Institut français des relations internationales

Assessing the Current Dynamics of Space Security

a SWF-Ifri workshop and report, June 18-19 2009, Ifri Paris

Introduction

Space security has become an increasingly important issue over recent years, with the international community witnessing a number of aggressive and/or debris-creating events in orbit.

To address this issue, Ifri and the Secure World Foundation (SWF) held a workshop in Paris on June 18-19, 2009. The Space Policy Program at Ifri runs an on-going research project on Space security issues. SWF is a private foundation working on space-related issues. Its three primary focus areas include space security, human and environmental security, and protection from Near Earth Objects (NEO).

The June workshop at Ifri was part of a steady stream of international discussions on ways to improve matters: official talks - bilateral or at the Conference on Disarmament (CD) in Geneva; conferences gathering academics, officials and industry representatives, such as the UNIDIR annual conferences on space security or the series of international Space Situational Awareness (SSA) conferences;.

The workshop was convened to complement these discussions. Similar to other initiatives of that type[1], it used a particular format that focuses on generating a productive debate:

1. It was a closed meeting of experts from government, civil society and industry. This allowed the discussion to begin right away from informed standpoints.
2. It was conducted under the Chatham House rules (protecting the confidentiality of sources), which fostered a more open discussion.
3. Presentations were few, short and informal, so that most of the time could be devoted to debate.

This paper is based on the discussions of the workshop and present a number of recommendations. These recommendations do not necessarily reflect the views of any particular participant to the workshop. This is not a consensus document.

[1] For instance, the Stimson Center and One Earth Futures Foundation (OEF) convened a workshop in Bellagio, Italy, in the Fall of 2008.

Executive Summary / List of Recommendations

#1: Exchanges between UN COPUOS and the CD

Finding: Information exchanges between UN COPUOS and the CD would foster better communication and understanding of the work of each committee with respect to outer space and resolve possible divergences should they occur. Efforts of the two most recent chairmen of UN COPUOS and of the director of UNIDIR to present UN COPUOS issues before the CD are a positive step that must be built upon.

Recommendation: As an independent entity active in the field, UNIDIR has played an important role in reinforcing the communication channels between the two bodies and should continue to do so. The NGO community can also make an important contribution to better understanding and assist in raising the level of technical and diplomatic expertise on outer space matters in both international entities.

#2: Better Informed Actors

Finding: It would be important to upgrade the level of technical knowledge of policy-makers sitting at negotiation tables, so that all technical issues are well-known and out of the way. In particular, examination of the remotely observable characteristics that could distinguish weapon versus non-weapon space applications would be quite fruitful. That may assist further political discussions.

Recommendation: Making available and widely circulating a manual or primer that describes the key physical attributes of outer space activities and how the associated technologies function would assist delegates at both the CD and UN COPUOS. In addition, NGOs can assist by holding periodic informational briefings on key outer space issues.

[A number of excellent resources are already available. For instance, the Union of Concerned Scientists published *The Physics of Space Security: A Reference Manual*, by UCS scientists David Wright, Laura Grego, and Lisbeth Gronlund, in 2005.]

#3: Developing a Strategy

Finding: The international community needs to devise a strategy for crafting appropriate international agreements for reaching long-term sustainability of outer space. The strategy should consider TCBMs as well as treaty proposals.

Recommendation: In addition to discussions in official fora, progress could be made by convening a small discussion group to discuss this and propose a strategy. Two possibilities:

1. A periodic review group on Space Security could be set up within UNIDIR. Review groups on Biological and Chemical Weapons meet every month under the aegis of UNIDIR.
2. A small team of perhaps four to six recognized private experts on space and disarmament could be convened outside the UN structure. This was a method used

to jumpstart the development of European space policy in the late 1990's when the so-called "Wise Men Report" was published[2]. This is also comparable to U.S. team efforts such as the larger Augustine Commission.

#4: Agreeing on Legal Definitions

Finding: The difficulty of reaching consensus on legal definitions of certain key space and disarmament terms impedes progress on draft treaty or TCBM discussions.

Recommendation: A study group could be convened to discuss legal definitions and provide further clarification of what the issues are. This would assist further discussion at the CD and UN COPUOS. The International Institute for space Law (IISL) could be involved, as well as experts who understand space law and disarmament law. A document produced by the group could be circulated.

#5: Orbital Debris

Finding: The voluntary space debris mitigation guidelines in UN resolution 62/217 of December 2007 demonstrated a growing political consensus that generation of debris must be limited. This is a good first step. However, it is not enough to avoid space debris from becoming a century-long curse. There are both political and technical issues to solve with regard to the increasing threat of space debris. They are not exclusively linked to disarmament issues.

Recommendation: The Working Group on Best Practices within the Scientific and Technical Subcommittee of UN COPUOS should pursue additional means to limit creation of space debris. Regular communication with delegates at the CD should ensure the latter understand the role of debris in contributing to an insecure space environment.

#6: Space Situational Awareness

Finding: The debris caused by the February 2009 collision between a commercial Iridium communications satellite and a retired Russian Cosmos satellite illustrates the pressing need to reduce the chances of future collisions. One way to do so is to increase the effort to locate and track satellites and debris in their orbits.

Recommendation: There should be a concerted effort to establish an international Space Situational Awareness (SSA) architecture in order to reduce the risk of accidental collisions in space. The larger spacefaring States have instituted SSA programs. In addition, the communication satellite industry and at least one non-governmental research entity collect and aggregate orbital data on satellites and debris. The growing number of SSA resources will soon make it possible to create better coverage than now exists. The community of interested States and commercial entities should consider developing an international civil SSA System of Systems, in analogy to the Global Earth Observation System of Systems (GEOSS). The United States has entered into discussions with Europe and with Russia over possible SSA collaboration. If those efforts bear fruit, such consultations could be extended to other States and lead to an international collaboration on SSA. An SSA System of Systems would also need to create the means for calculating accurate conjunction assessments as well as a warning mechanism for avoiding collisions.

#7: Debris Removal

[2] ESA portal to the "Wise Men" Report, accessed September 4th, 2009: http://www.esa.int/esaCP/GGGQS06UGEC_index_0.html

Finding: Debris experts warn that in order to keep existing space debris from causing a chain reaction of additional debris creation, removing key pieces of existing large debris from orbit may be necessary within a decade or so.

