital explosions and satellite breakups, whether intentional or accidental.

Collision-generated debris.

Particles and other forms of pollution ejected, for example, by sol id rocket exhaust.

Abandoned satellites.

(d) "Environment", for the purposes of this Instrument, includes both the outer space and earth environments within or beyond national jurisdiction.

(e) "Damage" means loss of life, personal injury or other impairment of health, or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organisations, or any adverse modification of the environment of areas within or beyond national jurisdiction or control.

Article 2: Scope of Application

The instrument shall be applicable to space debris which causes or is likely to cause direct or indirect, instant or delayed damage to the environment, or to persons or objects.

Article 3: The General Obligation to Cooperate

1. States and international organisations parties to this Instrument shall cooperate directly, and/or through the pertinent international organisations, to protect the environment and implement this instrument effectively.

2. States and international organisations parties to this Instrument shall take all appropriate measures to prevent, reduce, and control any damage or significant risk arising from activities under their jurisdiction or control which are likely to produce debris.

Article 4: Obligations to Prevent, Inform, Consult, and Negotiate in Good Faith

States and international organisations parties to this Instrument have, in addition to the duties set forth in Article 3, the following obligations:

(a) To cooperate in the prevention of damage to the environment and make every effort to avoid situations that may lead to disputes.

(b) To cooperate, in accordance with their national laws and practices, in promoting the development and exchange of technology to prevent, reduce, and control space debris.

(c) To encourage and facilitate the flow and exchange of information of a scientific, technical, economic, legal, and commercial nature relevant to this instrument.

(d) To hold consultations when a State, group of States or international organisation parties to this instrument have reasons to believe that activities carried out under their jurisdiction or control, or planned to be carried out, produce space debris that is likely to cause damage to the environment, or to persons or objects, or significant risk thereto.

Any State or international organisation party to this Instrument may request to hold consultations when it has reasons to believe that the activity of another State or international organisation party to this Instrument produces space debris that is likely to cause damage to the environment.

Refusal to hold consultations, or the breaking up of such without justification, shall be interpreted as bad faith.

(e) To negotiate in good faith which means, *inter alia*, not only to hold consultations or talks but also to pursue them with a view of reaching a solution.

(f) To give special attention, when promoting these activities, to the needs of developing countries.

Article 5: Compatibility with Other Agreements

The rules laid down in this Instrument shall not be considered incompatible with the provisions of other international agreements concerning activities in outer space.

Article 6: Responsibility and Liability (general rule)

The rules laid down in this Instrument concerning responsibility and liability apply to damage caused by space debris in the space environment and, in the absence of other international agreements on the matter, to damage caused to the earth environment.

Article 7: International Responsibility

The State or international organisation, party to this Instrument, that launches or procures the launching of a space object shall bear international responsibility for assuring that national activities are carried out in conformity with the provisions of this Instrument, the 1967 Space Treaty, and the 1972 Liability Convention.

Article 8: International Liability

Each State or international organisation party to this Instrument that launches or procures the launching of a space object is internationally liable for damage arising therefrom to another State, persons or objects, or international organisation party to this Instrument as a consequence of space debris produced by any such object.

Article 9: Dispute Settlement

1. Disputes concerning the interpretation or application of this Instrument shall be subject to consultation at the request of any of the parties to the dispute with a view to reaching a prompt and amicable settlement.

2. Failing this, if the parties to the dispute have not agreed on a means of peaceful settlement within twelve months of the request for consultation, the dispute shall be referred, at the request of any party thereto, to arbitration or adjudication. In such case, the ILA Draft Convention on the Settlement of Space Law Disputes, which is appended as an Annex to this Instrument, shall be applicable, unless a party to this Instrument has excluded such application, in full or in part, by a declaration as provided in paragraph 3 of this Article.

3. Each Party to this Instrument, when signing, ratifying, accepting, approving or acceding thereto, or formally confirming its acceptance, or at any time thereafter, may declare that it chooses any of the non-binding or binding settlement procedures envisaged in the Annex to this Instrument, or that it excludes in part or in full the application of the Annex.

4. In these procedures it shall be possible, whenever appropriate, to prescribe interim measures binding on the parties in order to preserve rights or to prevent serious damage to the environment, or persons or objects. These measures shall be implemented by the parties without delay.

Article 10: Signature

1. This Instrument shall be open for signature by all States and international organisations at the United Nations Headquarters in New York. Any State or international organisation which does not sign this Instrument before its entry into force may accede to it at any time.

2. This Instrument shall be subject to ratification or formal confirmation by signatory States and international organisations. Instruments of ratification, instruments of accession and of formal confirmation shall be deposited with the Secretary-General of the United Nations.

3. The Secretary-General of the United Nations shall promptly inform all signatory and acceding States and international organisations of the date of each signature, the date of deposit of each instrument of ratification and of accession and the date of each formal confirmation of the present instrument, the date of its entry into force, and other notices.

Article 11: Entry into Force

1. This Instrument shall enter into force among States and international organisations which have deposited instruments of ratification or formal

confirmation thirty days after the deposit of the fifth instrument with the Secretary-General of the United Nations.

2. For States and international organisations whose instruments of ratification or accession, or of formal confirmation, are deposited subsequent to the entry into force of this Instrument, it shall enter into force on the date of the deposit of their instruments of ratification, accession, or formal confirmation.

Article 12: Amendments

Any party to this instrument may propose amendments to the Instrument. Amendments shall enter into force for each party to the Instrument accepting the amendment upon their acceptance by a majority of the parties to the Instrument and thereafter, for each remaining party to the Instrument, on the date of acceptance by it.

Article 13: Reservations

No reservations may be made to this Instrument except as provided in Article 9.

Article 14: Review Clause

Ten years after the entry into force of this Instrument the question of the review of the Instrument shall be included in the provisional agenda of the United Nations General Assembly in order to consider, in the light of past application of the Instrument, whether it requires revision. However, at any time after the Instrument has been in force for five years, the Secretary-General of the United Nations, as depositary, shall at the request of one third of the parties to the Instrument and with the concurrence of the majority of the parties, convene a conference of the parties to review the Instrument.

Article 15: Withdrawal

Any party to the Instrument may give notice of its withdrawal from the Instrument one year after its entry into force by written notification to the Secretary-General of the United Nations. Such withdrawal will take effect one year from the date of receipt of this notification.

Article 16: Authentic Text

The original of this Instrument, of which the Arabic, Chinese, English, French, Russian, and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations, who shall send certified copies thereof to all signatory and acceding States and international organisations.

In witness thereof, the undersigned, being duly authorised by their governments, have signed this Instrument, opened for signature at the United Nations Headquarters in New York, on...

Notes

1 General Assembly, *Information on the activities of international intergovernmental and non-governmental organizations relating to space law*, UN document A/AC.105/C.2/L.265, 16 January 2007, pp. 10–19; and General Assembly, *Information on the activities of international intergovernmental and non-governmental organizations relating to space law*, UN document A/AC.105/C.2/L.270, 25 January 2008, pp. 7–10.

2 General Assembly, *Principles relating to remote sensing of the Earth from space*, UN document A/RES/41/65, 3 December 1986.

3 See General Assembly, *Information on the activities of international intergovernmental and non-governmental organizations relating to space law*, UN document A/AC.105/C.2/L.265, 16 January 2007, pp.14–19.

4 General Assembly, *National research on space debris, safety of space objects with nuclear power sources on board and problems relating to their collision with space debris, Note by the secretariat*, UN document A/AC.105/918, 17 December 2007; and General Assembly, *National research on space debris, safety of space objects with nuclear power sources on board and problems relating to their collision with space debris, Note by the secretariat, Addendum*, UN document A/AC.105/918/Add.1, 10 January 2008.

5 General Assembly, *International cooperation in the peaceful uses of outer space*, UN document A/RES/62/217, 1 February 2008.

6 Article IV reads:

States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas. When astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle.

In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties.

States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts.

7 Conference on Disarmament, *Letter Dated 27 June 2002 from the Permanent Representative of the People's Republic of China and the Permanent Representative of the Russian Federation to the Conference on Disarmament Addressed to the Secretary-General of the Conference Transmitting the Chinese, English And Russian Texts of a Working Paper Entitled "Possible Elements for a Future International Legal Agreement on the Prevention of the Deployment of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects*, document CD/1679, 28 June 2002.

8 For example, the Institut de Droit de l'Espace of the Académie Internationale d'Astronautique is dedicating one of the working sessions of its forthcoming International Colloquium (Glasgow, September 2008) to the discussion of near-Earth objects from a legal viewpoint.

9 In 1969 Sir Francis Vallat, in those days head of the UK delegation to the Vienna Convention on the Law of Treaties, had already subjected this article to severe criticism considering that it did not manage to go beyond a loose duty of international cooperation. See "The Outer Space Treaties", *Journal of the Royal Aeronautical Society,* vol. 73, 1969, pp. 755 ff.

10 Lubos Perek, "Outer Space Treaty in Perspective", *Proceedings of the 40th Colloquium on the Law of Outer Space, American Institute of Aeronautics and Astronautics*, 1998, pp. 291–302. Also, Maureen Williams, "The Development of Article IX of the 1967 Space Treaty", ibid., pp. 177–84; and Maureen Williams, *El Riesgo Ambiental y su Regulación—Derecho Internacional y Comparado*, Abeledo-Perrot, 1998, chps. 1–5.

[11] See *Report of the Sixty-fifth Conference of the ILA*, Cairo, 1992, p.144. At this conference the pillars for an International Instrument on Space Debris were agreed, leading to the adoption, in 1994, of the "ILA International Instrument on the Protection of the Environment from Damage caused by Space Debris", at the Sixty-sixth Conference, Buenos Aires, 1993. This has been published in book format and may be requested from the International Law Association headquarters, <www.ila-hq.org>.

[12] For more details, see Maureen Williams, "International Instrument concerning the Protection of the Environment from Damage Caused by Space Activities (Third Draft)", *Report of the Sixty-Fifth ILA Conference*, Cairo, 1992, pp. 142–62.

[13] Principle XI of this Declaration speaks of a "general obligation to cooperate", this being one of the first times the principle of international cooperation—which used to appear in earlier international instruments as an expression of ideals—is seen as a general obligation.

[14] This draft was amended in 1998 at the Sixty-eighth ILA Conference and adopted as the 1998 Revised Draft Convention on the Settlement of Disputes related to Space Activities. See *ILA Report to its Sixty-eighth Conference*, resolution 5/98, p. 20.

[15] For further details and explanations of each of the articles of this ILA International Instrument, see Maureen Williams, "Report and Final Text of the International Instrument on the Protection of the Environment from Damage caused by Space Debris", *ILA Report to its Sixty-Sixth Conference*, Buenos Aires, 1994, pp. 305–25.

[16] Available at <www.unoosa.org/pdf/reports/ac105/AC105_720E.pdf>.

[17] The colloquium was held in Cologne on 16–19 May 1988 under the heading "Environmental Aspects of Activities in Outer Space—State of the Law and Measures of Protection". The papers were published in book format by Carl Heymanns Verlag in 1990.

[18] See the NGO Position Paper adopted in Vienna on 9 October 2007, available at <http://www.ngocongo.org/index.php?what=doc&id=1181>.

[19] General Assembly, *Information on the activities of international intergovernmental and non-governmental organizations relating to space law*, UN document A/AC.105/C.2/L.265, 16 January 2007, pp. 10–19.

[20] General Assembly, *Information on the activities of international intergovernmental and non-governmental organizations relating to*

space law, UN document A/AC.105/C.2/L.270, 25 January 2008, pp. 7–10.

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AN INTERNATIONAL CIVIL AVIATION ORGANIZATION FOR OUTER SPACE?

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The international space community has identified the rapid international commercialization of outer space, in particular in the fields of telecommunication, navigation and launch services, as an important and positive step toward the continual global and national economic growth. Recent interest and actions from the private sector in the field of commercial human spaceflight illustrates the widening range of financial commitments and business risks the private sector is willing to make in outer space. In addition, several government and business communities around the world are cooperating to help fund the building of commercial spaceports. Corporations, like Virgin Galactic and the European Aeronautic Defence and Space Company, have made firm commitments in pursuing a new suborbital space tourist market and shown interest for a possible extension to point-to-point international hypersonic travel. At the same time the Russian and US governments are promoting early steps toward commercial orbital human spaceflight. The Russians flew to the International Space Station the first paying orbital space tourist customer back in 2001 and have continued regularly to do so since then. In the meanwhile, the US National Aeronautics and Space Administration (NASA) launched an important initiative to procure commercial transportation services to the space station.

However, the Space Shuttle Columbia accident in 2003, a sequence of accidents on the ground, recently at a commercial spaceflight company in July 2007, and various spectacular launch failures demonstrated that the business of outer space is still fraught with risks not only for the crew on board and ground personnel, but also for the public on the ground, at sea or travelling by air. Furthermore the space and ground environments are at risk. Currently there are thousands of objects tracked in orbit, which are

* The opinions expressed here are those of the author and the International Association for the Advancement of Space Safety, and not necessarily those of the European Space Agency.

a potential direct threat to manned and unmanned orbiting space assets, and indirectly threaten the terrestrial safety of critical services. There are also important atmospheric effects from chemical rocket propulsion, and environmental impacts on the ground in case of launch failure. In September 2007 the explosion briefly after launch from Baikonur of a Russian Proton M rocket, which was carrying 200 metric tons of toxic fuel, has been reported to have caused contamination of a vast swath of land.

Though there is great promise about the further commercial potentials of outer space for the world economy, and the safety risks are very real and growing, there is no international cooperative effort to balance the multiple commercial interests in outer space with internationally agreed and nationally enforceable safety-risk mitigation standards. Because of this, the International Association for the Advancement of Space Safety (IAASS) Legal and Regulatory Committee established a working group called "An ICAO for Space?" , ICAO being the International Civil Aviation Organization, the existing UN organization for international civil aviation safety. The working group was composed of outstanding international experts in space safety and related fields. They were requested to answer two basic questions: a) if the international civil aviation cooperation represented by the ICAO is a valid model for a future civil/commercial international organization for outer space, and b) if there were a valid rationale for extending the scope of the current ICAO to include outer space, as at national level the United States did by creating their space transportation office within the Federal Aviation Administration. The working group has produced a white book for public distribution about the stakes involved and the merits of an international civil space regulatory framework. The white book discusses the various legal and regulatory treaties, organizations and standards that currently impact commercial space safety. It notes that the International Standards Organization (ISO) is the only international body that has attempted so far to develop space safety standards for global use. They are in any case unstructured, sparse, generic and not endorsed by national space regulatory bodies. Because the ISO mission is to develop industrial standards to facilitate international commerce and not safety regulations, all its past and present efforts in the field of safety are doomed to be neglected (as currently the case for the ISO standards for toy safety). Furthermore ISO standards are meant for voluntary use thus defeating the key purpose of achieving an even level of risk worldwide while preventing unfair competition due to the use of national substandard safety practices. However, some national and multinational space bodies have developed their own space safety standards, which are the natural reference for any international harmonization effort. In addition few countries actually formally regulate commercial space activities. The US Federal Aviation Administration Office of Commercial Space Transportation is one example, and also the most advanced.

Examining international regulatory organizations from analogous industries can give us important insight into how such an international space safety regulatory framework might look. For example, the International Telecommunications Union regulates radio broadcasts. The telecommunication industry found that an international body that can control and manage the broadcast spectrum was necessary to help the industry grow in a sustainable way. Important search and rescue frequencies are reserved to ensure that they are not negatively impacted by telecommunications spectrum use and growth. The International Maritime Organization is another example. Again, to support an orderly growth of international maritime people, goods and services, it was paramount to determine international safety regulations. The United Nation's definition of national and international waters and boundaries was critical to solving very difficult "state's rights" issues. Probably the best analogy is the ICAO, which was created toward the end of the Second World War. States quickly realized that a commercial civil aviation industry could not achieve and maintain sustainable growth without an international regulatory framework to ensure that civil aircraft could take off, fly and land safely anywhere in the world. Common international safety standards have made civil aviation one of the most successful and safe transportation modes. For this reason, and also because there is a wide commonality of interests, first of all the sharing of crowded airspace, the IAASS white book focuses particular attention on ICAO as a model for a future international commercial space safety regulatory body.

Review of the variety and interrelationship of safety risks that space organizations are facing is important to fully comprehend the scope of the challenge of creating an international space safety regulatory framework. Launch and ground-processing hazards are real and impact those communities contiguous to the launch range. Orbital and suborbital flights face safety risks such as avoiding orbital debris, spacecraft traffic management and accidents in outer space that impact other spacecraft. There are additional risks from spacecraft re-entering the atmosphere and landing.

SPACE LAW: MANY PRINCIPLES, NO RULES

United Nations space treaties

The following four United Nations international treaties and agreements apply to space activities:

- the Treaty on Principles Governing the Activities of States in the exploration and Use of Outer Space, including the Moon and other celestial Bodies (the Outer Space Treaty, 1967);
- the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the Astronaut Treaty, 1968);
- the Convention on International Liability for Damage Caused by Space Objects (the Liability Convention, 1972); and
- the Convention on Registration of Objects Launched into Outer Space (the Registration Convention, 1976).

The space treaties provide generic principles but no implementing rules. They were produced at a time in which the United States and the Soviet Union, locked in the Cold War atmosphere, had a monopoly on space activities with little presence of the private and commercial sector. The space treaties were therefore conceived for the purpose of defining the overall limits applicable to each state's space activities and not to facilitate and promote commercial and civil international cooperation. During the negotiation of the Outer Space Treaty, the Soviet Union even proposed a text which would have prohibited private activities in outer space. The negotiation on this point eventually lead to a compromise which represents a fundamental difference in space law with reference to both maritime and air law, and which makes states both "responsible" and "liable" for the space activities of their nationals (persons, companies and so forth), while for commercial ships and planes states exercise a supervisory role (responsibility) but do not bear financial risk (liability).