Recommendation: Research should be increased on methods of deorbiting critical pieces of debris safely and effectively. In addition, research should start on the legal and political issues of removing debris from orbit in order to provide the legal and policy bases for such activities.

#8: The Role of the Commercial Satellite Operators

Finding: Commercial space operators have a large financial stake in maintaining a secure, safe and sustainable space environment. Hence, they are becoming increasingly central in the effort to maintain the long-term sustainability of outer space.

Recommendation: Commercial space operators should be involved in discussions that relate to space sustainability. The model adopted in the creation of a draft Set of Best Practices that will be considered by UN COPUOS is a good one. Commercial communication satellite companies, especially, have contributed directly to the draft text that will be presented for consideration by the UN COPUOS Scientific and Technical Subcommittee and its Working Group on Best Practices in February 2010.

#9: Coordinating Emergency Collision Avoidance

Finding: There needs to be a means to coordinate collision avoidance activities when they are deemed necessary.

Recommendation: The space community should have a “phonebook” of the satellite maneuvering centers maintained by operators to contact them quickly in case of need. In addition, satellite operators could agree to conduct “collision avoidance” exercises. They could be conducted virtually so as not to put precious space systems at risk and cause the satellite to be out of service for the required period. Such exercises might be part of a TCBM agreement drafted to address appropriate behavior for outer space activities.

Table of content

Introduction *1*
EXECUTIVE SUMMARY / LIST OF RECOMMENDATIONS 2
Table of content *5*
List of acronyms *6*
PART ONE: FURTHER AGREEMENTS FOR SPACE STABILITY 7
Chapter 1: The situation in 2009 ..... *7*
The current proposals 8
Chapter 2: The negotiation process *11*
UN forums for discussion 11
Foster communication and circulate knowledge 12
Pursuing several efforts versus one single goal 13
How to devise a strategy? 14
How to involve developing countries? 14
Chapter 3: TCBMs in space *15*
Chapter 4: Arms control in space *16*
Definitions 16
Retaliation or sanctions? 17
Verification 17
PART 2: THE DEBRIS ISSUE AND SSA 18
Current efforts to monitor space 18
One or several data centers? 19
The European effort for SSA 20
How does collision avoidance work today? 20
Legal aspects of the SSA issue 21

List of acronyms

ABM:	Anti-Ballistic Missile
CD:	Conference on Disarmament
CFE:	Commercial and Foreign Entities
CoC:	Code of Conduct
UN COPUOS:	United Nations Committee on the Peaceful Uses of Outer Space
EDA:	European Defense Agency
ESA:	European Space Agency
EU:	European Union
FAA:	Federal Aviation Administration
FCC:	Federal Communications Commission
GEO:	Geosynchronous Earth Orbit
GMES:	Global Monitoring for Environment and Security
GRAVES:	Grand Réseau Adapté à la Veille Spatiale
IAASS:	International Association for the Advancement of Space Safety
IADC:	Inter Agency Space Debris Committee
IGO:	International Intergovernmental Organizations
ISES:	International Space Environment Service
ITU:	International Telecommunication Union
MEO:	Medium Earth Orbit
NEO:	Near Earth Object
NGO:	Non-Governmental Organization
NORAD:	North-American Aerospace Defense Command
NRO:	National reconnaissance Agency
OEF:	One Earth Future
PAROS:	Prevention of an Arms Race in Outer Space
PPWT:	Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects
SSA:	Space Situational Awareness
SSN:	Space Surveillance Network
SWF:	Secure World Foundation
TCBMs:	Transparency and Confidence-Building Measures
UNGA:	United Nations General Assembly
UNIDIR:	United Nations Institute for Disarmament Research
USAF:	United States Air Force
WMO:	World Meteorological Organization

Part one: Further agreements for space stability

Chapter 1: The situation in 2009

The panorama of space security has changed significantly since the end of 2008 and currently presents a very positive confluence of events. A number of encouraging steps have been taken, that were even reinforced by the fright caused by the satellite collision of February 2009. We now have an unprecedented opportunity to make greater progress toward space stability:

a. A draft Code of Conduct was adopted by the European Union (EU) in December 2008 and the UN Committee on the Peaceful Uses of Outer Space (UN COPUOS) approved the establishment of a Working Group to develop Best Practices Guidelines for space operations in early 2010. In May 2009, the Conference on Disarmament (CD) adopted a Program of Work that provided for substantive discussions dealing with issues related to the "Prevention of an Arms Race in Outer Space" (PAROS) and the establishment of a respective working group. Nevertheless, objections by the government of Pakistan to the Program of Work on subjects unrelated to space issues later halted formal consideration of space issues within the CD. Nevertheless the international space community overall now has several proposals to consider, including the Chinese/Russian proposal of February 2008 (PPWT), a new working paper by the Canadian government, and a treaty proposal by the Henry L. Stimson Center (see below).

b. The new U.S. administration seems committed to making changes in its approach to space security. A space policy review is underway in the summer of 2009, inspired by the attitude of the Obama team that puts a greater emphasis on international cooperative mechanisms than the last administration. Under Secretary of defense for policy Michèle Flournoy, wrote in particular that "First, U.S. strategy must be grounded in a common sense pragmatism rather than ideology. U.S. national security strategy must be based on a clear-eyed assessment of the challenges and opportunities of the new security environment as well as realistic objectives derived from our national interests.[3]" In concrete terms, the US government openly supports Transparency and Confidence Building Measures (TCBMs) initiatives, and in particular the Best Practices Guidelines initiative.

Another aspect of this increased involvement in international space policy has to do with freedom of commerce, where the US supports "free and fair access to global commons". There is indeed a commitment to develop unified global standards, as a result of increased interdependence. The U.S. government plans to expand current transatlantic discussions on technical standards internationally.

c. Another encouraging consideration is that Earth orbit is probably easier to stabilize than other environments, because not many space weapons are yet operational. As opposed to "traditional" arms control agreements, that deal with weapons that are already deployed (and encompasses most existing treaties), space would rely on "preventive" arms control, dealing

[3] Michèle Flournoy and Kurt Campbell, "The Inheritance and the Way Forward", Report from the Center for a New American Security, June 2007.

with weapons that are not yet deployed, and for which in many cases the technology is not even ready.