It should be noted that Article IX of the Outer Space Treaty does require safety cooperation in the form of consultation in case of international risk of space activities, but such consultation consists basically in participating to few specialized committees of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), which issues only generic guidelines, if any. After two decades of debate COPUOS has been even unable to agree where to lay the legal border between airspace and outer space.

COPUOS

COPUOS was established in 1959 by the UN General Assembly with the wide mandate of reviewing the scope of international cooperation in the peaceful uses of outer space. COPUOS and its subcommittees work on the basis of consensus and make recommendations to the General Assembly for endorsing resolutions.

With reference to space safety issues, in 1980 COPUOS established a Working Group on the Use of Nuclear Power Sources in Outer Space which took more than a decade to produce a set of guiding principles, which were endorsed by the General Assembly in December 1992. Although the Working Group is still in place, nothing more than the original principles has been produced to date.

Another safety-related area in which COPUOS operates is that of space debris mitigation. After publishing its Technical Report on Space Debris in 1999, COPUOS mandated in 2001 the Inter-Agency Space Debris Coordination Committee (IADC) to develop guidelines regarding space debris mitigation techniques. Subsequently, the Scientific and Technical Subcommittee established the Working Group on Space Debris with the mission to develop a set of recommended principles based on the technical content of the IADC space debris mitigation guidelines. A revised draft of these guidelines was submitted by the Scientific and Technical Subcommittee of COPUOS during its forty-third session in 2006 and was endorsed in 2007 by the General Assembly. The guidelines are not legally binding under international law and it is also recognized that exceptions to the implementation of individual guidelines or elements may be justified. The relative value of UN guidelines was spectacularly underlined by the destruction of one satellite in 2007 and one in 2008, events which created a massive and hazardous amount of new orbital debris.

THE NEW SPACE AGE

The emerging trend for the twenty-first century is that of a global space industry involving, along with the traditional space powers, a multiplicity of government and corporate stakeholders worldwide. A mixture of factors ushered in this new space age. The worldwide spread of (dual-use) space technologies and services, global economic trends, but also the dramatic socio-economic and political changes that followed the end of the Cold War, the collapse of the Soviet Union and the abandonment of the communist economic orthodoxy by China. Finally the Space Shuttle Columbia accident in 2003 precipitated an overhaul of US space policy, first as a redirection of NASA toward exploration missions, and later in October 2006 with the enunciation of a new overall US civil, commercial and (in particular) military space policy. This policy made overnight the previous concept of "outer space" obsolete or at least pushed it somehow beyond the geostationary orbits, while a sort of "near space" has taken shape which a nation has the right to exploit for its own interest and no more as an ambassador of mankind for the benefit of all. The new US space policy is not revolutionary but it is just a factual picture of what outer space has become. Commercial and military space-based systems are nowadays synergetic with systems on Earth and indeed essential to human activities. Military and civil/commercial space operations need therefore to be clearly separated and their coexistence (in time of peace) adequately managed. In other words outer space has become as sea and air—another realm where it is in the interest of the global community to operate in accordance with clear international rules instead of vague principles. Not only orbital usage and telecommunication frequencies allocations, but also space traffic control, safety risk and a number of support services such as space weather forecasting and orbital debris monitoring need to be coordinated transparently and effectively at the national and international levels. The fallacy and limits of the current approach based on voluntarism and good intentions is becoming apparent, as clearly demonstrated by the vain attempts to limit the proliferation of space debris, a major threat to spacecraft and the primary source of risk for human spaceflight.

Widening access to outer space and its economic significance

By the end of the 1990s the extent and importance of the commercial space revolution and the merging of several technologies was already very clear as outlined in the following excerpts from testimony in March 1999 from Keith Calhoun-Senghor, then Director of the Office of Space Commercialisation, US Department of Commerce, before the House Subcommittee on Space and Aeronautics:

> This revolution is increasingly blurring the traditional distinction between things military and commercial, between things private and governmental, and things domestic and international. We are dealing with a new set of historical conditions, many of them unprecedented. Therefore, we must resist the temptation to apply models or adopt solutions that were more appropriate to the past, or to entirely different historical or economic circumstances without first understanding the implications for the future. … This New Space Age or era of "New Space" differs dramatically from the era we have just left in significant ways. First, it is increasingly privately funded and commercial in nature. Second, it will be predominantly international, blurring the once clear lines between what is "ours" and what is "theirs".

Already in 2000 the commercial worldwide satellite industry was generating revenues several times in excess of global military space expenditures. In 2003 China became the third world power, after Russia and the United States, with the capability of sending humans into outer space. India has announced plans to initiate a human spaceflight programme leading to a first mission in 2014 and landing on the Moon in 2020.

Also the number of actors with unmanned orbital launch capability continues to grow and now includes 10 states plus international operators such as Sea Launch and International Launch Services. A further 18 states have acquired suborbital flight capabilities (from Argentina to Syria). In February 2007 Iran launched its first suborbital flight. Iran and North Korea maintain long-range military missile programmes that could enable them to develop an orbital launch capability. As of 2007 about 50 states had accessed outer space, either with their own launchers or those of other states, and have assets in orbit. This number is expected to continue to grow rapidly. Finally in the first years of the twenty-first century commercial space has started taking the first (but epochal) steps in the ultimate frontier of personal spaceflight.

SAFETY RISK OF SPACE MISSIONS

The space industry is expanding rapidly worldwide and with it the safety risk is increasing even faster because of poor attention, lack of widespread knowledge in the field of risk control techniques, cumulative effects and weak or non-existent international rules. Eventually the prospect for industry growth will be badly hurt if the necessary course of corrective actions is not undertaken in the short term. In other words the technical progress in acquiring space access and use capabilities does not necessarily go hand-in-hand with safety awareness and management.

Accidents

Safety risk in space missions refers to the general public safety (on the ground, in air and at sea), the safety of launch range personnel and the safety of humans on-board. Space safety is also generally defined in a wider sense as encompassing the safeguard of valuable facilities on the ground (for example launch pads), of strategic and costly systems in orbit (such as space stations and global utilities) as well as the safeguard of the space and Earth environments.

Up to now, all space accidents in space programmes with human casualties happened either on the ground or during re-entry, with the one exception being the Shuttle Challenger in 1986, which exploded in the early ascent phase. As of today there have been nearly 200 people killed by rocket explosions during ground processing, testing, launch preparations and launch. The figure is only approximate due to discrepancies between some official accounts and media sources. In the last 10 years there have been also at least six launches that have been terminated by explosion commanded by the launch-range safety officer to prevent risk to the public. There were also several more cases of launchers that did not make orbit and crashed back to Earth. It should be noted that the ground safety record is not uniform worldwide. Europe has a spotless record, and also the United States except for the accident in July 2007 at Scaled Composites, a leading private spaceflight industry, with three killed and three seriously injured, and the spectacular explosion of a rocket fuel plant in May 1988 at Henderson, Nevada. The explosion claimed two lives, injured 372 people and caused damage estimated at over US$ 100 million over a large portion of the Las Vegas metropolitan area. Seismographs in California measured the event at 3.5 on the Richter scale. Of the 200 killed on the ground since the beginning of the space age, 35 casualties were counted just at the beginning of this century. First the blast in August 2001 at the Russian Space Agency fuel production plant in Omsk, which killed four, then the explosion in October 2002 of a Russian Soyuz which killed a young soldier and just by luck did not involve members of a large international support team that was on site. Then there was the explosion in August 2003 of the Brazilian VLS-1 rocket at Alcantara Launch Range which claimed 21 lives, and the accident at the Indian solid-rocket processing facility in Sriharikota in February 2004 with six people killed. Finally, there was the terrible accident mentioned above at Scaled Composites.

A total of 22 astronauts have lost their lives since the beginning of human spaceflight. The first was the Soviet cosmonaut trainee V. Bondarenko in March 1961 who died in a pressure chamber fire during training. Three US astronauts were also killed by a fire during training in January 1967 inside an Apollo capsule. The re-entry accidents are three in total: Soyuz 1 in April 1967, Soyuz 11 in June 1971, and the Columbia in February 2003. In the latter case, in addition to the loss of the crew, the public on the ground and passengers travelling by air, within the continental-wide curtain of falling debris, were subjected to an unprecedented level of safety risk.

International safety risk

In a different category are the environmental accidents such as failures leading to the dispersal of radioactive material. As of today there have been 10 such cases, including the plutonium on board the Apollo 13 lunar module jettisoned at re-entry, which ended up in the Pacific Ocean close to the coast of New Zealand, or the 68lbs of uranium-235 from the Russian Cosmos 954 which were spread over Canada's north-west territories in 1978. The most recent accident of this kind was in 1996, when the Russian MARS96 disintegrated over Chile releasing its plutonium, which has never been found.

Finally there is the risk represented by orbital debris, including those 200 "dead" spacecraft abandoned in valuable geostationary orbits, and the risk of uncontrolled spacecraft re-entry. Of the 12,500 identified objects larger than 10cm, 40% are satellites no longer in operation and spent rocket upper stages, and the rest are fragments and other objects. There are then at least 300,000 objects between 1cm and 10cm, and possibly several million below 1cm. Some of this material will remain in Earth orbit for hundreds or thousands of years and constitutes a potential catastrophic hazard for operational spacecraft because of the high relative velocities at impact. Currently the debris hazard is partially controlled by manoeuvres for debris large enough to be above the detection threshold. Shielding is also used on manned spacecraft to (partially) protect those in the habitable modules. Debris impacts on the Space Shuttle are counted on every mission and samples of residual materials are routinely recovered from the thermal protection for examination. The second largest hit ever experienced by the Space Shuttle was the perforation of a thermal radiator which happened during the STS-115 mission in September 2006. It did not cause any major problem to the orbiter, but could have killed instantly an astronaut performing an extra-vehicular activity during that mission.

To reduce the space debris risk, satellites should be disposed of at the end of their operational life by either de-orbiting (those in low orbits) or moving to "graveyard" orbits (those in geostationary orbits). De-orbiting space hardware means also the possibility of debris surviving re-entry and causing casualties on ground. Here it is not so much a matter of trading one hazard for another because natural de-orbiting in any case would take place in due time because of the physics of the residual atmosphere in low Earth orbit. Currently there are no means to remove the re-entry risk but only guidelines to move it in the timeframe (the well-known 25-year rule). Instead the use of "graveyard" orbits is quite a dilemma for commercial operators. In fact they support the common good at the loss of substantial profits (by using the remaining fuel for spacecraft disposal and not for commercial operations), while there is no national or international legal obligation to do so. Even accounting for the self-interest of commercial companies in protecting their operational orbital environment, there is a substantial percentage of satellites that cannot be moved to graveyard orbits with their own means because of failures or malfunctions. Although nowadays the technological capability exists to develop "space tug" systems (for example the HERMES project of GEO Ring) to come to the aid of spacecraft in distress, the lack of legal obligations for the operator to remove an inactive spacecraft does not allow such services to become established and economically viable.

The limits and failure of the "voluntarism" approach, instead of binding regulations, was spectacularly demonstrated by the January 2007 destruction of an orbiting Chinese satellite by a medium-range missile, resulting in the creation of a debris cloud. This was the second-ranking fragmentation event in space history, and probably the most severe one concerning the damage potential of the fragments. The debris has caused an increase of collision risk for many satellites. For example, the collision risk for the International Space Station (ISS) increased by nearly 60% for fragment sizes bigger than 1cm, which is above the shielding capability of the ISS and below the threshold for detection in order to initiate anti-collision manoeuvres.

Finally, launch and re-entry operations are very much international in nature. Typically, launch support personnel are confined to an area about the launch point within the territorial domain of the launching state. As launch vehicles proceed downrange, they typically leave the territorial domain of the launching nation and begin to overfly international waters and the territory of other nations. As a matter of fact the risk to the overflown population is managed by the launch state based on their national space safety standards, which may well differ from those of the foreign populations at risk. Furthermore it should be noted that current practice is for each range to manage risks on a mission-by-mission basis. Minimal attention is addressed to annual risks generated by the range's launch operations. There is no agency—national or international—that monitors and controls risk imparted to overflown populations. An area may be placed at risk by launches from multiple launch sites without the launching states performing any coordinated calculations to assure the levels are tolerable and indeed accepted by the states at risk. With reference to re-entry risk, most rocket upper stages, and all satellites operating in low Earth orbit, except the cargo spacecraft servicing the ISS, are destined sooner or later to re-enter uncontrolled into the atmosphere thus creating a risk anywhere for the general public. In February 2008, US President Bush ordered the destruction of a malfunctioning national intelligence satellite. The reported reason was to prevent the potential danger to populations on the ground from the spacecraft's half ton of hydrazine, a highly toxic propellant.

PROPOSED PRINCIPLES FOR NEW REGULATIONS

The ever increasing number of international actors involved in civil and commercial launch and re-entry activities, the envisaged expansion of human access to outer space for tourism and point-to-point hypersonic travel, the increase in the use of nuclear power systems in support of civil exploration programmes and the placement in orbit of global utilities raise the central question of how to ensure the public and space passengers and crew safety as well as the integrity of other valuable unmanned assets in orbit. It comes as logical consequence the necessity to develop a harmonized framework of international rules, which would include in particular uniform safety certification practices for ground and flight systems, personnel, activities, as well as the establishment of the means to control space traffic to prevent interferences with air traffic and orbital operations. We should also further consider that currently there is little (commercial) interest for the region of outer space beyond the geostationary orbits, while there are substantial strategic interests (civil/commercial and military) for the region up to and including the geostationary orbits, the so-called “near space” region. It is therefore proposed that a new civil/commercial international regulatory framework be established for that region for the purpose of achieving the following ultimate goals:

- ensure that citizens of all nations are equally protected from the risks posed by launching, overflying, and re-entering/returning of space systems;
- ensure that all space systems are designed, developed, built and operated in accordance with common minimum ground and flight safety rules, procedures and standards based on the status of knowledge and the accumulated experience of all spacefaring nations;
- establish international traffic control rules and management for launch, on-orbit and re-entry operations to prevent collisions or interference with other space systems and with air traffic and air navigation systems;
- ensure the protection of the ground, air and on-orbit environments from chemical, radioactive and debris contamination related to space operations;
- ban intentional destruction of any on-orbit space system or other harmful activities that pose safety and environmental risks; and
- ensure that mutual aid provisions for emergencies involving space safety are progressively agreed, developed, implemented and made accessible without discrimination or restriction anywhere on the Earth and in outer space.

The establishment of an international civil/commercial space regulatory framework is sometimes perceived as a potential threat to national sovereignty. As a matter of fact it would instead have far reaching beneficial consequences in removing obstacles to the international space trade, as well as meeting the growing demand of military commands for the transparent and accountable use of outer space by civil and commercial operators. An international regulatory framework is not only needed to ensure that citizens of all nations are equally protected from “unacceptable levels” of risk from space missions, but also to ease the barriers that different national safety regulations may create to international space commerce, to prevent distortion of the commercial competition due to substandard safety practices, and to allow for mutual assistance and rescue in case of need. Some examples of such benefits are as follows.

Commercial payloads safety requirements

Commercial launch sites tend nowadays to be quite international by hosting large foreign teams during (foreign) spacecraft preparation for launch. As a first step, the harmonization of launch range safety requirement for payloads would:

- develop and propagate a common safety culture in the specific field;
- allow spacecraft developers to design their systems according to a single set of safety requirements, no matter which launch vehicle and site is later used; and
- exclude safety programme costs from the commercial competition equation.

In perspective, uniform safety technical requirements would allow a regime of mutual recognition of safety certificates which may be granted by a national safety authority for international use, as is already the case in many comparable fields (aviation, for example). Such an approach would allow a further enhancement of overall system safety by not limiting the safety certification to the safety design aspects as is currently the case, but including all elements of independent quality assurance surveillance of the actual manufacturing and testing by the national space authority.

Space tourism

In the field of space tourism there are currently about 26 different concepts and vehicles under development, mainly in the United States, but also in Canada, Russia and Europe. Spaceports dedicated to suborbital flights are being established in Malaysia, Scotland, Singapore, Sweden and the United Arab Emirates. Several civil aviation authorities have initiated their own studies on possible regulatory frameworks. The SpaceShipTwo vehicles being built by the US company Scaled Composites will be owned and operated by the UK company Virgin Galactic. This is similar to the Canadian Arrow, to be operated by the US Company PlanetSpace.

Because of such cross border relationships, complicated legal and regulatory issues arise. For example, as SpaceShipTwo is classified as rocket, Virgin Galactic had to obtain technical assistance agreements under US armament technology transfer rules to work and exchange data with Scaled Composites. Because of the Outer Space Treaty clauses, the vehicle has to be certified by UK space authorities and by those of each state, legally "launch state" (therefore also responsible and liable), in which the vehicle would be operated. A coordination and indeed harmonization of the national spaceflight certification regulations becomes therefore unavoidable to make space tourism a worldwide industry.

ICAO AS A MODEL

What is the ICAO?

In 1910, just a few years after the first uncertain "jump" into the air of the Wright brothers, the first important conference on an international air law code was convened in Paris. The treatment of aviation matters was a subject at the Paris Peace Conference of 1919 and it was entrusted to a special Aeronautical Commission. Later, an International Air Convention was established which brought about the creation of an International Commission for Air Navigation in 1922. A small permanent secretariat was located in Paris to assist the commission in its tasks of monitoring the developments in civil aviation and to propose measures to states to keep abreast of developments.

In consideration of the great advancements being made in the technical and operational possibilities of air transport during the Second World War, the United States initiated in 1943 studies of post-war civil aviation. The studies confirmed, once more, the belief that civil aviation had to be organized on an international scale or it would not be possible to use it as one of the key elements for driving the economic development of the post-war world. The US government therefore extended an invitation to 55 states to attend in November 1944 an International Civil Aviation Conference in Chicago, which culminated with the signature on 7 December 1944 of the Convention on International Civil Aviation.

The 96 articles of the convention established the privileges and restrictions of all contracting states and provided for the adoption of international standards and recommended practices to secure the highest possible degree of uniformity in regulations and standards, procedures and organization regarding civil aviation matters. The convention set up the permanent

International Civil Aviation Organization. In October of 1947 ICAO became a specialized agency of the United Nations.