The current proposals

A number of recent proposals for a new international agreement on space stability are currently on the table. The following paragraphs summarize proposals on the EU draft Code, the Set of Best Guidelines, the PPWT, the Canadian and the Stimson proposals. Websites of the official texts are mentioned when available.

The EU draft Code of Conduct for Outer Space Activities[4]

The European Union considers that strengthening the security of activities in outer space is an important objective in the context of expanding space activities. A draft "Code of Conduct for Outer Space Activities" was adopted by the Council of the European Union on 8-9 December 2008. The main purpose of the Code of Conduct (CoC) is twofold:

1. To strengthen the existing United Nations treaties, principles and other arrangements, as the subscribing parties would commit to comply with them, to make progress towards adherence to them, to implement them, and to promote their universality,

2. To complement them by codifying new best practices in space operations, including measures of notification and of consultation that would strengthen the confidence and transparency between space actors and contribute to developing good faith solutions that would permit the performance of space activities and access to space for all.

As the Code of Conduct would be voluntary and open to all States and would lay down the basic rules to be observed by space faring nations, it does not include any provision concerning the specific question of non-placement of weapons in space. The purpose of such a Code is neither to duplicate nor compete with the initiatives dealing with this specific issue, nor to oppose them. On the contrary, the project complements and contributes to those initiatives, inter alia by insisting on the importance of taking all measures in order to prevent space from becoming an area of conflict.

The European Union is currently consulting with other space faring nations with the aim of reaching a consensus text that would be acceptable to as many States as possible. It is envisaged that at the end of the consultation process an ad hoc conference would be organized in order for States to subscribe to the Code. While the draft Code is not intended for negotiation at any existing international forums, the EU Presidency will continue to inform multilateral bodies, such as UN COPUOS, the CD, ESA and others on progress with this initiative.

Official text of the proposal, accessed July 22nd:
http://register.consilium.europa.eu/pdf/en/08/st17/st17175.en08.pdf

Best Practices Guidelines[5]

The work on space debris done by the Inter Agency Space Debris Committee (IADC) over many years led to the adoption of the UN COPUOS "Space Debris Mitigation Guidelines" in 2007, endorsed by UNGA Resolution 62/217 of December 2007. To bolster these guidelines and encourage responsible use of outer space by all actors, it was recognized that an

[4] Pr. Petr Lála 's presentation on this topic, accessed July 22nd:
http://www.ifri.org/files/Espace/PresentLALA.pdf
[5] Gérard Brachet's presentation on this topic, accessed July 22nd:
http://www.ifri.org/files/Espace/GBrachet.pdf

additional technically-based and bottom up approach to develop a set of recommended «Best Practices» in space operations would be advantageous. .

In early 2008, led by Mr. Gerard Brachet, then Chairman of UN COPUOS, France set up an informal working group on «Long Term Sustainability of Space Activities». Participants included 20 space-faring nations and three large commercial operators of geosynchronous satellite constellations. Several IGOs and NGOs were also involved, such as the International Telecommunication Union (ITU), the World Meteorological Organization (WMO), the International Space Environment Service (ISES) and the International Association for the Advancement of Space Safety (IAASS).

The informal working group is preparing a report that should be ready by the end of 2009. It will propose information exchange mechanisms and consensus-based "Best Practices Guidelines" on the various issues affecting the sustainability of space activities:
- Space debris mitigation and remediation;
- Improving the safety of space operations;
- Managing the electromagnetic spectrum;
- The impact of space weather and other natural causes;
- Review of existing international mechanism(s) to improve the safety and sustainability of space activities.

The information report on Best Practices Guidelines is meant to be circulated and used as a basis for UN COPUOS consideration of the issue of "Long Term Sustainability of Outer Space" in 2010. It can additionally be considered as possible implementation guidelines for political agreements such as the EU draft Code of Conduct.

The "Best Practices Guidelines" do not address the issue of deployment of weapons in outer space, which is addressed by the Conference on Disarmament.

The draft Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT)

In February of 2008, Russia and China proposed a draft treaty to the CD. In this PPWT, both countries make the case for a legally-binding treaty with an expanded scope.

The PPWT defines space weapons and would ban the deployment of weapons of any kind in outer space. While the deployment of space-based weapons might not be imminent, the draft treaty recognizes that this eventuality cannot not be ruled out in the future. In this view, preventive arms control measures are warranted, and it would be best to foreclose this avenue of competition before it begins.

The treaty would also encompass an important provision on the non-use of force (article 2). This could be understood to forbid some types of ground-based systems, such as lasers or electronic jamming devices.

A dispute settlement mechanism would be set up within the executive organization of the treaty. Verification provisions would be negotiated in an additional protocol. Since verification of a no-test provision would be too difficult to put in place, testing would not be covered by the treaty.

The CD at its session of 2008 and 2009 conducted several rounds of discussion on the PPWT.

Official text for the proposal, accessed July 22nd:
http://daccessdds.un.org/doc/UNDOC/GEN/G08/604/02/PDF/G0860402.pdf?OpenElement

A Ban on the Testing and Use of Weapons that Cause Space Debris

All actors who depend on the benefits that space activities provide can agree that debris-causing technologies are destructive to the space environment and the ability to use outer space productively. Hence, Michael Krepon and Sam Black of the Henry L. Stimson Center advocates a "Treaty Banning the Testing and Use of Destructive Methods Against Space Objects"[6]. The logic of the Krepon-Black proposal is as follows:

1. This initiative would address the issue of space debris, which many perceive to be the most immediate and pressing threat to space security.

2. The proposal would ban testing and use of destructive methods, of whatever kind, against man-made objects. The focus on "actions" rather than "weapons" makes it inherently verifiable, therefore effective. Debris-producing systems include for instance ground-based missiles modified for ASAT use or spacecraft that can maneuver for kinetic destruction of their target. Their deployment would be possible in theory, as long as they are never tested nor used.

3. This pressing threat would be addressed in a legally-binding treaty, a format that some States strongly support.

4. A treaty of narrow scope focusing on destructive testing and use against space objects lends itself to monitoring by national technical means, especially by the United States. For these reasons, it is conceivable that a treaty of limited scope focusing on destructive testing and use against space objects might secure bipartisan support in the US Senate, some members of which have been strongly opposed to proposals that might limit US military freedom of action in outer space.