International airspace and space operations

Uninhabited areas such as oceans and seas are very important for the safety of space launch and re-entry operations. Major spaceports and launch sites are usually located close to the ocean coastline for the obvious safety reason of launches quickly clearing inhabited areas. In some cases launches even take place directly from modified, self-propelled, ocean platforms to provide for the most direct route to orbit and maximum lift capacity. Spacecraft re-entry trajectories are selected as much as possible with similar criteria, and all controlled destructive re-entries are directed toward oceans.

Because the nationality of airspace is determined by a state's landmass and waters, the large majority of space-bound traffic takes place through international airspace under ICAO jurisdiction. More precisely, states are sovereign in their "territorial sea" which extends a mere 12 nautical miles from the coast. There are then the so-called "contiguous zones", which states have the right to control to prevent infringements of their customs, fiscal, immigration and sanitary laws, which are set at 24 nautical miles. Finally the "exclusive economic zones" are defined as extending up to 200 nautical miles, where a state controls natural resources of the water and seabed. Beyond that line the "high seas" begin. States are sovereign in their airspace which is defined as the atmospheric zone directly above their landmass and territorial sea, all the remaining worldwide airspace is international. The civil aviation convention of 1944 placed such international airspace under the authority of ICAO.

Responsibility for the provisions of air traffic control services in this airspace is delegated by ICAO to various states, based generally upon geographic proximity and the availability of the required resources. Currently the oceanic air traffic control system is procedurally based, relying heavily on filed flight plan data. There is no radar coverage over the ocean. Pilots must report their positions verbally or have them automatically sent through a relay station. The infrequency of position reports, coupled with limitations in navigational accuracy and communications, have resulted in the large separation standards between aircraft. As aviation and space traffic continue to grow, ICAO has an increasing primary responsibility and duty for promoting innovative strategies to ensure the safety of the "integrated" air and space traffic in the international airspace, which is where those traffics mostly interact.

Air and space traffic control integration

Today's air traffic management system for civil aviation is still not much different from that of the 1960s. It is still fundamentally based on radar tracking, reliance on analogue voice radio and the guidance of air traffic controllers. In the future civil aviation will make use of space-based systems for traffic management, approach and landing. Such systems are currently under development and make use of a Global Navigation Satellite System (GNSS) such as the US Global Positioning System, plus various precision augmentation systems and position broadcasting capabilities. The improved navigation accuracy in the cockpit will allow further applications such as the Automatic Dependent Surveillance system. This system will truly be revolutionary for air traffic control by allowing aircraft to automatically broadcast their position to various receivers on other aircraft and on the ground.

Also in the case of rocket launches there is a forthcoming transition from ground-based radar to GNSS applications. One of the most important safety responsibilities of a launch-range safety officer is to monitor the track of launch vehicles during flight and, in case of malfunction and risk to the public, to terminate the flight. The method used for flight termination depends on the vehicle, the stage of flight and other circumstances of the failure. Propulsion is terminated and, in addition, the vehicle may be destroyed by on-board explosive charges to disperse propellants before surface impact, or it may be kept intact to minimize the dispersion of solid debris. Flight termination can also be initiated automatically by a break-wire or lanyard pull on the vehicle if there is premature stage separation. It can be expected that for hybrid manned vehicles (aero-spacecraft) there will be a preference not to include a flight termination system by explosive charges, but to rely on flight control redundancies as in traditional aircraft. In such cases the vehicles will make use, for navigation and traffic control purposes, of the same GNSS systems in use for aviation. Furthermore in the near future a number of critical aviation systems, from traffic control to high-resolution weather forecasts and digital aviation communications, will be based in near space, which extends up to and including geostationary orbits. This means that aviation safety will very much depend on the integrity and reliability of space-based systems and services.

In summary, air-traffic management and space-bound traffic management are highly interdependent, and both will be very much dependent in the future on space-based systems. Because orbital traffic management (to avoid collisions and interferences) is essential to ensure the integrity of space-based systems, integrated air and space traffic management is essential for ensuring aviation safety and public safety. Assigning the international coordination and control of near-space traffic management to ICAO, instead of a separate international space organization, would bring about obvious advantages in terms of synergy and efficiency.

Integration of aviation and space infrastructures and services

Similarly to traffic management integration, the trend to operate aero-spacecraft for space tourism from dual-use ground infrastructure (airport/spaceport), requires a well-integrated international regulatory framework both for flightworthiness certification and ground operations, which a single organization (the ICAO) could better achieve than separate international space and aviation organizations. Such integration would become unavoidable as soon as the space tourism industry starts offering point-to-point international flights (via outer space).

There are then further areas of integration and common interest. While it is well known that terrestrial weather forecasts are essential also for space system safety during launch and re-entry operations, only recently has the aviation community become interested and indeed concerned about dissemination of space weather forecasts, and planning of related operational responses.

Space weather is a collective term for radiation from a number of varying conditions on the Sun plus cosmic rays, which have potential serious effects on electronic systems and on human beings.

As airline cross-polar traffic (above 78º N) increases, the aviation industry is becoming concerned about a number of safety-related issues such as disruption in high-frequency communications, navigation system errors, the risk of failure of avionics and radiation hazards for crews. The same concern exists for high-altitude flights above 50º N (for example space tourism). The aviation and space weather communities are already soliciting ICAO to take the lead in coordinating international rules on space weather forecast dissemination and uniform risk mitigation responses.

CONCLUSIONS

A global civil/commercial space industry is emerging involving the traditional space powers with a multiplicity of government and corporate stakeholders worldwide. Today space activities are still too driven by national mission objectives while international interdependence and the global interest of safety tend to be overlooked. It is commonly believed in the private spaceflight industry that safety regulations are potentially detrimental to its development because of related costs. Such a misconception is quite singular. In fact there is no commercial industry in which safety risk is treated as secondary to commercial goals, costs or profits. Civil aviation, nuclear and pharmaceutical industry—even the toy industry—are examples of a deeply rooted safety culture being prerequisite for success and expansion. The idea that the pollution of the space environment by orbital debris can be controlled on a voluntary basis, and that the current safety risk of space projects cannot be substantially improved otherwise there would no space industry, is obsolete, faulty and may end up negating access to outer space for future generations. Furthermore because the safety risk of space operations is predominantly international in nature it should be no longer treated according to "local" policies.

As critical services for aviation safety move to outer space, space traffic through the international airspace increases, hybrid aero-spacecraft are developed, and aviation and space ground infrastructures and services are merged, the case for an integrated international civil aviation and space regulatory framework becomes clear. In this respect an international civil space regulatory branch within ICAO would fulfil at the international level the same role currently performed within the US Federal Aviation Administration by its space branch.

Near space, the region of outer space that extends up to and includes geostationary orbits, is nowadays a strategic asset of international interest comparable to the high seas and international airspace. The current international space treaties are insufficient to address near-space global safety and traffic management issues. It is time for a new air and space international convention.

LONG-TERM SUSTAINABILITY OF SPACE ACTIVITIES

Gérard Brachet

INTRODUCTION*

For 50 years, space systems have contributed enormously to maintaining peace and economic development.

First and foremost, they contributed greatly to stabilizing the political situation between the two major nuclear powers during the Cold War, thanks to early warning and reconnaissance satellites. Since the end of the Cold War, space systems dedicated to security have been deployed by several states besides the two superpowers, thus contributing to an increase of transparency and a more secure world.

The contribution of satellite systems to the modern information society as we know it today has also been significant, if only because satellite communication and broadcasting abolish borders and open access to global news and content. Satellites also came to play the major role in establishing a global positioning and navigation systems, which have gradually replaced most, if not all, ground-based navigation and positioning infrastructures.

Similarly, Earth satellites and deep-space probes allowed a quantum leap in our ability to peer through the history of the universe and of the solar system, including a major contribution to a better understanding of the mechanisms affecting our own planet, whether its atmosphere, its oceans and land masses—its biosphere.

Space systems and the services derived from them have become an indispensable factor in development programmes in many less advanced regions of the world, whether to facilitate educational programmes and health services, improve food security and water resource or forestry management, and so forth. In a more long-term vision, space-based systems

* The views expressed here are the personal views of the author and do not necessarily reflect the views of the UN COPUOS, nor of the UN Secretariat.

could play a role in lowering our dependency on fossil fuels for energy generation, whether by collecting and redirecting solar energy to the Earth's surface or by helping us getting rid of long-lived nuclear waste.

IS LONG-TERM USE OF OUTER SPACE SUSTAINABLE?

However, our ability to continue to use outer space in the long term is not guaranteed: one is indeed faced with two factors which may hinder the long-term, sustainable use of outer space:

- There is a significant increase in the number of government and private space operators;
  - At the present time, there are eight states who operate launching systems (launch base and launcher),[1] and South Korea might join this very select club during the course of the year;
  - Beyond the few states mastering the capability to launch satellites into outer space, there are more than 50 states and regional organizations that operate satellites in orbit;
  - In parallel, a rapidly increasing number of both large and small private companies operate commercial satellite systems; and
- This increasing number of actors in outer space will to continue to grow over the years and will inevitably lead to a continuous increase of the number of objects orbiting the Earth.

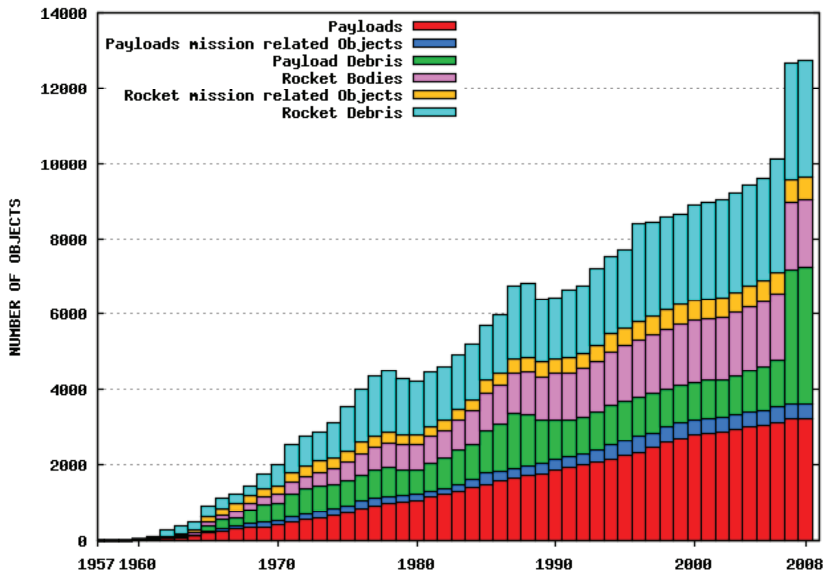
Let us review some numbers which reflect the first half-century of space activities:

There were 4,547 recorded launches of spacecraft from 4 October 1957 (the date of the launch of Sputnik 1) to the end of 2007. Today (the beginning of 2008), there are 660 operational satellites in orbit and 12,500 identified objects larger than about 10cm (that is, tracked by the US Space Surveillance Network), of which 40% are satellites no longer in operation or spent rocket upper stages and 55% are fragments and other objects. In addition, there are at least 300,000 objects between 1cm and 10cm and it is estimated that there are several million objects below 1cm.

Chart 1, taken from a presentation by Heiner Klinkrad of the European Space Agency to the Scientific and Technical Subcommittee of the UN Committee for the Peaceful Uses of Outer Space (COPUOS) in February

2008, illustrates the increasing number of catalogued space objects from 1957 to the end of 2007, most of them space debris. Note in particular the significant increase of payload debris in 2007, which for the most part resulted from the voluntary destruction and break-up of the Chinese satellite Fengyun-1C by a Chinese ballistic missile on 11 January 2007.

Chart 1. The number of space objects catalogued by the US Space Surveillance Network during each six-month period from October 1957 to January 2008



The figures above and the long-term trend of catalogued space objects in orbit shown in Chart 1 illustrates how the proliferation of space debris is a real concern for the future utilization of outer space. Although the actual deployment of weapons in outer space has not happened, ground-based weapons can be used against low-Earth-orbit spacecraft and aggravate the situation. If such weapons were activated in a conflict situation, the huge amount of space debris that they would generate and the feeling of insecurity that it would create would jeopardize the future use of near-Earth outer space.

In other word, space security is fragile and not guaranteed, particularly if one takes a long-term view.

It is therefore clear that maintaining safe and secure access to outer space will require a lot more attention. It will become necessary to develop rules of behaviour and instil a higher degree of discipline in all actors to be able to manage orbital traffic, orbital positions and facilitate space operations.

SOME REASONS TO BE OPTIMISTIC

Space security is not guaranteed but there are some reasons to believe that there are ways to improve the safe and secure use of outer space. First of all, the excellent work done over the last 10 years on the space debris issue by the Inter-Agency Space Debris Coordination Committee (IADC), which gathers 10 major space agencies,[2] and the unanimous adoption in 2007 by the 67 member states of COPUOS of the UN Space Debris Mitigation Guidelines,[3] which were later endorsed by the UN General Assembly,[4] provide a good model of how the international community can make some progress towards a regime of sustainable space operations.

Based on the model of the work on space debris mitigation, and as a follow-up to an idea that I first proposed at the George Washington University/Space Policy Institute workshop on space security held in Paris in May 2006,[5] I proposed to the COPUOS delegations in June 2007[6] that they should tackle the issue of long-term sustainability of space activities with a bottom-up approach comparable to the space debris mitigations guidelines. COPUOS has not yet taken a formal decision on this proposal but delegations are gradually becoming more conscious of the need to address this issue.

A FIRST STEP TOWARDS THE LONG-TERM SUSTAINABLE USE OF OUTER SPACE

However, without waiting for a formal decision by COPUOS, which will require the unanimous consent of 67 delegations, a first implementation step took place recently at the initiative of France. On 7–8 February 2008, France hosted in Paris an informal working meeting of spacefaring nations to address the topic of long-term sustainability of space activities. The purpose of this informal meeting was to discuss the possibility of setting up an ad hoc working group to develop information exchange mechanisms and consensus-based rules of behaviour which would contribute to a safer and more secure space environment.

Participation at the meeting reflected a widely shared interest by many delegations: there were representatives from 20 countries, including all the major spacefaring nations and some developing countries, as well as from the European Space Agency and the European Union; there were observers from the UN Office for Outer Space Affairs, the International Space Environment Service and the World Meteorological Organization; and commercial telecommunication satellite operators (Intelsat, Eutelsat and SES) were invited to participate in the second day of the meeting and share their views with the government and international organization representatives.

The informal working group meeting heard detailed presentations on the work of the IADC and on the long-term outlook for space debris. It also noted the need for establishing a mechanism to facilitate and ensure safe operations in the geosynchronous orbits and took note of the initiatives already taken in this area by commercial telecommunication satellite operators.

In the area of space weather, the informal working group also noted the mechanism set up by the International Space Environment Service to collect and distribute timely information and forecasts on solar activity, flares and coronal mass ejections.

The main conclusions of the meeting and plans to move forward can be summarized as follows:

- long-term sustainability of space activities is an issue that needs to be addressed by all nations interested in the future utilization of outer space. It is essential to brief the delegations of COPUOS on this initiative;
- it would be desirable to prepare a draft outline document on the topic of long-term sustainability of space activities to be circulated to participants, with a target date of late summer 2008. For this purpose, a drafting group was set up and will meet in conjunction with the plenary session of COPUOS in June 2008;

- a second meeting of the informal working group should take place during the later part of 2008, dedicated to discuss and, if possible, to finalize the outline document, with a view to submit it at the next session of COPUOS Scientific and Technical Subcommittee in February 2009;
- it is essential to organize communication channels with delegations involved in the discussions on the prevention of an arms race in outer space at the Conference on Disarmament; and
- finally, it would be good to brief non-government organizations actively involved in space security issues and activities on the safety of space systems and obtain their support and contributions.

Note that the fourth recommendation above is implemented by this presentation to the UNIDIR conference participants.

LOOKING FORWARD TO A SET OF BEST PRACTICE GUIDELINES IN SPACE ACTIVITIES

Hopefully, the approach taken via the informal working group approach described above will be fruitful and will produce a useful background document on the long-term sustainability of space activities, on the basis of which a set of best practice guidelines for space activities may be developed during the next year or so.

The outcome of the informal working group will then be introduced formally to COPUOS, either directly to its plenary session or via its subcommittees. The next step would be, if a consensus can be found, to develop them as recommended best practices for space operations for eventual endorsement by the UN General Assembly.

CONCLUSION

Ensuring secured and sustainable access to and use of outer space is a major issue for all nations, including those nations that do not have yet any space activities.

The benefits from the uses of space systems are shared by all stakeholders—commercial, research, civilian and military communities.

Because they share the same environment around our planet and beyond, states, international and regional organizations, and private commercial operators must find a common approach to use outer space in a sustainable way.

The ad hoc, bottom-up approach recommended here is a non-political, pragmatic way forward to reach consensus on how to keep outer space safe and secure for the long term.

ANNEX

SPACE DEBRIS MITIGATION GUIDELINES OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE[7]

Background

Since the Committee on the Peaceful Uses of Outer Space published its Technical Report on Space Debris in 1999, it has been a common understanding that the current space debris environment poses a risk to spacecraft in Earth orbit. For the purpose of this document, space debris is defined as all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional. As the population of debris continues to grow, the probability of collisions that could lead to potential damage will consequently increase. In addition, there is also the risk of damage on the ground, if debris survives Earth's atmospheric re-entry. The prompt implementation of appropriate debris mitigation measures is therefore considered a prudent and necessary step towards preserving the outer space environment for future generations.

Historically, the primary sources of space debris in Earth orbits have been (a) accidental and intentional break-ups which produce long-lived debris and (b) debris released intentionally during the operation of launch vehicle orbital stages and spacecraft. In the future, fragments generated by collisions are expected to be a significant source of space debris.

Space debris mitigation measures can be divided into two broad categories: those that curtail the generation of potentially harmful space debris in the near term; and those that limit their generation over the longer term. The former involves the curtailment of the production of mission-related space debris and the avoidance of break-ups. The latter concerns end-of-life procedures that remove decommissioned spacecraft and launch vehicle orbital stages from regions populated by operational spacecraft.

Rationale

The implementation of space debris mitigation measures is recommended since some space debris has the potential to damage spacecraft, leading to loss of mission, or loss of life in the case of manned spacecraft. For manned flight orbits, space debris mitigation measures are highly relevant due to crew safety implications.

A set of mitigation guidelines has been developed by the Inter-Agency Space Debris Coordination Committee (IADC), reflecting the fundamental mitigation elements of a series of existing practices, standards, codes and handbooks developed by a number of national and international organizations. The Committee on the Peaceful Uses of Outer Space acknowledges the benefit of a set of high-level qualitative guidelines, having wider acceptance among the global space community. The Working Group on Space Debris was therefore established (by the Scientific and Technical Subcommittee of the Committee) to develop a set of recommended guidelines based on the technical content and the basic definitions of the IADC space debris mitigation guidelines, taking into consideration the United Nations treaties and principles on outer space.

Application

Member States and international organizations should voluntarily take measures, through national mechanisms or through their own applicable mechanisms, to ensure that these guidelines are implemented, to the greatest extent feasible, through space debris mitigation practices and procedures.

These guidelines are applicable to mission planning and operation of newly designed spacecraft and orbital stages and, if possible, to existing ones. They are not legally binding under international law.

It is also recognized that exceptions to the implementation of individual guidelines or elements thereof may be justified, for example, by the provisions of the United Nations treaties and principles on outer space.

Space debris mitigation guidelines

The following guidelines should be considered for the mission planning, design, manufacture and operational (launch, mission and disposal) phases of spacecraft and launch vehicle orbital stages:

Guideline 1: Limit debris released during normal operations

Space systems should be designed not to release debris during normal operations. If this is not feasible, the effect of any release of debris on the outer space environment should be minimized.

During the early decades of the space age, launch vehicle and spacecraft designers permitted the intentional release of numerous mission-related objects into Earth orbit, including, among other things, sensor covers, separation mechanisms and deployment articles. Dedicated design efforts, prompted by the recognition of the threat posed by such objects, have proved effective in reducing this source of space debris.

Guideline 2: Minimize the potential for break-ups during operational phases

Spacecraft and launch vehicle orbital stages should be designed to avoid failure modes which may lead to accidental break-ups. In cases where a condition leading to such a failure is detected, disposal and passivation measures should be planned and executed to avoid break-ups.

Historically, some break-ups have been caused by space system malfunctions, such as catastrophic failures of propulsion and power systems. By incorporating potential break-up scenarios in failure mode analysis, the probability of these catastrophic events can be reduced.

Guideline 3: Limit the probability of accidental collision in orbit

In developing the design and mission profile of spacecraft and launch vehicle stages, the probability of accidental collision with known objects during the system's launch phase and orbital lifetime should be estimated and limited. If available orbital data indicate a potential collision, adjustment of the launch time or an on-orbit avoidance manoeuvre should be considered.

Some accidental collisions have already been identified. Numerous studies indicate that, as the number and mass of space debris increase, the primary source of new space debris is likely to be from collisions. Collision avoidance procedures have already been adopted by some Member States and international organizations.

Guideline 4: Avoid intentional destruction and other harmful activities

Recognizing that an increased risk of collision could pose a threat to space operations, the intentional destruction of any on-orbit spacecraft and launch vehicle orbital stages or other harmful activities that generate long-lived debris should be avoided.

When intentional break-ups are necessary, they should be conducted at sufficiently low altitudes to limit the orbital lifetime of resulting fragments.

Guideline 5: Minimize potential for post-mission break-ups resulting from stored energy

In order to limit the risk to other spacecraft and launch vehicle orbital stages from accidental break-ups, all on-board sources of stored energy should be depleted or made safe when they are no longer required for mission operations or post-mission disposal.

By far the largest percentage of the catalogued space debris population originated from the fragmentation of spacecraft and launch vehicle orbital stages. The majority of those break-ups were unintentional, many arising from the abandonment of spacecraft and launch vehicle orbital stages with significant amounts of stored energy. The most effective mitigation measures have been the passivation of spacecraft and launch vehicle orbital stages at the end of their mission. Passivation requires the removal of all forms of stored energy, including residual propellants and compressed fluids and the discharge of electrical storage devices.

Guideline 6: Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission

Spacecraft and launch vehicle orbital stages that have terminated their operational phases in orbits that pass through the LEO region should be removed from orbit in a controlled fashion. If this is not possible, they should be disposed of in orbits that avoid their long-term presence in the LEO region.

When making determinations regarding potential solutions for removing objects from LEO, due consideration should be given to ensure that debris that survives to reach the surface of the Earth does not pose an undue risk to people or property, including through environmental pollution caused by hazardous substances.

Guideline 7: Limit the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit (GEO) region after the end of their mission

Spacecraft and launch vehicle orbital stages that have terminated their operational phases in orbits that pass through the GEO region should be left in orbits that avoid their long-term interference with the GEO region.

For space objects in or near the GEO region, the potential for future collisions can be reduced by leaving objects at the end of their mission in an orbit above the GEO region such that they will not interfere with, or return to, the GEO region.

Updates

Research by Member States and international organizations in the area of space debris should continue in a spirit of international cooperation to maximize the benefits of space debris mitigation initiatives. This document will be reviewed and may be revised, as warranted, in the light of new findings.

Reference

The reference version of the IADC space debris mitigation guidelines at the time of the publication of this document is contained in the annex to document A/AC.105/C.1/L.260.

For more in-depth descriptions and recommendations pertaining to space debris mitigation measures, Member States and international organizations may refer to the latest version of the IADC space debris mitigation guidelines and other supporting documents, which can be found on the IADC website (www.iadc-online.org).

Notes

1 Thirty-seven satellite launches were performed in 2007.

2 The Agenzia Spaziale Italiana, the British National Space Centre, the Centre National d'Etudes Spatiales (France), the China National Space Administration, the Deutsches Zentrum für Luft- und Raumfahrt, the European Space Agency, the Indian Space Research Organisation, the Japan Aerospace Exploration Agency, the National Aeronautics and Space Administration (United States), the National Space Agency of Ukraine and Roskosmos (Russia).

3 The COPUOS space debris mitigation guidelines are reproduced in the Annex.

4 UNGA Resolution A/RES/62/217 of 10 January 2008, paragraph 26.

5 "Collective Security in Space, European Perspectives", Space Policy Institute, The George Washington University, Washingon, DC, January 2007.

6 General Assembly, *Future role and activities of the Committee on the Peaceful Uses of Outer Space*, UN document A/AC.105/L.268, 10 May 2007, § D.

7 General Assembly, *Report of the Committee on the Peaceful Uses of Outer Space*, UN document A/62/20, supplement no. 20, 26 June 2007, annex.

FROM SPACE DOMINANCE TO EQUITABLE RULES AND MUTUAL RESTRAINT

Nancy Gallagher

INTRODUCTION

My remarks today are based on a new monograph on space security policy that John Steinbruner and I wrote in conjunction with the American Academy of Arts and Sciences.[1] This monograph is intended for US "opinion shapers"—independent experts who know little about current US space policy, but who care a lot about how the United States interacts with other countries and who might be influential in shaping security policies of the next US administration. We hope that the monograph will convince Americans that the United States should start talking seriously with the rest of the world about additional legally binding rules for space security—and stop blocking a negotiating mandate for the Conference on Disarmament or pretending that all problems of space security can be solved through increased transparency and voluntary codes of conduct.

We hope the monograph will also be useful for diplomats and security experts in other countries who want to know whether the United States really could achieve comprehensive military space dominance if the next administration continues to pursue that objective—either because their country is a US ally, and thus implicated to a certain degree, or because it might some day be on the receiving end of US efforts to control who can use outer space and for what purposes.

Our goal is to raise awareness and facilitate informed discussion, not to provide definitive answers. In the time available now, I will give a brief overview of our analysis, encourage you to read the whole monograph, and invite you to respond with your reactions and suggestions.

TWO CONCEPTIONS OF SPACE SECURITY

The United States recognized from the outset of the Cold War that the only way it could do what it most wanted to do from outer space—which was to use vulnerable satellites to collect information in order to stabilize deterrence, to support arms control and to encourage the Soviet Union to evolve in a more open and cooperative direction—was to promote international agreement on the protective rules and mutual restraints embodied in the 1967 Outer Space Treaty (OST) and other formal and informal tools of policy coordination. The OST drafters anticipated many of the developments that have occurred in outer space, including the growing number of spacefaring countries and the expanding array of space activities, thus they put together an equitable package of general principles that could stand the test of time.

The end of the Cold War and the increased economic and military importance of outer space in the information age started a debate, which remains unresolved today, between two different ways of thinking about which uses of outer space were most important and how they could best be protected. Most space users—including governments of all spacefaring nations besides the United States, and most civilian, commercial and even military space users in the United States—believed that outer space would increasingly be an environment where cooperation was the norm. They expected that the unintentional problems that one user's activities might create for another user could be managed through codes of conduct and other types of policy coordination to minimize space debris, manage space traffic, and equitably allocate scarce space resources.

A small group of hawkish US defence experts and the part of the US military that wanted outer space to become a full-spectrum combat command, and not just a support service for terrestrial military space operations, used documents such as the US Space Command's *Vision 2020* and the Rumsfeld Commission's space report to advance a completely different conception of outer space. They viewed it as an increasingly competitive environment in which continued US military and economic superiority depended on the United States—and only the United States—being free to use outer space for a wide array of purposes beyond the traditional interpretation of "peaceful" (that is, passive) military support operations allowed under the OST.

The United States has never conducted a balanced assessment to determine which conception of outer space is more correct and whether international cooperation or military competition provides a more realistic and reliable route to space security. Instead, US electoral politics put proponents of space dominance into key policy positions, first with Republican control of Congress in the mid-1990s, then control of the executive branch starting in 2001, even though space policy was never a salient electoral issue.

The bulk of our monograph focuses on two questions: first, how much have proponents of US military space dominance actually been able to accomplish? And second, how realistic is it to expect that, if the United States continues on its current quest for space dominance, it could achieve the US Space Command (SPACECOM) vision—that is, to have an unlimited ability to project force in, from and through outer space; to protect all its own space assets and those of friendly countries; and to prevent anybody else from using outer space for purposes that the United States deemed objectionable without also precluding the full development of outer space for peaceful purposes.

ASSESSMENT OF SPACE DOMINANCE

Even though the United States has been spending vastly more on military space than the rest of the world combined, it is nowhere close to achieving total space dominance. Most of the Bush administration's accomplishments have been in the realm of intentions, not capabilities.

First, it changed the context for US space policy by replacing deterrence as the central principle of US national security policy with a much more ambitious objective that can be called coercive prevention. Coercive prevention is characterized by a declared intention to use force, unilaterally if necessary, to stop potentially hostile states and terrorist groups from acquiring technology that could threaten the United States. The Bush administration also removed legal and policy constraints on US freedom of action in outer space, including withdrawing from the Anti-Ballistic Missile Treaty, narrowly interpreting the OST to prohibit only weapons of mass destruction orbiting in outer space and military activities on celestial bodies, and issuing the 2006 National Space Policy that rules out any new legal restrictions on US military space activities.

The Bush administration carried out a sharp and steady increase in the US military space budget, especially for the acquisition of advanced military space capabilities. Precise numbers are impossible for independent analysts to obtain because the Bush administration has become less transparent about military space spending, but US military space spending seems to have roughly doubled over the past eight years.

This rapid increase in spending does not translate into an equally rapid advancement of US military space capabilities though, because most of the money is being spent on incremental upgrades to existing space-based military support programmes and these projects are all seriously behind schedule and over budget.

As best one can tell from the unclassified record, the total amount of money being spent on things that are traditionally considered space weapons—that is, weapons based in outer space, space-based missile defence and any type of anti-satellite weapons (ASATs)—is very small and is primarily for basic research. This spending bears close watching, though, largely because of the damage that it does to normative constraints on the development of space weapons, but there is time to stop these programmes before they come close to providing a deployed weapons capability.

Problems in the space acquisition process have forced a scaling back of US ambitions, at least in the short term. There is more emphasis now among military space professionals on using existing or near-term technology to achieve incremental improvements in US space capabilities, rather than to transform fundamentally how the United States uses outer space for military purposes. But a somewhat more realistic approach to acquisition among military space professionals has not yet caused those policymakers who have embraced the SPACECOM vision to reconsider whether space dominance is desirable or feasible over the long run.

There are good economic, technical and strategic reasons to believe that even if the next US administration wanted to make the quest for military space dominance an even higher priority than it has been under former Defense Secretary Donald Rumsfeld and other true believers in the Bush administration, the United States still could not get to the point where it could use outer space to solve some of its toughest military challenges on Earth. Nor could it physically protect or rapidly replace any satellite needed for global power projection, or prevent other countries from using outer space for any purposes that the United States did not approve of without also unduly interfering with legitimate uses of outer space. Nevertheless, the United States is better positioned than anyone else to compete for military advantage in outer space and will continue to be tempted to do so unless the likely long-term consequences are better understood.

If the United States continues to pursue its space dominance policy, it will progressively acquire more advanced capabilities to use outer space for long-range precision power projection—including the so-called "prompt global strike" mission. In the near term, this would involve the increasing use of outer space to find, track and target objects that would then be destroyed by aircraft, cruise missiles or conventionally armed ballistic missiles, but this could eventually also include weapons in outer space. The more the United States heads in this direction though, the more vigorously other countries will look for ways to emulate these uses of outer space, or to offset them through asymmetrical means.

The net result of an incomplete US effort to dominate outer space for national military advantage would be to make outer space a much more difficult and dangerous place to operate. The United States would have removed legal protections for satellites, undermined diplomatic mechanisms to coordinate policy and manage conflicts of interest in outer space, and stimulated other countries to develop more advanced space capabilities without being able to provide reliable military protection for its own satellites, let alone those of its allies or neutral commercial and civilian space users.

NEGOTIATED PROTECTION AS AN ALTERNATIVE APPROACH TO SPACE SECURITY

Given the Bush administration's antipathy towards legally binding arms control, most observers who recognize the ruinous consequences of a competition for military advantage in outer space propose some type of informal rules of the road or code of conduct as a way to get US agreement on some modest cooperative measures. Such informal coordinating mechanisms would be insufficient given the magnitude, the competitive momentum and mutual suspicions that have developed over the past decade. If you compare the space security debate today with where it was 10 years ago, it would be fair to say that both the idea that the United States could achieve total military space dominance at some acceptable cost and the idea that outer space would naturally evolve into a harmonious realm of international commercial and civilian space cooperation seem equally unrealistic. Outer space is much more closely connected to terrestrial military competition today than it was 10 years ago, and capabilities to use outer space for both benign and threatening purposes are spreading around the globe in ways that make it much more important that rules regulating space activities be explicit, equitable, legally binding and sufficiently institutionalized to ensure their effective implementation. Therefore, we believe that one of the early moves of the next US president should be to offer to start formal negotiations, both to enhance protections for US satellites and to reassure the rest of the world about US intentions.

By using “equitable” rather than “equal,” we mean that the rules must treat like countries in a like manner instead of having one set of rules for the United States and a different set for all other spacefaring powers. The package of rules must also reflect all countries’ interests, needs and capabilities in some fair way. Negotiations must address not only those behaviours that the United States might like to constrain, such as debris-generating ASATs, but also other military space activities that might be an equal or greater problem in the eyes of countries such as China or Russia. Debris-mitigation guidelines, shared space surveillance information and other types of policy coordination mechanisms that have been discussed so far would be able to make a much larger contribution if they were part of a comprehensive strategy to address the central problems of space security in the information age.

A more refined set of rules for outer space would build on the general principles in the OST to protect legitimate space activities while providing reassurances about how those activities will operate and how their benefits will be shared. This set of rules should start with a categorical prohibition on the destruction of peaceful space assets and on interference with their legitimate uses. The rules should also prevent testing and deployment of dedicated space weapons—not only weapons based in outer space, but also space-based missile defence and any type of ASAT.

Because so many space technologies have both benign and malign uses, there will need to be some basic behavioural rules for dual-use space capabilities. “No threat or use of force against space assets” is a reasonable place to start, but negotiators will need to figure out what secondary rules are needed to provide adequate reassurance that no one is positioning themselves to gain some type of decisive advantage through a sneak attack.

Some have argued that any behavioural rules should only apply during peacetime, either because they want to keep open the option of attacks on satellites during war or because they believe that such attacks, while undesirable, would be impossible to prevent. A strong case can be made though, that rules protecting communication, imagery and navigation satellites are especially important during a crisis in order to minimize the chances of misperception, miscommunication and destabilizing fears about pre-emptive ASAT attack. Even during wartime, the benefits of denying one's adversary satellite services could easily be outweighed by the risks that a limited conflict would turn into a much larger conflagration, either because the belligerents lack the information and communication systems they need to control escalation, or because neutrals join the fighting when their access to vital satellite services becomes a casualty of war.

Rules against interference and attacks on space-based military support activities will require agreement about the limits of permissible use. It would probably not be practical to try to roll back existing space-based military support activities, but the United States needs to acknowledge that advancement cannot continue indefinitely without becoming unacceptably threatening to other countries, just as the United States would not like to feel perpetually under threat of a prompt global strike if other countries followed the US lead in developing such capabilities.

Finally, if we want a serious discussion about legally binding rules to protect legitimate uses of outer space and prevent dangerous ones, we need to have an equally serious discussion from the outset about verification, compliance management and enforcement, based on the principle that the extent of the implementation mechanisms should match the significance of the rules.