Working Paper on the Merits of Certain Draft Transparency and Confidence-Building Measures and Treaty Proposals for Space Security (presented by Canada at the CD, June 2009)

In the Spring of 2009, Canada circulated a Working Paper at the Conference on Disarmament in Geneva. Together with its introduction by Amb. Grinius, it proposes to negotiate a code of conduct or a Space Security Treaty based on three rules:

1. Ban the placement of weapons in outer space;
2. Prohibit the test or use of weapons against any satellite so as to damage or destroy it;
3. Prohibit the test or use of satellites, themselves, as weapons.

These three simple rules deal simultaneously with the security, safety and sustainability issues for outer space as they essentially ban the application of physical force in outer space and the devices that give rise to the need to use physical force in outer space. To meet the vital needs of national security for states, the proposal, by omission, retains the existing international rules governing the use of electromagnetic and electro-optic interference to meet the challenges of threats posed by space systems.

The Canadian working paper has proposed that a grand bargain be struck in order to preserve the continued use of outer space for all humankind. Physical violence in outer space must be prohibited and purposeful interference should be restricted to reasons of self-defense as is permitted by the UN Charter. While the principles have been presented in the form of a legally-binding treaty, the principles could be first codified in a code of conduct in order to begin state practice and attain space security for the benefit of all humankind.

These behavioral rules have also been fashioned in a manner that does not require the

---

[6] Sam Black's presentation on this topic, accessed July 22nd: http://www.ifri.org/files/Espace/SBlack.pdf

development of contentious definitions, and again in a manner that is verifiable, relying as it does on those observational characteristics of space objects that can be collected by national technical means of verification. For those that prefer definitions, Canadian officials define a weapon as "a device based on any physical principle that injures or kills a person, damages or destroys an object, or renders any place unusable."

The Canadian proposal is thus seen by many to occupy the middle ground between the EU's draft Code of Conduct, which does not address the space security issue of the weaponization of outer space, and the Russian-Chinese PPWT proposal that does not permit the use of electromagnetic interference to protect a state's national security interests during times when the UN Charter could be expected to apply.

Canada's Working Paper, accessed on August 27th:
http://www.reachingcriticalwill.org/political/cd/papers09/1session/CD1865.pdf

Chapter 2: The negotiation process

The current debate over space security is intensifying and involving more players internationally. This brings about a debate on where negotiations should be held. While the EU Code of Conduct is discussed on a bilateral basis, Canada, for instance, would prefer to keep discussions within UN structures such as the CD and UN COPUOS.

The UN is indeed playing a larger role on space issues. The utilization of space applications within the UN system has increased significantly and the creation of a "UN space policy" was proposed by Ambassador Ciro Arevalo from Colombia, Chairman of UN COPUOS, in the last session of the Committee. A United Nations space policy would serve as an umbrella on space affairs for the UN stakeholders benefiting from space applications. The UN Space Policy will urge for the peaceful uses of outer space for the benefit of all human kind as well as fair and responsible use of space in accordance with all international treaties and best practices.

Civil society can also play a role in moving along the discussion of some of these issues by encouraging constructive dialogue and international exchange of ideas on space security.

UN forums for discussion

The UN entities that discuss space and space policy have been very active in recent months.

The **Committee on the Peaceful Uses of Outer space** (UN COPUOS) is a UN body created in 1959 "to review the scope of international co-operation in peaceful uses of outer space, to devise programmes in this field to be undertaken under United Nations auspices, to encourage continued research and the dissemination of information on outer space matters, and to study legal problems arising from the exploration of outer space"[7]. A number of ambassadors or high-level diplomats attend the meetings while many delegates have a strong scientific or technical background.

While UN COPUOS cannot directly address military space and the problem of weapons in space, it has addressed it indirectly through the issue of space debris: Guideline 4 of the Set of Space Debris Guidelines adopted by UN COPUOS in 2007 states that actors must not destroy spacecraft if such actions create long-lived orbital debris. Also, some delegations at

[7] From UN COPUOS' official website, accessed July 3rd, 2009. The annual session was held at the beginning of June with 69 very motivated members. UN COPUOS operates on a two-year rotating presidency. In June 2009, Colombia.

UN COPUOS include military consultants. For example, there is adequate civilian and military expertise in the Russian, Chinese and US delegations.

The **Conference on Disarmament** (CD) was established in Geneva in 1979 as the single multilateral disarmament negotiating forum of the international community. Delegations discuss military issues and seek arms control solutions.

The CD established an "ad hoc" committee on the Prevention of an Arms Race in Outer Space (PAROS) in 1985, in relation with the PAROS resolution that is voted every September by the UN General Assembly. However, discussions on space have been stalled for many years and the working group was discontinued in 1994. The negative attitude of the United States toward this initiative has been blamed, though other factors are also at work. For instance, space security is often discussed in relation with other issues, which complicates the discussions. Russia for example explicitly links the debate on space security to that on strategic arms reduction[8].

However, major progress was initially made in 2009 with the adoption of a Program of Work for the 2009 session (CD/1863)[9]. A working group on PAROS was reinstated. Delegation members comment that progress is slow but promising. Despite this optimistic turn of events, Pakistan later objected to the Program of Work on issues unrelated to space matters and progress on space discussions is on hold for the time being.

The two organizations have very different mandates. The CD deals solely with disarmament issues and outer space is only a relatively small component of its mandate, while UN COPUOS deals exclusively with peaceful uses of outer space (which includes non-aggressive military uses). Besides, UN COPUOS tends to use a bottom-up approach to what actors can do in space, while the CD favors top-down discussions among delegates leading to a treaty. In the view of some of its delegates, UN COPUOS should not meddle in disarmament issues and indeed, it does not plan to address these issues. Similarly, some CD delegates would like their forum to keep away from the debris issue as long as it is not directly linked to disarmament matters.

However, as there is an indisputable overlap between safety and sustainability handled by UN COPUOS, on the one hand, and security issues handled by the CD, on the other, good communication between the two entities will be of the essence as they handle their own areas of responsibility and as we move forward. Initiated under the UN COPUOS Chairmanship of Gérard Brachet (2006-2008), information exchanges between the CD and UN COPUOS started in recent years and are now on-going. As an independent entity active in the field, UNIDIR has also played a role in reinforcing the communication channels between the two bodies and could continue to do so. UNIDIR could be strengthened in order to provide a more effective bridge between UN COPUOS and the CD.