PROSPECTS FOR THE FUTURE

It is too early in the US presidential election season to know who the next president will be, let alone whether he or she will recognize the need for the United States to engage more constructively with the rest of the world on this topic. The Center for International and Security Studies at

Maryland and its affiliate Program on International Policy Attitudes recently conducted a polling project to assess Russian and US public attitudes toward space security and various other arms control items on the Conference on Disarmament agenda, in hopes that this might indicate what the next administration could do, if it were so inclined.[2]

The bottom line is that even though public awareness of space security is probably not very high, more than 80% of both American and Russian respondents thought that their governments should make preventing an arms race in outer space a priority (although more Russians than Americans see this as a "high priority" right now). Regardless of what type of cooperative option the poll questions proposed—from informal reciprocal restraint, to a legally binding ban on all space weapons, to a prohibition on interference with satellites even during times of war—Americans and Russians overwhelmingly preferred the cooperative option to the more unilateral choice. We found roughly an 80/20 split among Americans and similar proportions, but a larger number of "don't know" responses, among Russians.

These numbers offer no guarantee that the next Russian and US leaders will actually try to work together on this issue, but if they did, they would have the strong support of their publics behind them.

Notes

1. Nancy Gallagher and John Steinbruner, *Reconsidering the Rules for Space Security*, American Academy of Arts and Sciences, 2008, <www.amacad.org/publications/reconsidering.aspx>.
2. The reports and related articles are available at <www.cissm.umd.edu/projects/pipa.php>.

SESSION IV

TREATIES AND AGREEMENTS: THE NEW GENERATION

THE DRAFT TREATY ON THE PREVENTION OF THE PLACEMENT OF WEAPONS IN OUTER SPACE, THE THREAT OR USE OF FORCE AGAINST OUTER SPACE OBJECTS

Victor Vasiliev

INTRODUCTION

Speaking in Munich on 11 February 2007, Russian President Vladimir Putin warned against the emergence of new high-technology destabilizing types of weapons and new areas of confrontation, particularly in outer space. He emphasized that weaponization of outer space could trigger unpredictable consequences for the international community—no less serious than the onset of the nuclear era. He also noted that a draft special treaty was being prepared aimed at preventing such a development.

At its plenary meeting on 12 February 2008, Sergey Lavrov, Minister of Foreign Affairs of the Russian Federation, addressed the Conference on Disarmament (CD) and officially introduced the draft of the Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects (PPWT), prepared jointly by Russia and China, for consideration by the CD.

The PPWT is not a new idea. The draft is based on the working document CD/1679 on possible elements of the treaty tabled by the delegations of Russia and China together with a group of co-sponsors in June 2002. It is the result of the subsequent discussions in various formats, reflected in a series of working papers and three versions of compilations of the views expressed at those discussions. All these documents are available at the CD website. So, the draft PPWT has not come as a surprise.

THE RATIONALE BEHIND A PPWT

Modern international space law does not prohibit deployment in outer space of weapons which are not weapons of mass destruction. However, such weapons, if deployed in outer space, would have a global reach, high readiness and capability for engagement not only with other space objects to render them inoperative, but also with critical infrastructure on Earth. Such weapons would be fit for real use, generate suspicions and tension among states and frustrate the climate of mutual trust and cooperation in space exploration, rather than serve as a means of containment. This, in fact, will equate their military utility to that of weapons of mass destruction.

Besides, deployment of weapons in outer space by one state will inevitably result in a chain reaction. And this, in turn, is fraught with a new spiral in an arms race both in outer space and on the Earth.

The objective of the draft PPWT is to prohibit the placement of weapons of any kind in outer space, and the use or threat of force against space objects. The treaty is to eliminate existing gaps in international space law, create conditions for further exploration and use of outer space, preserve costly outer space property and strengthen international security and arms control regimes.

So, why do we need a PPWT?

First, because without such a treaty it would be difficult to predict the development of the strategic situation in outer space and on Earth due to the global operating range of space weapons. It would be impossible to claim that space weapons were “not targeted” at a given nation. Moreover, space weapons will enable actors to discreetly tamper with outer space objects and disable them.

Second, because the international situation would be seriously destabilized due to a possibility of unexpected, sudden use of space weapons. This alone could provoke pre-emptive acts against space weapons and, consequently, the spiral of an arms race.

Third, because space weapons, unlike weapons of mass destruction, may be applied selectively and discriminately, they could become real-use weapons.

Fourth, because the placement of weapons in outer space would arouse suspicions and tensions in international relations and destroy the current climate of mutual confidence and cooperation in exploration of outer space.

Fifth, because attaining monopoly of space weapons would be an illusionary goal, all kind of symmetrical and asymmetrical responses would inevitably follow, which in substance would constitute a new arms race, which is exactly what humankind wants to avoid.

PPWT VERSUS OTHER MEASURES

Transparency and confidence-building measures (TCBMs) in outer space activities are important for strengthening trust in outer space activities, for enhancing safety in outer space manoeuvres, for decreasing motivation for weaponization of outer space and for obtaining the necessary climate for negotiating a PPWT. Through the relevant UN General Assembly resolutions, Russia has initiated a new round of elaborations on updating recommendations on TCBMs in outer space activities in the United Nations. TCBMs may also become a part of the new treaty. But they cannot be a substitution for a legally binding PPWT, they should not deviate our efforts and attention in the CD away from a PPWT, although reaching a certain agreement on TCBMs could be a relatively easy and consolidating step on the way to a PPWT.

We are not proposing a treaty on the prevention of an arms race in outer space (PAROS). But we intend to nip the problem of PAROS in the bud. If we prohibit the placement of weapons in outer space and everyone observes this ban, there will be no an arms race in outer space. There can be no room for an arms race there where even the placement of weapons as such is forbidden. In other words, by addressing the issue of non-weaponization of outer space we are at the same time averting the danger of a possible arms race in outer space. However, this prohibition alone is not enough. The functioning of outer space objects can be disrupted without using space-based weapons, but with weapons based elsewhere or by other actions not related to the use of weapons. In order to protect outer space objects from such a threat and to prevent any other force-related actions in outer space, we propose to supplement the non-weaponization obligation by another one—that of non-use of force or threat of force against outer space objects. Thus, in our view, a PPWT will be a solution to the problem of PAROS.

DEFINITIONS AND SCOPE OF A PPWT

We are proposing a treaty which is realistic and practicable. No weapons are placed in outer space now. We want to keep this status quo. Nothing of what the states now possess in outer space will be affected in any way by a PPWT. On the contrary, the main purpose of a PPWT is to assure that safety and security of outer space assets is assured. This fully applies to the satellites which provide information services in the interests of national defence of the states.

The draft PPWT provides some basic definitions which could be useful for the clarification of the specific scope of the treaty. They are as follows: "outer space", "weapons in outer space", "outer space object", "placement of weapons in outer space" and others. These definitions are supposed to answer some important questions. For example, ballistic missiles flying through outer space will not qualify for being "placed" in outer space, and thus will not be affected by the treaty. On the other hand, these missiles will not qualify as "outer space objects" and will be exempt from the rule of no-use-of-force against outer space objects. This means that ballistic missile defences will not be subject to a PPWT, except for the prohibition of placement of their "striking" components in outer space, because they would qualify as "weapons in outer space". We understand that the proposed definitions may raise questions. Our objective was to give a general idea what we mean using best practices and existing definitions and approaches. We are open to negotiate the final formulations within a PPWT.

The no-use-of-force obligation is an application of the UN Charter principle to outer space activities. It covers a wide range of possible hostile actions against outer space objects: destruction, damage, injuring normal function, disruption of channels of communication with ground command and control centres, deliberate alteration of the parameters of their orbit and so forth. In any case, it implies the prohibition of such actions against outer space objects, and not the prohibition on the means (the hardware) to exercise such actions. It would be impractical to create things for the use of force in outer space if the use of force itself is banned. This obligation, *inter alia*, while not prohibiting directly the development of non-space-based anti-satellite weapons, bans their testing against outer space objects and their use against such objects. This obligation seems to be more verifiable than a ban on the "development" of such systems.

A special verification protocol can follow the treaty at a later stage or a PPWT verification mechanism may be substituted by a set of confidence-building measures. This does not mean at all that compliance with a PPWT's provisions is unverifiable and that verification is not needed. A special study of this issue by our Canadian colleagues (see CD/1785) has proven that verification of non-placement of weapons in outer space is possible in principle. We agree with their conclusions.

THE DRAFT PPWT AND THE CD

The CD has been discussing and developing basic elements of a PPWT for five years. The results of the discussions have been reflected in three compilations and in the set of CD working documents submitted by Canada, Russia and China. They speak for themselves.

We have not heard any substantive or convincing arguments against a PPWT. The overwhelming majority of our partners reacted positively to the PPWT draft. Many states are looking forward to substantive work on this issue at the CD.

We think it is now essential to focus on substantial discussions on a PPWT within Item 3 of the CD Agenda without linking it to any other issues. We also believe that such discussion will allow us to develop necessary interaction with the UN Committee on the Peaceful Uses of Outer Space (COPUOS) and thus deal with what directly corresponds to the CD mandate—that is, elaborate a PPWT.

We have submitted the draft PPWT with a research mandate. It has been supported by the majority of member states of the CD and does not add any complications to achieving a compromise on the current draft programme of work of the CD. We hope that subsequently, when appropriate conditions are there, our work can be channelled into a negotiating format through establishment of a relevant ad hoc committee of the CD.

NEXT STEPS

We believe that we can subsequently conduct discussions on PPWT issues if we follow the structure of the proposed treaty elements. Hence, the subject of the further work could be divided in the following topics:

- preamble—aims of a new treaty, its place in the system of international space legislation, explanation of how important and practically useful it is;
- terms and definitions—the real need for them, and what they might possibly contain;
- the scope and basic obligations;
- use of outer space for peaceful and other purposes;
- TCBMs in outer space activities—the appropriateness, the opportunity for and the content of measures to verify implementation of basic obligations;
- a settlement of disputes mechanism;
- the need for and the opportunity to establish an executive body to deal with the implementation of a PPWT, how it would interact with COPUOS and other international organizations;
- a PPWT and international cooperation in research and use of outer space for peaceful purposes;
- organizational issues—the possibility of making amendments, signature and ratification of the treaty, and its entry into force; and
- possible additional elements for such a treaty.

In the course of the recent CD debates on the issues of outer space we have already reached a common understanding that all states are interested in keeping outer space from turning into an arena for military confrontation, in assuring security in outer space and uninterrupted functioning of outer space objects. It is important that we all share this interest. The issue is how to realize this interest in practice.

A number of countries have already submitted some specific proposals in connection with the draft treaty. We should have thorough discussions and take maximum account of them. We hope that the timetable of meetings to be finalized by the six presidents of the CD would allow us to continue substantive discussions on all matters related to a PPWT.

CONCLUSION

We are driven by the belief that the PPWT will serve the security interests of all states and will contradict the interests of none.

We should remember that the nuclear arms race was started with a view to preserve the monopoly on this type of weapon, but this monopoly was to last only four years. However, that spell was sufficient to channel the world politics along “Cold War lines”, which lasted for over four decades and resulted in a gigantic waste of material and other resources at the expense of finding solutions to the problem of development. Is it worthwhile to repeat such a history?

Let us hope that “Star Wars” will remain the domain of Hollywood rather than a business plan in other headquarters.

RUSSIAN–CHINESE SPACE-WEAPONS-BAN PROPOSAL: A CRITIQUE

Theresa Hitchens

Any initiative attempting to put diplomatic reins on the weaponization of outer space is to be welcomed, and therefore the Russian and Chinese delegations to the Conference on Disarmament (CD) are to be thanked for all their effort on crafting a draft space-weapons-ban treaty. Sadly, discussions within the CD of the issue over the past many years have been largely futile—and hopefully many nations are now recognizing that the time has come for that to change. Nonetheless, the Russian–Chinese treaty text continues to have some problems that raise fundamental questions about the viability of any treaty based on it. The biggest problem with the draft treaty is the fact that it does not capture terrestrially based anti-satellite weapons (ASATs), which are the most serious near-term threat to the security of outer space. The second problem is the clause regarding the "threat or use of force against outer space objects", which is vague and open to interpretation. The third problem is the perennial one of classifying a "weapon" system coupled with problems of verification, due to the fact that most on-orbit technologies are multi-purpose—a problem that this language fails to fully resolve.

First, the threat to space security that is squarely in our sights today is the proliferation of destructive ASAT technologies based on Earth—weaponry that is not restricted by this draft treaty. China, Russia and the United States have all displayed capabilities to use physical force to attack and destroy satellites, and some other spacefaring powers now also consider following suit. In India, in particular, there appears to be a growing debate about whether India needs to develop and test such weaponry—either to keep up with an incipient ASAT arms race or to "beat" the announcement of any treaty so that they will not be stuck in the same "have not" position as they were when the Nuclear Non-Proliferation Treaty was signed. The proliferation of destructive, debris-creating ASATs however is in fact in no one's interest—as sooner or later, someone would finally fail to resist the temptation to use them. Space debris is already a serious problem, and debris threatens all satellites indiscriminately. It knows no nationality, even during times of war. Unfortunately, last year was the worst year ever for debris creation, with the US Air Force now tracking about 18,000 pieces of debris larger than 5cm in diameter—that is, large enough to do serious damage to satellites. Estimates of smaller debris range from the hundreds of thousands to the millions, and even debris of 1cm in diameter can damage or destroy an operational satellite. As it is, the UN Committee on the Peaceful Uses of Outer Space has adopted voluntary guidelines to mitigate the creation of debris because of concern about the ever-more polluted space environment. One of those guidelines is a pledge not to deliberately create debris through the destruction of on-orbit objects. However, that pledge is weakened by both a clause that says if you "must" destroy something on orbit, be sure to do it in a very low orbit where the debris will re-enter the atmosphere—leaving room for ASAT testing in lower orbits. It also includes a waiver for national security. Thus, there remain very few normative or legal obstacles to constrain the development and testing of such ASATs—despite their clear danger to the security of all satellites. Sadly, some nations seem to be ignoring the fact that this type of weapon system would be self-defeating in the long run in their short-term concern about maintaining a military edge in future conflicts—the same dynamic that has resulted in nuclear proliferation despite the dangers of nuclear weapons to the entire human population, as well as to the planet itself. Hopefully, the international community can be more successful in stopping an ASAT arms race than it was at limiting nuclear proliferation—not out of some wish for "peace in outer space", but out of the recognition that if outer space is rendered unusable by warfare, the entire planet will suffer. I recognize that restricting this technology would be inherently difficult, due to the fact that missile technology designed for other purposes has inherent ASAT capability—as the recent US decision to destroy its ailing spy satellite using a sea-based missile defence system has proven—as do some other technologies that could be adapted to destroy satellites, such as lasers. That said, it would be imprudent for the international community to ignore a threat to outer space that is nearly upon us. One possible solution would be for nations to focus on designing and implementing a ban on the testing and use of destructive, debris-creating ASATs, both in peacetime and in wartime—that is, to focus on restricting dangerous behaviour rather than technology. Further, such a ban is ultimately verifiable because you can easily see the destruction of a satellite. Perhaps this is something that could be added to the current draft treaty text but, as it is, the failure to address this issue would ensure that a treaty based on this text would fail in the mission of ensuring sustainable use of outer space by future generations.

Second, while it may be counterintuitive, it is unclear what is meant by Article III's "not resort to the threat … of force against outer space objects". This is because the concept of a "threat"—outside of a direct, declaratory statement of intent to do harm—is really a matter of perception. The current US National Space Policy says that the United States holds the right to "if necessary, deny adversaries the use of space". Is that a threat? I suppose if one considers oneself as a potential US adversary, yes it is. Is the destruction of the Chinese satellite in 2007, even if it proves to be an isolated case, a threat of force? Arguably, yes—especially considering that such an event can instil fears of development and testing of destructive space capabilities. What about missile defences, or laser tracking stations, that could be tweaked to harm satellites? Are they threatening? Maybe, maybe not. The point is that what one nation might see as legitimately preparing to ensure its "right to self-defence" may be seen as "a threat" by another. How do you mitigate that? It strikes me that even finding an agreed definition of "threat" would be awfully difficult; but failure to define it would run the risk that charges of non-compliance would be a recipe for never-ending international dispute. Even the issue of the "use of force" in this article is not clear. Does the text mean that the use of positioning or communications jammers in wartime would be a prohibited use of force? While the draft treaty language defining "use of force" and "threat of force" seems to include them in its scope, such jamming devices already exist in large numbers and have been used in warfare; does anyone really expect nations in possession of such systems to just hand them over? And while this clause does some good to mitigate against the non-inclusion of terrestrially based ASATs directly, its vagueness leaves a great deal of room for concern about how it would or could be applied.

Third, the issue of classifying what is a weapon and what is not, coupled with the problem of verifying a space object's status, has long been the central problem for any space weapons treaty proposal. The first question that needs to be asked is the definitional one: how do you parse what is or is not a weapon in outer space? The draft treaty language uses the term "specially produced or converted to eliminate, damage or disrupt" objects in outer space. But the problem is how do you know if a space system was specially produced, or converted, to do this? Would all nations simply be willing to believe each other's declarations that nothing they intended to put in orbit was a weapon, even it had weapons capability? Because of the dual-use nature of many on-orbit technologies, the ability to define what is and is not a weapon becomes a critical problem. For example, there has been some interest in building vehicles to refuel satellites or tugs to take down space debris. Each of those systems could also do double duty as an ASAT. And how would you verify that a space tug was really only for use in taking down ailing satellites and large debris, and not operational satellites? It is clear that nations could, in the course of negotiations, simply assign weapons status to objects based on a judgment about their capabilities and their intentions and need for the capabilities, but such a process is likely to be unwieldy and extremely politically contentious. This language, however, says nothing at all about a process for classification—something that I believe needs to be redressed. And it may be that the concern about space weapons is so great that nations could accept a treaty without verification, but given the classification problem, I am not certain that would be the best route. While I understand that before any verification discussion takes place, negotiators need to know what it is they are trying to verify—it does seem to me that it would be useful for the draft to perhaps lay out some options that might be pursued regarding verification. I must reiterate that I am not against the idea of a treaty to ban on-orbit weapons—I personally think the introduction of weapons into orbit would be a very bad thing for international stability, especially among the nuclear powers, and would lead to an ASAT arms race that would be even more destabilizing. Indeed, I think that a simple agreement among all nations in which each declared their intention not to put weapons in orbit would be useful as a norm-setting, confidence-building device. But I do not think that a treaty that seeks to actually prevent their deployment can be designed without some clarity about what is and what is not a weapon—or at least clarity about how exactly that determination is made—and some measures for verifying non-compliance. The language in this draft, in my own humble opinion, would not prevent deployment, and at the same time would become a vehicle for constant political conflict about compliance. That is not to say solutions cannot be found, as any arms control effort is primarily a question of political will, simply that there needs to be more work to find them.

Despite the problems that I have highlighted, I do want to again thank our Russian and Chinese colleagues for their dedicated work on keeping the issue of the non-weaponization of outer space on the table at the CD. It is a critical issue, and one that must be addressed internationally—as the actions of any one actor in outer space affect all others. The utilization of outer space is fundamentally important to each and every one of us on Earth; indeed, to our ability to ensure the long-term sustainability of Earth itself. The weaponization of outer space would surely restrict the peaceful uses of outer space that are so fundamental to humankind, as well as raise the risks of conflict on Earth. Serious multilateral efforts to prevent that outcome continue to be necessary and ever more urgent. I urge all the members of the CD to continue to try to find ways—including near-term alternatives to an orbital-weapons-ban treaty such as the development of confidence-building measures, pursuit of a binding code of conduct for space actors, and an agreement to prevent testing and use of destructive ASATs—to lower the risk of warfare in outer space.

INTERNATIONAL LEGAL STANDARDS AND THE WEAPONIZATION OF OUTER SPACE

David Koplow

I would like to broaden our discussion of the mechanisms through which international law may contribute to the effort to restrict the impending weaponization of outer space. So far, most of our analysis has focused on overt written international agreements, either formal, legally binding treaties, designed to complement the 1967 Outer Space Treaty (OST) and its progeny, or less formal, politically binding commitments embodying "rules of the road" or codes of conduct as transparency and security-building measures for outer space. Documents of either sort, if carefully drafted and meticulously implemented, can provide tangible support to the ongoing international campaign to forestall an expensive, unnecessary and destabilizing arms race in outer space, and I applaud the efforts to think creatively about the political, legal, and physical realities that can enable them.

For my contribution to this conference, however, I would like to turn our attention, at least briefly, in another direction: customary international law (CIL). As some participants will doubtless already appreciate, CIL is a leading, well-respected source of international law, fully on a par with treaties, explicitly specified in the statute of the International Court of Justice (ICJ), and routinely applied by the ICJ and by the national courts in countries around the world. Although customary international law is often less definite than treaty law—it can be somewhat harder to ascertain the content of an unwritten CIL rule or to be confident that it has, in fact, attained the status of a binding legal obligation—it is a prominent, dynamic component of international jurisprudence, regularly applied and enforced in other contexts, and perhaps having some novel, salutary effects in the realm of outer space as well.

In pursuit of that possibility, I would like to explore here three distinct flavours of CIL, which may be suggestive for applications to anti-satellite weapon (ASAT) activities. First, I will describe "general" CIL, noting how it is formed, what power it has to compel states to conform and how it might apply to exoatmospheric activities. Second, I will turn to a particular, specialized subset of CIL, the international law rules applicable to situations of armed conflict, especially to consider how the well-accepted norms of "discrimination" and "proportionality" might find expression in our topic. Finally, another emerging area of *lex specialis*, customary international environmental law, may also make a contribution to preserving the security of outer space.

CONSTRUCTING CUSTOMARY INTERNATIONAL LAW

CIL arises from "a general and consistent practice of states followed by them from a sense of legal obligation". Two factors are therefore required to constitute a binding rule: an "objective" element, relying upon an empirical finding of wide-spread, long-standing concordant state practice, and a "subjective" element, attributing that pattern of practice to a sense of obligation, rather than to mere habit, courtesy or political convenience.

The objective element need not require proof of absolute unanimity in behaviour among all states on the planet, but the more, the better—and the actions of the "leading" states (those which are most regularly engaged in the particular field or most affected by it) will count extra. Moreover, the traditional requirement that the observed pattern be "long standing" can be tempered; if the consensus among states is genuinely deep and wide-spread, its short duration may be forgiven.

In assessing the relevant "behaviour" of states, we look to words as well as deeds, and to silences as well as inactions—and especially to the deliberate reactions of other states who respond to any initial behaviours. In most countries, the lion's share of the relevant international behaviours is typically generated by the state's executive branch, but in appropriate settings, legislative and judicial actors, too, may contribute. These days, there is often a flood of state behaviours on a wide range of topics, promulgated by the most internationally active countries, and other states must be diligently attentive to that flood, lest their silence or inaction be construed as acceptance or acquiescence.

The subjective element for creating CIL poses something of a conundrum: it seems that a pattern of behaviour counts toward articulation of a new norm only if the countries who act in the concordant fashion do so out of a sense that they are already obligated to do so. If they instead perceive themselves to be engaged in merely voluntary behaviour, from which they feel free to depart at any time without incurring any international legal liability, then the *opinio juris sive necessitatis* is absent.

In many CIL instances, the evolution from "voluntary" to "obligatory" is incremental and opaque: a state behaviour that may start as an entirely optional choice could become accepted and reciprocally followed by others; over time, the increasingly recognized pattern of behaviour induces other countries to conform to it, to expect others to act similarly and to rely upon its continuation. Eventually, perhaps, the pattern generates a sense that it is "legitimate" to behave in that way, and "improper" to deviate. And at some point, the conformity reaches a depth of consensus that it is deemed to have "hardened" or "crystallized" into a binding norm of CIL.

In one sense, CIL dramatically possesses even more jurisprudential power than does treaty law: once a norm is established as CIL, it becomes binding on all states, even those that did not participate in the evolving pattern, that may not be fully aware of its occurrence and that might not be entirely supportive of the norm, if they thought more deeply about it. Moreover, states that were not even in existence at the time the norm evolved (for example, colonies), and that therefore never had an independent opportunity to express themselves about it as it emerged, are nonetheless generally deemed to be bound by the entire corpus of CIL existing upon the date they become sovereign states. Only states that publicly and consistently dissent from the norm are exempted from it—and there are precious few examples of states that have overtly preserved their autonomy as dissenters in this way as a rule of CIL advances.

In contrast, of course, any state may absent itself from any treaty simply by declining to sign or ratify it. Ordinarily, treaties do not implicate the rights and responsibilities of non-parties, and a country's inaction (that is, failure to take the affirmative steps necessary to affiliate with the treaty regime) results in an exemption from the legal rules—but with CIL, that "default position" may be reversed.

The relationship between treaty law and CIL is complex in yet another respect that must also be noted here: what leads to what? That is, sometimes, the global evolution of a growing sense that a particular kind of state behaviour ought to be illegal (or, ought to be compulsory or voluntary—depending on the shape of the particular norm) can lead to its emergence as a rule of CIL. Perhaps later, the same inter-state pressures can also motivate countries to undertake to negotiate a treaty that would then cover the same issues in the same way, but with the greater clarity that can be generated by reducing the inchoate behaviours to agreed-upon text. So a rule of CIL can prompt the articulation of a treaty.

Conversely, sometimes the treaty comes first. Perhaps the negotiation and conclusion of a multilateral instrument, especially one that is intended to attract, and does, in fact, attain, very broad participation by all kinds of countries around the world, can also stimulate the concordant behaviours and the sense of legal obligation, even among states not joining the treaty, that would simultaneously identify that norm as being a new rule of CIL. In that instance, the treaty can prompt the articulation of a new customary international law rule, and the CIL can become binding even upon countries that have deliberately absented themselves from the treaty regime.

Finally, a note about the role of the United Nations in developing CIL. Ordinarily, of course, resolutions of the UN General Assembly are not legally binding—they constitute politically weighty recommendations, observations or exhortations. Unlike the Security Council (whose decisions states have pledged themselves to accept and carry out), the General Assembly has little direct power to bind Member States. Nonetheless, the General Assembly can sometimes play a leading role in helping to midwife the development of new norms of CIL. The General Assembly has often served as the most convenient venue through which states have expressed their views about potential emerging norms—it has provided the forum in which they have declared their preferences, stated their expectations and defined their sense of what is legitimate for civilized states. A General Assembly resolution, therefore—depending on how it is worded, what the intentions of its drafters have been and how widely it is supported—can provide persuasive evidence of the existence and content of a putative CIL rule and its acceptance from a sense of legal obligation.

In arms control matters, it need hardly be stressed, the Conference on Disarmament (CD) can play a similarly leading role—it can be the world's most authoritative instrument for collecting the relevant behaviours of states and their attitudes about each other's actions. Where participating states opt to use the CD as the "bully pulpit" for declaring their sense of what is now legally obligatory in the realm of outer space weaponry, those articulations can carry great weight in measuring CIL.

THE CUSTOMARY INTERNATIONAL LAW OF OUTER SPACE

Outer space has proven to be an especially illustrative region for the development of CIL. Here, the nominal requirement that the pattern of observed state behaviour be "long standing" has been particularly observed in the breach—within only a decade or so after the first Sputnik orbits, the basic framework of the CIL of outer space was already largely in place as "instant" CIL.

The early activities of the first spacefaring nations, eliciting near-uniform endorsement from other countries, initiated a remarkably rapid period of CIL generation in the new realm of outer space. Prominent precedent-setting resolutions of the General Assembly, underwritten by the leading states, quickly defined many of the applicable rules of conduct for extraterrestrial human operations. Even before the conclusion of the 1967 Outer Space Treaty, many of its key principles had already been instituted as binding rules, accepted by the sometimes elusive, but here quite emphatic, consensus process of CIL.

For example, the notions that states cannot validly assert sovereign claims to outer space, that the exploration and use of outer space must be carried out for the benefit and in the interests of all countries, and that activities in outer space must be conducted in accordance with international law were probably all embedded as accepted propositions of CIL even before they were written into the OST. These principles, asserted as solemn pronouncements by the international community, had attained sufficiently widespread acceptance, from a sense of legal obligation, even before the act of codification. The treaty became a more-definite, easier-to-cite expression of those rules, but they were promulgated in the first instance by CIL, not by the OST.

GENERAL CIL AND ASATS

To assess whether general customary international law can now make further contributions to the security of outer space, we need to consider two specific ASAT activities: testing in outer space and use in combat. (A comprehensive ASAT treaty might well seek to regulate other aspects of the weapons-development cycle, too, such as the research, development, possession and deployment of ASATs, but for present purposes, it will be sufficient to focus on testing and use.)

What do we observe about the actual pattern of state behaviour in this area? First, regarding space testing of ASAT devices, we have a reasonably public history to scrutinize. The United States tested two main types of interceptor vehicles approximately 30 times from the late 1950s through the early 1970s, and the Soviet Union tested its interceptor anti-satellite vehicle a total of approximately 20 times from 1968 to 1971 and from 1976 to 1982. The United States also conducted two tests of a rather different sort of interceptor in 1984 against unoccupied points in outer space, and one test against a target satellite in 1985. China became the third state to destroy a satellite in orbit, with a couple of exercises that did not involve collisions, and one, on 11 January 2007, that did impact and destroy its target. Most recently, on 20 February 2008, the United States employed a modified ballistic missile interceptor to destroy a failing reconnaissance satellite as it re-entered the Earth's atmosphere.

In addition, these three have also explored systems based on high-energy lasers or other directed-energy technologies, rather than on physical interceptors. The most conspicuous illustration of such was the 1997 US experiment with the MIRACL (Mid-InfraRed Advanced Chemical Laser), based in New Mexico. That test, intended to assess the extent to which a powerful ground-based energy beam system could locate, track, illuminate, and damage, disrupt, or destroy an orbiting satellite, has still not been fully described to the public. The possible laser systems of other countries have been even more shrouded from public view. The Soviet Union allegedly developed a capability of this sort at Sary Shagan in Kazakhstan in the 1980s, and furtive press reports indicate that China may have tested a directed energy system to illuminate, temporarily blind or otherwise affect the operations of satellites in the fall of 2006.

Totalling up all that activity, we find (depending upon how one counts the ambiguous reports) fewer than 60 genuine tests in outer space, conducted by only three states, with only about a half dozen of those incidents occurring in the past 25 years.

Regarding “use in combat”, the story is even shorter—there have been no such uses. That is, in the half century since the space age began, a period ravaged by countless international armed conflicts, there have been zero incidents in which one combatant has actually employed any sort of ASAT against its enemy.

If the “objective” evidence of state practice shows so few exercises of ASAT capabilities, what about the subjective side of the CIL calculation: have countries generally refrained from testing or using their ASATs out of a sense that they are already legally obligated to do so? Here, frankly, the evidence is less persuasive about the existence of any CIL norm.

ASAT-testing space actors have certainly never said anything that suggests that they consider space weapons to be already illegal. Even when they refrain from aggressively pursuing interceptors or energy beams, they act as if that self-restraint were a matter of national policy, not one of international law. More pointedly, when they criticize each other’s space activities (which they sometimes do), they do not employ the vocabulary of CIL obligations. Instead, they complain that the other nations’ space weapons programmes are ill advised, provocative, unwelcome or adverse for global peace and stability, but they do not express the notion that international law already constrains those programmes.

Similarly, other countries, whether expressing themselves in the context of the United Nations, the CD or otherwise, generally adopt similar rhetorical stances. They criticize such testing; they call for countries to exercise restraint; and in particular, they advocate the initiation of negotiations on a new treaty that would establish a more protective regime for securing space assets. But—with precious few exceptions—they do not generally assert that such exercises are already improper, illegitimate or contrary to the justified expectations of the world community.

THE *LEX SPECIALIS* OF ARMED CONFLICT

If general CIL currently gets us only half-way toward a ban on ASAT testing or use (because while the observed pattern of behaviour might be sufficient to establish the objective criteria, the subjective sense of obligation is missing or weak), what can we learn from the first specialized area of international law, concerning the use of military force in combat?

CIL has always been an important component of the law of armed conflict (LoAC). Widely accepted treaties have codified many of the relevant principles but, as noted above, codification does not deprive those principles of their concurrent status as CIL, and as CIL they remain legally binding even upon states that have shunned the written instruments. Two-century-old principles, in particular, stand out in this context.

First, "discrimination" (or distinction) requires that a combatant direct its force exclusively against military targets, not against civilians, neutral states or other protected persons or objects. Some "collateral damage" to non-combatants and their property is probably inevitable (see below), but the first fundamental legal mandate is that weaponry must be aimed at legitimate targets. A weapon that cannot be so directed (or one that is capable of adequate directionality, but that is, in fact, used in an indiscriminate way) is illegal.

This rationale is largely responsible for the legal antipathy toward chemical weapons, biological weapons and the like—in many applications, these armaments are incapable of being sufficiently precisely targeted upon an enemy's military. Once the gas is unleashed, it is uncontrollable, apt to waft randomly with the winds, perhaps drifting far from the battlefield and into urban areas. Where the user cannot control, or even reliably predict, where the lethal effects may be felt, the weapon is unacceptably indiscriminate under robust LoAC standards.

ASAT systems—at least the kinetic-energy variety of space interceptors—are vulnerable under this analysis. The cloud of lethal debris generated by ASAT use is typically large, persistent and hazardous to the space activities of civilians and non-belligerent nations. Other presentations at this conference document very well the insistent perils posed by space junk: travelling at enormous speeds, even small shards can prove fatal to any satellite that wanders into their path. Moreover, depending on the altitude at which an ASAT test or use occurs, the capricious threat could endure for decades or even centuries—far longer than the danger posed by wandering chemical or biological agents.

Even if an ASAT attack might initially seem lawful under LoAC principles, because the user sought to inflict damage specifically upon an avowedly military satellite that its enemy was employing for hostile purposes, this discrimination problem could invalidate the operation. Even if the ASAT user were successful in hitting precisely the target it was aiming at, the residual effects—the inevitable random scatter of lethal debris—could inflict significant, unacceptably indiscriminate secondary harm upon others.

A similar result is reached via consideration of a companion fundamental LoAC principle, “proportionality”. Here, the traditional analysis commands that a legitimate armed attack must seek to balance the military gain to be expected from a particular use of force versus the unintended collateral losses to civilians, other non-belligerents and their objects. If the spin-off losses to protected persons and places outweigh the projected military advantage (admittedly, this judgment can be ineffably complex, requiring a comparison of wholly incommensurable variables), then the attack must be modified or aborted. The law does not require that a military force preclude all collateral damage—that would likely prove impossible in any realistic operation. But there must be a conscious act of balancing; proportionality does legally require the force not to inflict “too much” accidental harm—and even long-term, second-order adverse effects must be included in the calculation.

ASAT attacks that generate clouds of space debris are, once again, subject to challenge under this CIL principle. The evaluation would weigh the direct military advantage to be gained from destroying an enemy satellite (which could be substantial, depending upon how the enemy used the satellite, and how adequate the enemy’s fallback alternatives would be to respond to the elimination or interruption of this particular asset) versus the foreseeable harm to civilians, neutrals and other non-belligerents from the long-term pollution of this sector of outer space. Depending on where the satellite was operating, how far the debris might spread, how long it would remain in orbit, how many and how large the debris pieces would be, and how feasible it would be to track them and manoeuvre to avoid them in the future, the collateral damage might well outweigh the military benefit. Especially when one considers that the debris could create a hazardous “keep out” zone persisting for many decades after the immediate war was finished, and could jeopardize the future peaceful space operations of neutral countries that played no role whatsoever in the current fighting, the proportionality judgment could well come out negative.

The specialized CIL applicable to armed conflict, therefore, may already provide some meaningful legal constraints upon the military operation of ASATs. Discrimination and proportionality require respect for civilian and neutral space assets, even if the ASAT user were motivated by legitimate military objectives. If the ASAT mechanism generates an indiscriminate cloud of long-lasting hazardous debris, and if it thereby inflicts too much collateral damage on protected assets, then its use would already be illegal.

Notably, these considerations apply only to debris-creating ASAT weapons; the directed-energy variants, which disrupt, damage or destroy without causing fragmentation, would be largely beyond this analysis. Moreover, LoAC applies only during moments of armed conflict; it is essentially irrelevant, therefore, to peacetime testing of ASATs, even those which spawn volumes of debris.