Foster communication and circulate knowledge

Some observers have expressed concern that experts at the CD and UN COPUOS and indeed elsewhere are always reinventing the wheel. In their view, many technical issues are discussed at length in diplomatic forums when the technical community has already reached conclusions about what should be done.

Sometimes, this is caused by a global lack of communication between and amongst stakeholders. Interested parties do not communicate enough, even within States, which often causes disconnects between political, technical, military and legal matters. Many delegations at the CD and at UN COPUOS are too small to maintain all the necessary knowledge. For

[8] The debate on space security is also linked to industrial security issues, through the relationship with private commercial actors.

[9] http://rescommunis.wordpress.com/2009/05/29/conference-on-disarmament-adopts-programme-of-work/ accessed July 3rd, 2009.

instance, only a few delegations are capable of writing technical TCBMs.

Fortunately, the separation between the CD and UN COPUOS that caused a lack of communication on military and civilian issues is less strict nowadays, and this is an important improvement.

We need to link policy and technical issues and generally upgrade the level of technical knowledge of policy-makers sitting at negotiation tables, so that all technical issues are well-known and out of the way. Political discussion can often then be quicker. A manual or primer on space technologies should be widely circulated at the CD and UN COPUOS.[10]

Pursuing several efforts versus one single goal

The EU draft Code of Conduct, the Best Practices Guidelines, the PPWT, the Canadian proposal and the Stimson Center proposal have been tabled and considered in several venues. Some observers believe that current multiple initiatives are diluting efforts to reach a secure, safe and sustainable outer space environment. Pursuing an effort outside of the UN negotiating bodies could for instance undermine their legitimacy to make real progress on issues confronting outer space. It may also re-awaken old rivalries, between the CD and UN COPUOS, for instance, or between old adversaries. The difficulties of the CD Working Group on TCBMs in the 1980's are a case in point. Also, such dilution of efforts could be used to prevent any real action towards space security. Instead, according to these observers, we should choose one format and pursue it, just like the international community did at the time of the "Open Skies" Treaty negotiations.

Others experts contend that multiple efforts do not necessarily undermine each other if the different initiatives can be seen as complementary. Indeed, there are two different tracks. The first one pursues arms control agreements per se while the second tries to ensure better behavior in day-to-day operations. The situation is similar to that of the nuclear non-proliferation effort in which the International Atomic Energy Agency (IAEA) supervises government discussions while the Nuclear Supplier's Group sets up non-binding rules. In that light, the European draft Code of conduct belongs to that second track and would not necessarily disrupt or impede broader UN efforts towards an arms control treaty.

Moreover, negotiations on a treaty will take several years whereas the EU draft Code could be relatively quick to put in place. It does not aim to disarm and therefore would not have to go through the difficult negotiation process of the CD. In any case, the adoption process of the CoC could be similar to the adoption process of the "Space Debris Mitigation Guidelines" by UN COPUOS. As we saw, these Guidelines were inspired by an IADC proposal. Not all of the IADC recommendations were transcribed into the UN COPUOS text, prompting some to call the latter a "watered-down" version of the IADC proposal. But at least a UN-approved set of guidelines now exists. If an international Code is adopted based on the EU proposal, this could be considered as a first step in the right direction.

More generally, TCBM efforts could be considered as steps on the road to a treaty. Small steps build confidence. Additionally, bilateral approaches, such as the post-February 2009 collision exchanges of information between the US and Russia can reinforce multilateral talks and constitute a useful input.

However, differentiating between ultimate goals and intermediary steps, right and wrong steps may be difficult. If we need to choose one priority, limiting actions that cause debris would be a good first step. There is a political consensus that this problem must be dealt with now, otherwise it may become a century-long curse. It is an issue that working groups at the

[10] A number of excellent resources are already available. For instance, the Union of Concerned Scientists published *The Physics of Space Security: A Reference Manual*, by UCS scientists David Wright, Laura Grego, and Lisbeth Gronlund, in 2005.

CD and at UN COPUOS can pursue in parallel with regular communication.

How to devise a strategy?

The different efforts for space sustainability can be complementary, but not without an overall strategy on how to proceed. The Code was an excellent initiative for the timeframe of 2007-2008 and remains a promising start. But given the current international consensus that we need to stabilize the conditions of the space environment and prevent it from becoming unusable, the Code and the Best Guidelines, if adopted internationally, could now be the lowest common denominator. More ambitious goals could now be aimed for, but we need a coordinated strategy to build on the political momentum.

Major conferences constitute good opportunities to brainstorm on such a strategy. In 2010, there will be the annual UNIDIR conference on PAROS. There should also be a fourth Space Situational Awareness (SSA) conference. In addition, the German government may organize a follow-up to the June 2007 Berlin workshop on space surveillance and SSA. It would take place in Berlin in January-February 2010.

A smaller group may be more productive to devise a strategy, however. Here are two ideas for a proper discussion group.

The United Nations Institute for Disarmament Research (UNIDIR) is a good place to facilitate discussion. UNIDIR was established in 1980 by the United Nations General Assembly as an independent research entity within the UN structure, to assist States and the global community on questions of international security and disarmament. UNIDIR has a council, rolling meetings and a rolling briefing book, as well as monthly review groups for the Biological Weapons Convention and the Chemical Weapons Convention.

UNIDIR currently depends on voluntary contributions from countries and NGOs to pursue its different programs. If sufficiently funded, UNIDIR efforts could create a larger momentum for negotiations. A monthly review group on Space Security could be set up, similar to the Biological and Chemical Weapons review groups. An added benefit of this option is that formal groups always generate informal bilateral meetings on the side. These are often very important. That is where much, if not most, of the real progress is made.

Alternatively, a small team of perhaps four officials, two NGO and two industry representatives could meet outside the UN structure. This would be a multi-track effort, joining non-government and inter-government representatives with government officials in an effective combination. In 2000, ESA convened a working group of four high-level personalities to come up with a strategy for the future relationship of ESA and the EU. They came up with what was called the “Wise Men Report”. The report was full of innovative ideas and was considered a success. This could be the model for the space community.