INTERNATIONAL ENVIRONMENTAL LAW

We turn next to a second area of specialized CIL, the restraints intended to preserve the natural environment. Here, too, emerging CIL can already make something of a contribution to the preservation of space security.

International environmental law is still a relatively new discipline. But it is already sufficiently well accepted to assert certain guiding principles that apply to the exoatmospheric environment, especially relating to debris-creating ASATs. Foremost among the general proscriptions is the notion that a state is barred from undertaking activities that inflict significant injury upon the environment of another state or upon areas beyond the limits of national jurisdiction. This proposition has been authoritatively asserted by numerous General Assembly resolutions and by solemn pronouncements of important international conferences over a period of decades; it has been well embedded in the international legal consciousness.

The phrase “areas beyond the limits of national jurisdiction” has been applied most vigorously to the high seas, Antarctica and the atmosphere. Clearly, serious pollution or other long-lasting harm to those global resources would be a matter of common concern for all people, regardless of whose national territory was most closely implicated. By the same analysis, significant, enduring damage to the outer space environment would likewise be illegal under extant CIL, and would be a subject of concern for all states, even those which did not currently attempt or plan to occupy or exploit the particular region of outer space that was despoiled.

The specific type of harm envisioned by debris-creating ASATs could be much more substantial than that occasioned by illegal ocean dumping, air pollution and the like. Space debris, we have seen, may be nearly permanent, and it is so hazardous that it creates a virtual "dead zone", totally precluding activities in that region, rather than inflicting merely a temporary diminution in other states' abilities to enjoy the area and exploit the resources.

Notably, this branch of CIL applies to peacetime activities (some aspects of international environmental law would apply, *ceteris paribus*, to wartime situations too, but many would be suspended during active hostilities). It thereby neatly complements the LoAC principles surveyed above, which constrain ASAT activities only during combat. Like LoAC, however, the international environmental law principles are focused on the catastrophic effects of space debris, and would seem to have little to say about directed-energy ASAT systems.

THE PRECEDENT: CHEMICAL WEAPONS

Some members of the audience, doubtless, will be thinking at this point that the analysis of CIL, however interesting and novel it might be in this application, remains largely an abstract or theoretical point, far removed from the reality of national security decision-making and from the practicalities of global political interaction. In fact, however, my interest in this inquiry, and my affinity for the hypothesis derive from intensely practical experience: it has happened before.

That is, in another realm of arms control—in fact, in a sector of special interest to the CD—the world has once before confronted a weapon that was deemed indiscriminate and disproportionate in its effects, and the world found it convenient to deal with that provocation first through CIL, and only later through a comprehensive treaty.

The precedent is chemical weapons (CW), a widely reviled tool of warfare, which have been both wielded by military forces and abhorred by civilians throughout the centuries. International law has resolutely attempted to negate this avenue of combat, through a long series of agreements stretching back to antiquity and including the partially successful 1925 Geneva Protocol.

Despite that fistful of treaties, however, the pattern of manufacturing, testing, occasionally using and perpetually preparing to use chemical weapons persisted through the twentieth century. Each of the major participants in the Second World War voluntarily and unilaterally declared that it would not be the first to introduce chemical weapons into combat, but each zealously manufactured thousands of tons of the stuff (including new generations of nerve agents that were immensely more lethal than the relatively simple toxins that had inflamed the central battlefields of the First World War). Even after 1945, massive stockpiles were assiduously retained, tested and improved, and there were repeated incidents of the use of CW (or at least allegations about use—it has typically been very difficult to prove conclusively that lethal chemicals were, in fact, employed). Deadly CW polluted the battlefields in conflicts as diverse as that between Egypt and Yemen in the 1960s, Chad and Libya in the 1980s and Iran and Iraq in the 1980s.

Only in 1993 did the world conclude, through the good offices of the CD, a comprehensive treaty absolutely forbidding this nasty form of conflict, the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (the Chemical Weapons Convention, or CWC). This instrument has proven to be remarkably successful, already attracting the adherence of some 184 participating states and leading to the internationally supervised destruction of almost 30,000 tons of lethal agent.

Still, equally remarkable is one crucial CIL-related aspect of this story: even before the CWC came onto the scene, CIL had already instituted a legal prohibition on CW. That is, most experts would concur that at some point during the twentieth century (after 1925 but before 1993), the use of CW (or at least the first use of CW in international armed conflict) had been rendered illegal. The prohibition was instituted by the now-familiar combination of the objective criteria (long-standing, wide-spread concordant state practice) and the subjective *opinio juris* (the sense that CW combat was no longer acceptable, and that states were already under a legal obligation to refrain from initiating its use).

This CIL barrier against chemical weapons, based upon the entrenched sense within the international community that it was no longer tolerable as a method of warfare, even in pursuit of legitimate objectives, predated the CWC and is not superseded by it. The CIL rule thus remains obligatory even for states that have not yet joined the CWC (and there are eleven such states, some of which are of considerable concern to treaty supporters). And it would likewise retain its validity even for a country that elected, at some future date, to exercise its right to withdraw from the treaty regime.

Notably, the uniformity and persistence of the world's conformity to the emerging CIL rules are demonstrably greater in the case of ASAT than in the case of CW. That is, during the middle of the twentieth century, many countries proceeded with vigorous CW development programmes, and there were several conspicuous deviations from the norm against using CW in combat. In contrast, as we have seen, over the more than 50 years of the space age, there have been only a few countries actively pursuing ASAT capabilities, there have been precious few tests in outer space and exactly zero uses in combat. If the observed pattern of states' words and deeds was sufficient, in the case of CW, to create a CIL rule against the use of the weapon, then *a fortiori* they could suffice in the ASAT context.

CONCLUSIONS

This short presentation cannot, of course, offer a thorough assessment of the possibly emerging CIL regarding the security of outer space; I have undertaken merely to surface this somewhat novel topic, raising questions about the concept, rather than providing comprehensive answers.

In particular, a more searching analysis of CIL in this context would have to evaluate the fact that, in contrast to CW, so few countries have affirmatively sought the capability to undertake ASAT development and testing activities. Moreover, in their respective wars to date, those few states have had relatively few occasions in which the actual use of ASATs in combat would have proven advantageous—they have so far been able to accomplish their various space-related military objectives via other means. As the states most active in the relevant areas, the actions and statements of China, Russia and the United States will inevitably carry extra weight in considering the emergence of any ASAT-related CIL rules.

We would also need to explore, with greater empirical data, exactly how profound the danger of debris has become, and what the marginal contribution to that hazard might be, if leading countries were to accelerate their destructive ASAT test programmes or to start employing those weapons in combat. Outer space is, of course, a very big place, and the actual scope of the peril to civilian and neutral satellites would have to be assessed carefully—what is the probability that future peaceful space activities would be compromised by explosions or collisions today?

Still, the prospect that CIL might be able to make a contribution in this area is intriguing—if only because it has to date received no real attention. I would not see CIL and treaty law as "competitors"—they are, instead, complementary avenues, and the world community might well pursue both possible strategies as the opportunities arise. Treaty law, in general, offers the distinct benefits of greater clarity and precision in the articulation of the legal obligations. Treaties (as in the case of the CWC) can also establish verification rules to ensure effective compliance with the norms, and can create new international organizations to oversee and implement the new legal standards.

But CIL offers some advantages, too, including the ability to reach countries that for whatever reason stand aloof from treaties but that are not so zealous in opposition as to credential themselves as "persistent dissenters" from the CIL norm. Moreover, while we might tend to think of CIL as growing only slowly, in contrast to the more rapid articulation of treaties, the actual practice of the world community might sometimes suggest the reverse: CIL has on occasion evolved quite rapidly regarding outer space, and the decade-long paralysis of the CD deliberations on outer space indicates that sometimes the route to overt international agreement can be unduly constipated, too. In short, in the quest to achieve true "universality" in a disarmament commitment, both treaty and CIL can play a role.

It is noteworthy that most of the analysis here is concerned only with debris-creating ASATs; laser, particle beam, and other hypothetical directed-energy systems seem largely to escape both the LoAC and the international environmental law standards. I regret this; it would seem to me to be only an incomplete, modest gain for security in outer space if future ASAT competition were simply funnelled exclusively into directed-energy, instead of kinetic-energy, systems.

That leads to my final observation: this is an area in which the CD can already act. Even if the organization's hands have, regrettably, been tied for too long by procedural wrangling that has precluded the effort to commence the negotiation of a formal treaty on the prevention of an arms race in outer space, the incremental contributions to the development of a CIL norm require no such consensus. Individual countries could already begin to articulate their views about what ASAT-related behaviour is acceptable, and what is intolerable. They could sharpen their criticisms of debris-generating events. They could assert the view that directed-energy ASAT systems, too, even without the debris factor, are equally unwelcome as intrusions into the security of outer space. All states, regardless of their size and power, and regardless of the sophistication of their outer space programmes, can participate in this vocal behaviour today, not being unduly impeded by the preferences of China, Russia or the United States.

In particular, concerned states could emphatically assert, in the CD and elsewhere, that ASAT activity is not only unwelcome, not only counterproductive from the standpoint of security and stability, but also already “illegitimate”, already “contrary to the settled expectations of the world community”, and already “incompatible with the obligations incumbent upon states”. If the ambassadors do assert those forward-looking propositions, then the magic of CIL—a dynamic process of assertion and challenge—can help establish the “ought to be” as the “is”.

SESSION V

NEXT GENERATION, NEXT STEPS

ACHIEVING A SUSTAINABLE SPACE ENVIRONMENT

Ray Williamson and Cynda Collins Arsenault

In the 50 years since the launch of Sputnik, the world has made great strides in the development and use of the space environment. Developed nations, especially, have become highly dependent on space applications for communications, broadcast services, navigation and daily weather forecasts, among other useful services. Developing states as well are increasing their dependence on such systems. Today, however, growing numbers of in-orbit spacecraft, increasing amounts of orbital debris and the threat of space weapons in orbit endanger the future use of outer space.

Some 830 working satellites now orbit Earth, providing benefits in the form of useful services, scientific observations and peacekeeping. This chapter outlines the primary threats to future space activities and explores the steps that will be needed to ensure the continued peaceful use of outer space. In particular, it examines orbital debris mitigation, cooperative space situational awareness and space traffic management. It analyses the opportunities and challenges faced by the space community in addressing these important steps to a sustainable space environment.

BENEFITS FROM SPACE ACTIVITIES

Since October 1957, the use of the orbital Earth environment has grown substantially to the point that governments, the private sector and the world's militaries now depend on satellites and their associated ground systems to provide numerous social and economic benefits.

Yet the benefits are not solely economic in nature. Position, navigation and timing (PNT) systems provide numerous non-quantifiable social benefits around the world, including enhancing safety of life and property and easing the plight of lost drivers everywhere. In the United States, satellite systems now provide more than 90% of the data that feed into the models for the US National Weather Service forecasts.[1] Further, space systems enhance the ability to secure borders, fight natural disasters and reduce fraud in agricultural support systems.

The striking thing about space systems today is that many of the benefits they provide are so suffused throughout society that we hardly even notice that they derive from satellite systems. Whether the application is on-line banking, cell phone use or using a credit card to purchase fuel from the local service station, citizens both of developed and developing countries are making increasing use of such services. In the future, the nascent use of satellite services in tele-health and tele-education is expected to grow, bringing numerous benefits to rural communities around the world and reducing the gap between rich and poor. Additionally, in some cases satellites offer developing countries the opportunity to catch up to more developed countries in communications and natural resources management without going through an initial stage of expensive infrastructure development.

THREATS TO CONTINUED USE OF THE ORBITAL SPACE ENVIRONMENT

Operating spacecraft successfully has always been a challenge because outer space is a risky place where spacecraft designers need to plan for extreme vacuum, extreme cold and a high radiation environment, among many other engineering issues. The design challenges the space environment pose have been largely, if expensively, solved. However, recently, orbital crowding, growing clouds of orbital debris and the threat of destructive space weapons have added to the threats faced by the systems that we depend upon daily.

Increasingly crowded orbits

Outer space is vast and mostly empty, with collisions between working satellites only a remote possibility. However, certain choice orbits are becoming sufficiently crowded that satellite-to-satellite collisions are increasingly possible. For example the sun-synchronous polar orbits that Earth observation satellites use to provide valuable reconnaissance, weather and commercial information to users are particularly at risk.

As a case in point, on 4 July 2007, the US National Aeronautics and Space Administration (NASA) found it prudent to move the US–Canadian

CloudSat satellite in order to avoid a possible collision with the Iranian SINAH-1 remote-sensing satellite. CloudSat, launched in April 2006, is an experimental satellite devoted to providing, among other things, new data about the relationship of clouds to storms using advanced radar. SINHA-1 is Iran's first remote-sensing satellite, launched in October 2005. The manoeuvre reduced the risk of collision.

A few days later, NASA moved CloudSat back into its earlier position in order to synchronize its orbit with the Cloud-Aerosol Lidar and Infrared Pathfinder (CALIPSO) satellite, a joint project between NASA and the French Centre national d'études spatiales. Working together, the two satellites provide "new, never-before-seen 3-D perspectives of how clouds and aerosols form, evolve, and affect weather and climate".[2]

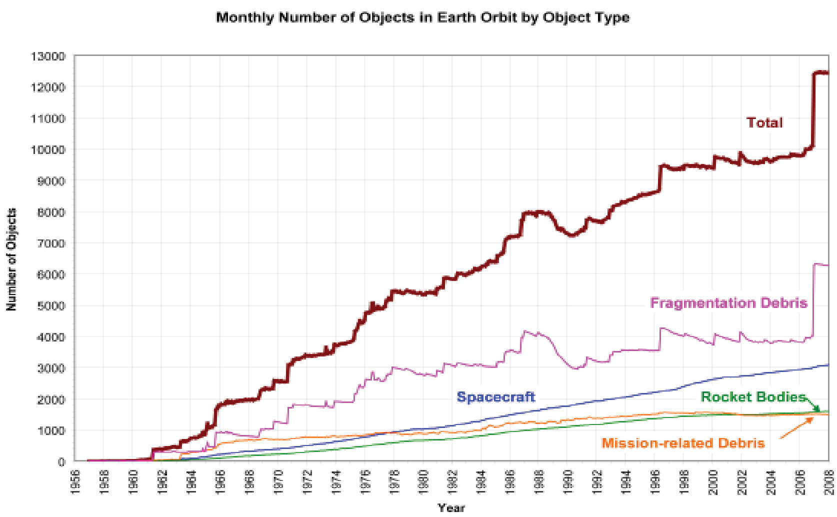
Not only would a collision between the US and Iranian satellites have dealt a significant blow to climate science and Iran's nascent remote-sensing efforts, it would likely have added to the significant political tension between the two countries.

The geosynchronous orbit (GSO) that is home to the world's communications and many weather satellites is also crowded. Commercial communication satellite operators are becoming concerned that in the foreseeable future, when making needed orbital manoeuvres, they will collide either with other working satellites, or even with defunct ones that have remained in GSO. Although these satellite operators know where their satellites are located with considerable precision, they do not necessarily know the positions of other working satellites with sufficient precision. Over time, as the valuable GSO becomes even more crowded, the risk of collisions will increase.

Growth of orbital debris

Orbital debris is an even greater threat to working satellites (see Chart 1). Debris creation is an unavoidable by-product of launching and operating spacecraft in Earth orbit. The process of releasing a spacecraft from the protective shell used during launch leaves a variety of small pieces in orbit. Upper-stage rocket bodies also stay in orbit, and have been known to explode, even after years in outer space. In addition, spacecraft batteries may fail and explode, spreading fragments of the satellite in ever increasing arcs around the initial orbit. Finally, orbital tests that have destroyed satellites by the Soviet Union in the 1970s, the United States in the 1980s and the Chinese in 2007 have left thousands of additional pieces of debris in orbit.

Chart 1. The yearly growth of objects in Earth orbit



Source: National Aeronautic and Space Administration, Orbital Debris Quarterly News*, vol. 12, no. 1, p. 12, January 2008. Information on classified satellites is withheld, as are the orbital elements of debris of uncertain provenance.*

Debris experts estimate that more than 17,000 pieces of debris 10cm in length or greater now speed around Earth in various orbits. The number of untrackable smaller bits is orders of magnitude greater. Yet, even small debris fragments can be highly destructive because the impact velocities between debris and a satellite approach an average of 10km per second. Such hypervelocity impacts can shred a satellite and leave it in bits, adding to the amount of debris in orbit.

Starting in the 1990s, the world's major spacefaring countries developed a series of measures to limit the creation of orbital debris from normal space operations. These measures have reduced, but not eliminated, the creation of new debris. Hence, debris experts expect the orbital debris population to increase steadily as more countries enter the world of space activities.

The threat of space weapons

The most serious threats to the continued sustainability of space activities are certain types of anti-satellite weapons, the most destructive of which can leave thousands of additional pieces of debris in orbit. As an example of the threat of debris creation, on 11 January 2007, China intentionally destroyed an aging Chinese weather satellite, Fengyun-1C. That incident added some 2,400 pieces of trackable debris to the deadly mix already in sun-synchronous polar orbit, sharply increasing the long-term danger to working satellites.[3] The satellite was orbiting at an altitude of about 800km and orbital debris at those altitudes takes tens of years to fall back to Earth. In the meantime satellites that we depend on for critical environmental, security and business-related information are at increased risk (notice the increase during 2007 in Chart 1).[4]

The United States and the Soviet Union had both tested anti-satellite weapons in the past, but had shut down those programmes for fear of creating more orbital debris. However, on 21 February 2008, the United States shot down an errant US satellite. The official reason given for this action was to prevent it spreading its large load of highly toxic fuel on the Earth's surface.[5] The United States justified the action on the basis of public safety and the fact that its orbit had declined to a relatively low 270km by time of impact, yet to much of the world, this action looked very much like an anti-satellite test.