How to involve developing countries?

Some developing nations are eager to participate in discussions on space stability. Algeria and Nigeria for instance are part of the informal working group on the “Best Practice Guidelines”.

Indeed, if the discussions on space security were to be continued outside the UN framework, there would be high sensitivities amongst developing countries. They would be concerned about the larger developed countries not including them in the negotiation process. Many of the developing countries’ attitudes can be explained by the fact that they want to be treated fairly by the international community. Emerging space nations try to keep all possibilities open. This is the policy they pursue within the International Telecommunications Union (ITU) for instance.

Developing countries could be included in space policy discussions on the international level.

For instance, UN COPUOS has participated in developing regional structures to build up capacities (in Asia and Pacific for instance). However, some of these countries may be reluctant to sign anything before they achieve an operational space capacity and may hold up discussions for a long while.

West-West debates are also present, centering on the issue of European autonomy. European governments have tended to insist on the development of independent capabilities. This has been seen with the development of European space launchers in the past, the Galileo navigation system more recently, and now with SSA (see below). As these latter means are required for the implementation of any agreement on space security, the issue of European SSA will come into play in any future negotiations.

Chapter 3: TCBMs in space

In the view of some, the adoption of Transparency and Confidence-Building Measures in space is an important first step on the road to stability. TCBMs can cover a large range of measures, from the comprehensive to the narrow. There is already a large corpus of TCBMs on many security matters -not only space- in the UN and the CD as well as extensive work being done on this by research entities such as UNIDIR. Original TCBMs were elaborated in the 1970's to facilitate relations between Western and Eastern Europe within bodies such as the Organization for Security and Cooperation in Europe (OSCE). They involved exchange of information on military force levels, troop maneuvers and border management. TCBMs were emulated in other regions of the World and with regard to different types of weapons.

As far as space is concerned, a Russian and Chinese working paper was circulated in the CD and led to the adoption of UNGA resolution 62/43 of December 2007 on "Transparency and confidence-building measures in outer space activities". There are also bilateral TCBMs, that can retain a higher degree of informality. Some were put in place by the U.S. and Russia after the February 2009 satellite collision and cover the exchange of satellite maneuver specialists. Similarly, there are information exchanges between the U.S. and China on computer programming linked to debris.

The legal value of current space TCBMs and of the EU draft CoC is limited. Although some other Codes such as the 1972 "Rules of the Road at Sea" are actual international agreements, the EU draft Code and other TCBMs would not be legally binding. They may evolve into international customary law if all states come to consider them as a legal obligation. For this to happen, governments would need the assurance that the other states also abide by those rules, which is where "confidence-building measures" come in again. The status of the TCBMs corpus is evolving and the political context on the international scene will prove an decisive factor.

It would be in the interest of all spacefaring States to convene a study group on space TCBMs examining acceptable behaviors and unacceptable behaviors for space activities under UN auspices. The study group could be considered as a parallel effort to the CoC bilateral discussions, this time involving all countries.

Critics of TCBMs say such initiatives miss the real issue because they do not discuss the possibility of space weaponization. They may even divert attention from "real" disarmament efforts that could come to fruition in the near future. The EU CoC calls for States to "prevent harmful interference" and refrain from debris-creating activities but does not tackle the issue of space weapons per se. This is for the arms control measures to do.

Finally, the difference between TCBMs and arms control treaties has to do with how we appreciate the balance between two conflicting interests: on the one hand, states wish to keep their own hands as free as possible. On the other hand, they wish to tie those of their

potential opponents as much as possible. Arms control treaties will tilt the balance towards more constraint for everyone, actually reducing weapon numbers, while TCBMs will choose to give more freedom to all, focusing on fostering reassurance and an atmosphere of trust. However, TCBM's will ideally lead countries to accept limits to their own actions based on the confidence that others also will.

Chapter 4: Arms control in space

Arms control agreements in space would seek to actually forbid a number of actions or deployments. Verification means would be necessary as well as a dispute settlement mechanism and perhaps even sanctions. Countries would be very much constrained by such a text and clear definitions of terms would be a pre-requisite in any negotiation.

Definitions

In other areas of security, words like "terrorism" or "weapons of mass destruction" have no legal definition and yet we can still devise agreements on these issues. Meanwhile, space TCBMs can avoid most of the issues over finding an adequate definition, because they are not legally-binding and do not address weapon systems per se.

Nevertheless, arms control in space needs legal definitions, because most space-related definitions can cover very different elements and the international community cannot proceed without knowing what it is talking about. This proves very difficult, however, as choosing to include one element or the other in the definition has consequences in terms of policy and strategy. This is not neutral, but indeed very much a political choice on the part of the governments involved.

A number of definitions come up in the treaty proposals for space security we have been considering. We will only take a few examples.

. How would one define **space weapons** for instance? This definition is probably the most open and the most contentious. The PPWT gives a very wide definition, including systems that target objects or population on Earth (art. 1c). Art.2 mentions that countries will "not resort to the threat or use of force against outer space objects", which can be understood to include a ban of ground-based system, such as jamming devices and lasers. The much narrower treaty proposal by the Stimson Center would not ban the latter systems, however, because it chooses to deal with debris-creating systems only. The three rules posited by the Canadian proposal eschew the need for a definition of the term weapons, but Canada usually uses the following definition: "a device based on any physical principle that injures or kills a person, damages or destroys an object, or renders any place unusable".

If the definition of space weapons includes "devices that follow part of an orbit" (art. 1d of the PPWT), this would include ground-based missiles. Indeed, the destruction of USA 193 in February 2008 involved a modified ABM missile. But it seems very unlikely that the U.S., Europe, Russia or China would accept to discuss a ban of their ABM systems for space security reasons. Banning the use of ABMs that are specifically modified for ASAT use is what the Stimson draft proposes to do. The Canadian proposal avoids such language difficulties by giving protections to satellites only and not to all space objects, which can include their launch vehicles. Thus it does not afford a protection to a space launch vehicle's payload until it orbits at least once, and it does not afford protections when satellites re-enter the Earth's atmosphere after performing their re-entry maneuvers. The benefit of this proposal is that ballistic missiles and their re-entry vehicles are fair game for ballistic missile defense systems located on the surface of the Earth (air, land, and sea).

Finally, another major issue is that some weapons are still in development when others are already fully operational. Should we rule out deployment of possible future weapons once and for all, or focus on preventing the dangerous systems that are already operational?

. The most exotic space–based ASAT systems remain in development today. However, any satellite that has a homing device and a maneuvering capacity can get close to another satellite and therefore be considered as a kinetic weapon. This depends on the **intention** of the satellite's operator. However, intention is a concept that is impossible to include in a treaty definition because it is generally only apparent after the fact.

. Some lawyers have a preference for the notion of **actions**, such as prohibiting the **use of force**, extended to the **threat of use of force**. These wordings appear in the PPWT proposal. The Stimson proposal adds that actions are "inherently verifiable" (and threats too) and focuses on banning them. Only three scenarios of acceptable use of force would have to be made room for in such a treaty: self-defense (article 51 of the UN Charter), "peace-enforcement" (art. 41.5), and possible actions against Earth-threatening asteroids.

. The banning of **tests** is also a debated issue. Numerous tests are being done in university laboratories, for instance, and a total ban would be very difficult to verify. This is unless tests are defined in a restrictive manner, as in the ABM and SALT treaties. The Canadian proposal follows this model: "Test means to flight or field test in a manner observable to the national or multinational *technical means of verification* or compliance monitoring". The fact that some countries will want to test an ASAT before they agree to sign a banning agreement may be more difficult to deal with.

Discussions on legal definitions tend to be lengthy and repetitive. A first step to remediate this would be to have better informed delegates (see above). At the end of the day, however, reaching a consensus will probably mean choosing one definition over the others and proceeding with one of the current proposals.

Retaliation or sanctions?

In the US 2006 National Space Policy, space is presented as a "vital national interest", because of US dependency on space infrastructures and assets. We can expect serious consequences if there is an attack on U.S. space assets. Other countries could have similar reactions if systems upon which they depend for security were attacked. However, there is a general international understanding that retaliation should be proportionate to the attack.

It remains to be seen whether retaliation could affect non-space elements in the attacking country. This would probably not work for countries that have a clause of self-defense in their Constitution (such as Canada or Japan). They would not be likely to attack, say, a harbor in retaliation for an attack on space assets.

Alternatively, future agreements could develop a "dispute settlement mechanism", as the PPWT proposes to do.

Verification

For TCBMs and the EU draft Code, verification may be less important, because security interests of the parties would not be seriously compromised by a breach in the respect of the rules.

Conversely, an organizing principle for arms control treaties could be verification. Verification is a trade off between technical difficulty and political necessity. As mentioned, it is easier to verify actions in space than the existence of systems that have not been used.

The example of the biological and chemical weapons conventions is different however. Verification was not a key issue in these instances because it would have been impossible

anyway. The US accepted these conventions because it was determined not to use biological and chemical weapons and could retaliate upon attack with nuclear weapons.

Part 2: The Debris issue and SSA

Space traffic is threatened by increasing crowding, increasing debris, risks from space weather and threat from the use of weapons. Thus, safe use of space is far from guaranteed. The risk of collision is particularly acute over the poles, because polar orbiting satellites and polar-orbiting debris tend to converge there. Present Guidelines, such as the UN COPUOS Space Debris Mitigation Guidelines, endorsed by the UN General Assembly in December 2007 are necessary but not sufficient to maintain the long term sustainability of activities in outer space.

Destructive ASAT tests include the US Solwind ASAT test in 1985; the Chinese ASAT test in January 2007 and the USA-193 removal episode in February 2008. The worst three events in terms of space debris generation are the 2007 Chinese ASAT test, the 2007 Russian Briz-M rocket break-up and the February 2009 satellite collision. Such destructive events are a serious threat to safe operations in space. One or two debris-creating actions can have severe long-term consequences.

Thus, even if debris from normal space operations were reduced to zero, accidental collisions and satellite breakups would eventually lead to unsustainable conditions in space. In order to maintain sustainability of space operations over the long term, the world will need a combination of stronger controls on debris creation in normal operations (i.e. debris mitigation) and some form of space traffic management. In addition, recent research has emphasized the need to begin debris removal efforts within a few years.[11]

Even if debris removal becomes feasible technically and financially, in order to operate safely, space operators will continue to need to know where their satellites are in relation to other functioning satellites and debris—so called space situational awareness (SSA). They will also need to be capable of performing conjunction assessments on the probability of their spacecraft colliding with other space objects. If changing the satellite orbit is feasible, satellite destruction can be avoided. For example, in July 2007, NASA felt it advisable to shift the orbit of its Terra satellite to avoid the possibility of colliding with debris from the Chinese ASAT test, and that same month moved its Cloudsat satellite out of the way of the Iranian Sinha-1 satellite, which was in danger of colliding with Cloudsat.

This situation is particularly challenging because most actors in space do not have the resources to provide indigenous SSA capabilities.

Current efforts to monitor space

1. Government systems. The United States operates the most complete and most sophisticated SSA system: the US Satellite Surveillance Network (SSN), with several optical

[11] Leonard David, "APL Scientists Contemplating Plan for Cleaning up Orbital debris", *Space News*, April 20, 2009, p.14.

telescopes and radar installations throughout the northern hemisphere. China, Russia and several European countries have telescopes and radars used for SSA, with more limited coverage. To date, however, there is no coverage of the southern hemisphere skies. ESA has started an SSA program, but it will not be fully operational for several years. It currently depends primarily on two optical telescopes and limited use of the French Graves radar to follow its satellites.

2. The International Scientific Optical Observation Network (ISON) collects high fidelity (special perturbation quality) data in GEO and MEO. It is coordinated through the Russian Academy of Sciences. Eighteen institutions in 9 countries contribute data to the network from 25 optical telescopes.

3. Amateur networks are also active in following satellites and publishing positional data on the World Wide Web. Some specialize in attempting to image low Earth orbit satellites. In one case, an amateur telescope operator was instrumental in alerting a commercial communications satellite company that a defunct US classified satellite was drifting through its satellite constellation.