Space weapons are of concern because many types, especially kinetic energy weapons, can leave huge amounts of debris in orbit. This debris spreads widely throughout its orbit, creating hazards for satellites orbiting nearby.

STEPS TOWARD THE SUSTAINABLE USE OF THE SPACE ENVIRONMENT

The Secure World Foundation is committed to assisting effective measures to achieve a sustainable space environment. Reaching this goal includes the following steps:

Limiting orbital debris formation

Fortunately, even non-experts have come to realize that it is important to keep space debris to the absolute minimum. That is why, after years of study and discussion, the United Nations Committee on the Peaceful Use of Outer Space (COPUOS) passed a non-binding resolution in June 2007 formally calling for the reduction of debris generation and the study of means to remove debris from orbit. The UN General Assembly accepted the resolution in October 2007. COPUOS followed closely the recommendations of the Inter-Agency Space Debris Coordination Committee (IADC), the group of spacefaring states that had been working on the development of debris mitigation guidelines for well over a decade.

Passage of this resolution was an important, perhaps crucial, step in providing long-term governance of our orbital environment. Part of the impetus behind its passage was apparently the 2007 Chinese incident mentioned above, which highlighted the seriousness of the debris problem and shocked many of the COPUOS delegates. However, this non-binding resolution is not enough. For these guidelines to be effective, each state will need to adopt binding national regulations at least as strong as the UN debris guidelines.

Space situational awareness and space traffic management

Larger steps toward space governance are needed. As additional countries and private companies launch spacecraft into orbit, popular orbits like the polar, sun-synchronous and geosynchronous orbits are becoming a lot more crowded and will eventually need an international space traffic management system to keep these highly useful orbits relatively collision free.

As the case of the CloudSat and SINHA-1 satellites reveals, a quasi-space traffic management regime exists now, mostly controlled by the United States. The US Air Force maintains ground-based optical and radar observatories that keep track of the 18,000 or so working satellites and larger debris—so-called space situational awareness (SSA). Through NASA, it publishes an open catalogue of orbital elements that commercial and non-US satellite operators can use to guide their spacecraft and avoid collisions. However, this open catalogue holds much less information on orbits of working satellites and debris than the full catalogue (information on classified satellites is withheld, as are the orbital elements of debris of uncertain provenance). Commercial entities and non-US national agencies can request and receive guidance from the US Air Force in planning needed for spacecraft manoeuvres. However, satellite operators complain that the US Air Force is often slow to respond to requests. That is understandable, given the demands of maintaining SSA against ever increasing amounts of debris and satellites. The US Air Force budgets for maintaining such a capability have generally not kept up with the need for personnel and information tools.

Further, other countries do not want to depend on the United States for such critical information. As a result, several countries, including China, France, Germany and Russia are now developing or strengthening their own SSA capabilities. Because the US military advantage in maintaining a closed catalogue is therefore declining, it would be in the interest of the United States to lead the way in a cooperative programme for SSA, first with close allies, and then broadening to other space-capable nations as experience is gained. This could be an important first step in developing an international space traffic management system for outer space, a system that would provide much greater safety and security for the many Earth observation satellites in the increasingly crowded sun-synchronous polar orbits.

THE ROLE OF INTERNATIONAL COOPERATION IN ADVANCING THE SUSTAINABILITY OF SPACE ACTIVITIES

Improving the sustainability of space activities requires the countries using the space environment to cooperate on the development of technical standards, legal instruments and practices that will improve as far as possible the continued ability to conduct beneficial space activities and prevent the placement of weapons in space. Cooperation can take many forms, ranging from bilateral cooperation on specific projects to broad sharing of plans and coordination of research and applications projects. Examples include the Global Earth Observation System of Systems, the Committee on Earth Observation Satellites, and the IADC.

Each of these cooperative mechanisms makes possible the sharing of technical standards and plans and fosters greater transparency among nations, an essential ingredient in reducing tensions and promoting peaceful solutions.

CONCLUSION

We at the Secure World Foundation are convinced that ensuring the long-term sustainability of outer space activities is most effectively achieved through a bottom-up approach focused on vigorous efforts to reduce the further generation of orbital debris, development of a code of conduct for outer space (leading eventually to a space traffic management regime), and agreements to ban anti-satellite weapon development and tests.

For example, the Secure World Foundation has begun a major project focused on exploring the technical, political and economic issues of an international space traffic management scheme or system. There are many possible models for such a system, ranging from one modelled on air traffic control to a system of systems, where each spacefaring state agrees to provide data of sufficient accuracy and precision to an internationally endorsed entity that then provides space agencies and commercial spacecraft operators with operational orbital guidance for manoeuvres and collision avoidance. Whatever scheme is put into place must be technically and legally sound and politically acceptable.

In order to pursue this thrust and its many other activities, the Secure World Foundation maintains partnerships with a variety of organizations focused on the development of technical, legal and political means to ensure the long-term sustainability of outer space activities.

Any new venture can be dangerous and has risks. The out-of-control satellite that the United States destroyed in 2008 is an example of the many risks we face in the future use of outer space. The odds of dying in a car accident are far greater than being hit by a falling satellite, and yet we continue the use of the automobile. Societies throughout the world have developed rules and regulations to mitigate some of the dangers of the automobile (speed limits, drivers licenses, standards for production, stop signs, seat belt regulations) as well as consequences for violations (speeding tickets, jail, fines). We do not yet have related “rules of the road” for outer space. When a satellite fails, what is the proper procedure to mitigate possible danger to the population, who makes that decision and how can disagreements be resolved? These questions must be answered as we move forward into the next 50 years of space activities. No country can or should attempt to act as policeman of the world with regard to space security. The Secure World Foundation contends that because outer space is a global commons, answering these questions requires global participation.

Notes

1 James Heil, National Weather Service, Office of Climate, Water, and Weather Service, presentation at the Space Policy Institute workshop on "The Value of Improved Weather and Climate Information from Satellites in the Electric Power Industry", 29–30 March 2004, presentation available at <http://www.gwu.edu/~spi>.

2 See <www.calipso.larc.nasa.gov>.

3 Secure World Foundation, *Secure World Newsletter*, no. 10, <www.secureworldfoundation.org/Newsletter10.pdf>, July 2008.

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SPACE SECURITY AND SATELLITE APPLICATIONS IN HUMANITARIAN AID

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INTRODUCTION

The UN Operational Satellite Applications Programme (UNOSAT) is a programme of the UN Institute for Training and Research, operated in collaboration with the United Nations Office of Project Services (UNOPS) and the European Organization for Nuclear Research (CERN). UNOSAT was called to present the experience and point of view of the United Nations on the use of satellite technology in various areas of work including humanitarian relief coordination, risk management and development.

While it is being debated whether more space actors may cause more insecurity in outer space, from the view point of view of civilian applications of Earth observation, the multiplication of actors and providers is rather beneficial to the development of Earth observation and integrated solutions in the emergency response and development fields.

The inherent vulnerability of satellites and the issue of security in outer space is of course of relevance when trying to evaluate the sustainability of Earth-observation-based solutions in support of the international agenda. UNOSAT underlined that space security, a matter typically of interest to the disarmament community, is of increasing importance to the international community at large even though the general public and development experts are not fully aware of its implications.

It was underlined that more space security means more options of peaceful uses of satellite applications and the hope of the UNOSAT community is that space security is not jeopardized in future.

EVOLUTION OF SATELLITE APPLICATIONS IN THE UNITED NATIONS

The evolution of the use of satellite applications in the UN family is relativity short yet it has rapidly increased since the launch in 2000 of the UNOSAT project. This project became a full programme a few years later, having successfully demonstrated in cooperation with the European Space Agency and a number of UN users that solutions based on satellite technology are beneficial to carrying out the mission of the United Nations in several areas of work.

The next phase of the programme was to develop tailored solutions meeting the specific requirements of various UN actors. In parallel, UNOSAT has established itself as a technical pole within the United Nations, able to keep pace with the rapid technological development in the area of satellites. This was a distinct benefit brought about by UNOSAT due to the simple fact that this is the only UN programme entirely dedicated to research and development in satellite applications. As the range of Earth observation and information and communication technology applications developed, the United Nations was able to remain in sync with the space community and abreast of new solutions being developed in public and private space domains. Today, the United Nations has virtually no lag in the area of space applications for humanitarian aid, risk reduction and development support. This is an asset that UNOSAT strives to maintain for the long term.

What is eventually at stake is the capacity of the UN system to support and monitor the implementation of the Millennium Development Goals, which need to find their realization at the regional and local levels to be able to percolate from the state of policy declarations of intent to that of tangible reality in the daily life of millions. Satellites offer today a range of investigation, assessment and monitoring solutions that, if and when applied correctly, represent millions of dollars in savings and substantially shorter implementation time. Countries and communities that could not otherwise afford it can now reasonably rely on the United Nations to gain access to technologies that are already pervasive in industrialized countries but still too scarce in developing countries, where the needs are far greater.

ROLE OF UNOSAT

The initial idea of UNOSAT is based on the emerging geographic information needs in UN projects in post-crisis countries. These needs were evident already at the end of the 1980s but the UN system was not in a position to respond to them. Today it is self-evident that Earth observation data and geographic information systems (GIS) are useful tools for effective decision-making. The environment, human security, vulnerability reduction, adaptation to climate change, emergency response and recovery are all areas in which these tools are becoming common requirements and the effects of their introduction in current practices are largely felt already.

UNOSAT is entirely dedicated to developing and applying, together with an ever-growing number of partners, the entire range of satellite solutions, including integrated ones, to the entire range of UN goals and objectives. The UNOSAT approach is innovative in that it suggests a new paradigm combining technical soundness with a constant focus on users and needs. The result is a number of activities and methodologies entirely aimed at producing concrete solutions with high impact at low cost.

UNOSAT has been not only an experimental lab for techniques to be used in achieving the mandate of the United Nations, but also a precursor in policy matters relating to the integration of Earth observation tools in international development and emergency response. Like in previous similar cases, the UN system has had to behave with caution, taking the time to understand the advantages brought about by technological innovation, test them and absorb the relevant practices gradually. A large number of space applications are emanating from the private sector. These represent globally the state of the art of the underpinning technology but are not tailored on the requirements of the UN family. While many satellite programmes have adopted labels indicating that they are “user driven”, it is nonetheless a reality that the whole sector of data procurement is driven by commercial interests. The response to this state of affairs should be one of constructive collaboration between the United Nations and the private/public sector in charge of outer space, not one of closure, not one of entrusting to the space sector the entire burden of creating solutions for the international community.

By taking the lead in developing technical solutions and implementing them in support of a number of sister agencies, UNOSAT has become visible to and recognized by private sector entities and space agencies. The result is that UN needs and requirements are today taken into account in various large international programmes, among these being the European Space Agency, the Global Monitoring for Environment and Security of the European Union, the Global Earth Observation System of Systems, and International Charter—Space and Major Disasters.

As the capabilities grow within the UN system itself and more solutions become available, UNOSAT is also contributing to better coordination among various UN users thus decreasing duplication and parallel efforts that are frequent when new tools are being developed.

CONCLUSION

Recognizing the international challenges linked to the world of geographic information is important. The main ones are the growing population of internally displaced persons, water resources and their management, adaptation to climate change, the struggle for information management and exchange, and the security threats linked to seeking information superiority. Others are less glamorous but equally important in the pursuit of the Millennium Development Goals.

Faced with these challenges, providing the United Nations with sound and independent capabilities is a choice that will have to be made sooner or later.

CANADA'S PERSPECTIVE ON SPACE SECURITY

Pearl Williams

I will talk briefly on Canada's perspective on space security, what we have done in the past and where we aspire to be in the "next generation".

As many of you are aware, less than two weeks ago, on 18 March 2008, Canada's two-armed robot called Dextre was successfully installed on the International Space Station. I mention this as evidence not only of Canada's leading role in space robotics, but also of our continued commitment to international collaboration toward the peaceful use of outer space. You will also be aware of the successful launch of the RADARSAT 2 Earth observation satellite in December 2007. This satellite is one of the world's most advanced commercially available Earth observation image providers and will provide users world wide with a range of high-quality data products. It will significantly contribute to monitoring the environment and to natural resource management.

It should come as no surprise, given Canada's strong and continuing advocacy of the non-weaponization of outer space, that Canada has signed and ratified the principal treaties governing space exploration (the 1967 Outer Space Treaty, the 1972 Convention on International Liability for Damage Caused by Space Objects and the 1975 Convention on Registration of Objects Launched into Outer Space).

Nonetheless, if that were all Canada did, we would merely be observing the status quo. If we reflect on the importance of outer space to humankind over the 50 or so years since the launch of Sputnik, what will we observe? There have been a number of significant changes.

Firstly, there is an increasing dependence on outer space as part of our "collective infrastructure"—from global communication and navigation links to the collection of environmental and natural resource management information.

Secondly, there is a rapid expansion in the number of actors in outer space at the state level and also by individual entities. We note for example that the Conference on Disarmament (CD) now has 65 members and the UN Committee on the Peaceful Uses of Outer Space (COPUOS) has 69. This is a far cry from the situation which existed during the early days of space exploration when the number of spacefaring nations, including Canada, was very small.

With this growing level of interest and activity, there is a growing appreciation globally of the need for a rules-based environment to ensure that the governance structure in place is sufficient to safeguard space exploration and its benefits for the future of all humankind. Sadly, we recognize that there are shortcomings. The real question then is what can we do, what structures can we put in place which will contribute positively to the objective of preserving outer space as a global resource for the "next generation" and beyond?

Historically, the CD has been regarded as the world's pre-eminent disarmament negotiating body whose mandate includes regulating the activities of nations with respect to the prevention of an arms race in outer space. While this may be one of its stated objectives, it is common knowledge that the CD has been deadlocked for years in terms of addressing emerging security challenges. In fact, in January of 2008, the Secretary-General of the United Nations, in an address to the opening session of the CD, stated "the Conference on Disarmament has accomplished a great deal—but its successes are distant memories". He pointed out that a disarmament stalemate can jeopardize other UN charter objectives, such as the Millennium Development Goals, and reminded the CD membership that the United Nations must lead efforts to improve the global security climate.

Canada has been honoured both in 2007 and in 2008 to have acted as coordinator for the CD agenda item on the prevention of an arms race in outer space (PAROS) (Paul Meyer in 2007 and Marius Grinius in 2008). Based on our observations, we have concluded that in spite of the current stalemate on key issues, there is scope for forward movement which could begin with something as straightforward as CD members agreeing to a programme of work and pursuing it with commitment. There is clear recognition that with the expanded membership of "spacefaring nations" the issues are broader than the "non-weaponization of space".

The draft treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects, tabled by China and Russia in the CD, will serve to further our discussion on how gaps in the legal framework of space security might be addressed.

As you are aware, many of the technologies used to access the benefits of outer space fall into the category of "dual-use technologies". From our perspective this affords the opportunity for COPUOS and its subcommittees to play a central role in responding to the challenges and opportunities posed by the international community's increased reliance on outer space. The work of COPUOS could be optimized by establishing closer links, for example, with the CD. Gérard Brachet, who made an earlier presentation on the long-term sustainability of space activities while addressing an informal coordinators' session of the CD in February 2008, pointed out that "Vienna's work covers both non-aggressive military and civilian use of outer space". In Canada's view it would be timely and beneficial for both bodies to reduce the outdated, artificial distinctions between the respective mandates of the CD and COPUOS and to initiate a formal, forward-looking collaboration in common purpose. In the case of the CD however, such a move would be predicated on first agreeing on a programme of work.

We note for example, that very useful work is being undertaken in the Legal Subcommittee of COPUOS, which would enhance the effectiveness of the Registration Convention in gathering information on "the manoeuvrability and effective irradiated power capabilities of newly registered space objects". This additional information could assist other registrants in computing a harm index that would assess the ability of the newly registered space object to interfere, damage or destroy other space objects by contact or at range.

In short, we remain convinced of the need to develop an increasingly broad and encompassing concept of space security that addresses not only the weaponization of outer space but also the broader military, environmental, commercial and civil dimensions of outer space. Practical steps toward achieving a common understanding of space security—steps which include realistically attainable objectives—can serve to establish a foundation for a more comprehensive regime which may be built in the coming years.

Though there is varying emphasis in terms of what activities may be the most useful to pursue, there is growing recognition that transparency and confidence-building measures can a play key role in moving the agenda forward. Here I am referring, for example, to codes of conduct that provide normative guidelines for certain activities. The Hague Code of Conduct guidelines provide a very useful precedent and we very much look forward to the tabling of the European Union Space Code of Conduct later this year.

In the category of practical steps, I would also include the recently adopted Space Debris Mitigation Guidelines. Although this is not a mandatory requirement, it is yet another step forward in promoting a "rules-based approach" for the use of outer space. Canada will be monitoring its activities to ensure that they are consistent with the guidelines.

With the increasing numbers of actors in outer space, we note that there is growing interest and discussion in various international forums about space traffic management. This is also a very positive example of a practical area which can be worked upon with directly beneficial results.

We have had many lengthy discussions over the last two days on the technical aspects of one approach versus another. For us to preserve the secure and sustainable access to and use of outer space we must redouble our efforts on all fronts, so that we can build mutual confidence among the expanding number of spacefaring nations. It is critical that we do not overlook the awareness-building which will contribute to creating this better understanding among our fellow citizens of how dependent they are on space technologies for many of the critical communication and navigation services they currently enjoy.

ACRONYMS

ASAT	anti-satellite weapon
CD	Conference on Disarmament
CIL	customary international law
COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
CW	chemical weapons
CWC	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction; the Chemical Weapons Convention
IADC	Inter-Agency Space Debris Coordination Committee
ICAO	International Civil Aviation Organization
ILA	International Law Association
LoAC	law of armed conflict
MDGs	Millennium Development Goals
NASA	US National Aeronautics and Space Administration
OST	Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies; the Outer Space Treaty
PAROS	prevention of an arms race in outer space
PPWT	draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects
SGAC	Space Generation Advisory Council
SSA	space situational awareness
TB	tuberculosis
TCBM	transparency and confidence-building measure
UNOSAT	UN Operational Satellite Applications Programme