4. Commercial communications satellite operators, including Intelsat, Inmarsat, Eutelsat, and SES have banded together to improve operational coordination among satellite operators and to share positional and other operational data in a way that protects proprietary information. Under this plan, the companies will develop common operating standards and contribute positional and other data to a trusted third party that will help the operators maneuver and conduct routine operations safely. This data center prototype is likely to be incorporated as a separate legal entity on the Isle of Man by the end of 2009, after which the participating companies hope to engage other commercial and governmental satellite operators in the enterprise. Just how this private sector initiative will interact with government efforts is currently unclear.

More generally, commercial operators should be engaged long-term in international discussions of SSA technical discussions and future agreements on SSA.

One or several data centers?

In order to contribute to a safer space environment for all actors, the USAF has for several years maintained a publically available database of orbital object positions, which can be accessed at http://space-track.org.

The USAF has also been experimenting with a pilot program to provide conjunction assessments for certain commercial and foreign entities (CFE). In this program, it has worked with commercial GSO operators like Intelsat and Inmarsat and European allies to assist in keeping their satellites from colliding with other space objects. However, as the February 2007 Iridium collision with a non-operational Russian satellite demonstrated, the CFE program is insufficient to cover all operational spacecraft.

The USAF is currently working toward an enhanced SSA effort that will in time provide conjunction analysis for all operational satellites, no matter what country. This could lead to the creation of one single data center under the US banner. However, such an SSA architecture will necessarily have limits, because satellite operators will not necessarily be willing to give up control over their own data sources to a single entity, no matter how well-meaning. Countries are not likely to share data in times of risk or crisis. Even in peaceful times, countries will not share all their data with everyone as the EU code proposes.

Most workshop participants were of the opinion that several data centers are needed in different areas of the world. Russia already has significant indigenous capacities and Europe is certainly working to that end. In order to balance the security sensitive value of satellites data and the need for general and easy access, these centers will operate their own systems

with some protection of security. The US data center could use the Commercial and Foreign Entities (CFE) system to communicate with the other centers. It already communicates with the Russian system through the bilateral Joint Data Exchange Center.

Eventually, SSA will have to be complemented with a proper international agreement to stabilize space and by the adoption of international standards for SSA architectures.

The European effort for SSA

As mentioned, SSA is an area where Europe wants to develop independent capacities. With the exception of the French radar system GRAVES[12], Europe cannot currently track objects in space without a cue from US SSN systems or the ISON network. The EU, ESA and EDA are eager to demonstrate that Europe can achieve SSA capacities.

A European program for SSA was launched during the ESA Ministerial Council of November 2008. Phase one is a 3-year demonstration effort due for completion in 2011. It will cover space surveillance, space weather and NEO threats. The budget for this initial phase is 50 million euros with the expectation that it will evolve into an operational SSA program after 2011.

There is a level of cooperation on SSA between ESA and the EU, similar to the Galileo and GMES[13] programs. The exact role of ESA as an operator of a European SSA architecture will be defined in 2011, during the next ESA ministerial council. EU ministers will then decide on continuing the program, managing and funding it, etc. The ESA charter is for "exclusively peaceful purposes", but this is understood to allow for non-aggressive uses of space. This covers military-support architectures, peacekeeping and peacemaking missions. Developing SSA systems in that context is wholly permissible.

European SSA data policy is currently rather restricted. Many of the existing observing systems and data processes are under military control and military officials tend to be very cautious when discussing data-sharing policies. Conversely, the US SSA data policy seems to be quite open: data is available on websites such as spacetrack.org, although at a reduced level of quality. Also, U.S. SSA data do not include orbital information about U.S. military spacecraft.

Initial talks on a possible collaboration on SSA data sharing are on-going between Europe and the United States[14]. The US Air Force, ESA, the EU and private satellite operators are conducting bilateral technical workshops on standards: explaining each other's models and trying to come up with a degree of interoperability. Eventually, interested States and commercial entities should consider developing an international SSA System of Systems, perhaps in analogy to the Global Earth Observation System of Systems (GEOSS). Existing efforts to cooperate on SSA, such as the current US-EU and US-Russian discussions, could be later extended to other countries.

How does collision avoidance work today?

The space community should have a phonebook of the satellite maneuvering centers maintained by operators to contact them quickly. Also, satellite operators could agree to conduct "collision avoidance" exercises. This could typically be part of a TCBM agreement.

Private operators could be invited to participate in such confidence-building exercises. An incentive will be that more accurate and timely SSA data joined with better satellite

[12] GRAVES : Grand Réseau Adapté à la VEille Spatiale.

[13] GMES : Global Monitoring for Environment and Security.

[14] Interview of Ken Hodgkins by James W. Canan, *Aerospace America*, July 2009-August 2009.

avoidance practice would increase operational efficiency and reduce some costs in the long run.

At this point, the French experience shows that LEO satellites have to be moved an average of 3 or 4 times a year to avoid collision. However, after-the-fact analysis shows that many avoidance maneuvers are actually not necessary and potentially even counterproductive. Nevertheless, satellite operators feel they have to proceed with these maneuvers because their data are not sufficiently accurate and they cannot take risks that a collision would occur.

The cost of maneuvering satellites is not measured in terms of fuel. That expense is negligible for avoidance maneuvers that are usually in-plane and relatively small in comparison to inclination corrections that happen once a year. Rather, this cost can be measured in terms of days when the satellite is being moved and is not operational.

Legal aspects of the SSA issue

The issue of debris is on the way to becoming international customary law. Although the IADC technical guidelines and the UNGA Resolution are still not legally binding, there is a level of national implementation in the licensing process that the US, the United Kingdom, and other governments are developing. This is visible in commercial deals, where rules for the disposal of satellites are now routinely included. In many cases, requirements on creation of debris and on disposal of non-working satellites is part of the licensing process.

The liability convention brings about complex issues. If the collision risk is between two satellites, who should move out of the way? If both operators get a warning and both decide not to move their satellite, who is at fault? Also, what if a collision avoidance maneuver inadvertently causes a collision? Operators have signed waivers with each others to hold each other harmless, and have set the liability convention aside. The data center prototype currently set up by the commercial operators includes that cross-waiver.

Sometimes, satellites are actually not operational and cannot be maneuvered, but countries do not say it publicly for reasons of national pride or policy. Also, if SSA data turns out to be faulty, can the provider (e.g., the US government) be held accountable? This question has been raised by Iridium following the February 2009 collision.