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BASIC DOCUMENTS OF THE CONFERENCE ON DISARMAMENT RELATED TO THE PREVENTION OF AN ARMS RACE IN OUTER SPACE

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Addendum

Document Symbol	Presented by	Title
CD/1778	The People's Republic of China and the Russian Federation	Working Paper - Transparency and confidence-building measures in outer space activities and the prevention of placement of weapons in outer space
CD/1779	The People's Republic of China and the Russian Federation	Working Paper - Definition issues regarding legal instruments on the prevention of the weaponization of outer space
CD/1780	The People's Republic of China and the Russian Federation	Working Paper - Existing international legal instruments and prevention of the weaponization of outer space
CD/1781	The People's Republic of China and the Russian Federation	Working Paper - Verification aspects of PAROS

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CD/1783	Russian Federation	Letter dated 29 May 2006 from the Permanent Representative of the Russian Federation to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting the address by the Minister of Foreign Affairs of the Russian Federation to the Conference on Disarmament
CD/1784	Canada	Working Paper - A gap analysis of existing international constraints on weapons and activities applicable to the prevention of an arms race in outer space agenda item of the Conference on Disarmament
CD/1785	Canada	Working Paper - Space-based verification: *PAXSAT A* then and developments since
CD/1786	Canada	Working Paper - Report of the Conference on "Building the Architecture for Sustainable Space Security" held on 30-31 March 2006 in Geneva

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WORKING PAPER

TRANSPARENCY AND CONFIDENCE-BUILDING MEASURES IN OUTER SPACE ACTIVITIES AND THE PREVENTION OF PLACEMENT OF WEAPONS IN OUTER SPACE

1. This document contains preliminary considerations which could lay a foundation for discussions among all interested states. These considerations constitute food for thought and may be corrected and supplemented in the course of further discussions.

I. General approaches

2. Transparency and confidence-building measures (TCBMs) are conducive to resolving international problems, as well as to improvement and advancement of cooperative international relations. They facilitate management of situations which could lead to international tensions.

3. TCBMs minimize the risk of erroneous perception and assessment of military activities of other states, help to prevent military confrontation, to implement on this basis the principle of no threat or use of force, to foster regional and global stability.

4. TCBMs are neither a substitute for the measures of arms control and disarmament, nor a pre-condition of implementation of such measures. Neither can TCBMs replace verification measures. However, TCBMs may facilitate work on disarmament commitments and measures of their verification.

5. Confidence-building requires good will of the states who should decide themselves whether to commence the confidence-building process, what concrete steps to take and how to practically implement them.

6. By its nature, confidence-building is a phased process.

7. It is impossible to create a universal and comprehensive model of TCBMs. They should be developed as applicable to particular areas of activities.

8. While working out and implementing TCBMs, every state should be confident that its security is not damaged and that other states gain no unilateral military and other advantages.

9. TCBMs can be worked out and applied by the states individually, bilaterally and multilaterally. They can be either voluntary or binding - if the international community deems it necessary. Multilateral character of TCBMs substantially increases their practical value. To avoid overlapping, in the process of developing multilateral TCBMs it is important to maintain coordination between all international institutions dealing with the same issue.

10. The above general observations on TCBMs can also be applied to outer space activities of the states.

II. TCBMs in the context of international law and outer space activities

11. Application of transparency and confidence-building measures in outer space activities is not a new issue. TCBMs have long been recognized as a significant element of international law and order on outer space. This is reflected, in particular, in the UNGA Resolutions 45/55B, 47/51 and 48/74B which reaffirm "the importance of confidence-building measures as means conducive to the attainment of the objective of the prevention of an arms race in outer space". The annually adopted UNGA resolution on PAROS recognizes that "the concrete proposals on confidence-building measures could form an integral part of..." "... an international agreement or agreements to prevent an arms race in outer space...". The issue of TCBMs was raised again in the new resolution "Transparency and confidence-building measures in outer space activities", adopted by the UNGA 60th session (60/66).

12. In one way or the other, TCBMs are already incorporated in a number of international agreements on outer space: the 1967 Outer Space Treaty, the 1968 Astronauts Rescue Agreement, the 1972 Liability Convention and the 1975 Registration Convention. These agreements provide, *inter alia,* for informing, to the greatest extend feasible and practicable, the UN Secretary-General, as well as the public and the international scientific community, of the nature, conduct and results of activities in outer space; providing data on the launched outer space objects, as well as outer space objects that ceased to exist on orbits or changed their earlier reported orbits; cooperation in joint management of emerging problems, etc.

13. A number of TCBMs are implemented by the states unilaterally and represent their political commitments. Russia has been informing the international community through the Internet on the forthcoming launches of spacecraft and their mission since 2003. In 2004 Russia made an important pledge not to be the first to place any type of weapons in outer space. This initiative was supported by the member-states of the Treaty on Collective Security Organization who made similar statement in June 2005.

14. All these measures are not comprehensive either in relation to different types of space activities or to participation of states in their implementation. Traditionally, this was explained by the fact that only a limited number of states could afford outer space activities. In recent decades the situation has been changing rapidly: already about 130 states in the world have their space-related programs now. The humankind is increasingly dependent on the results of its outer space activities.

15. The international community has already taken steps to develop comprehensive recommendations on TCBMs in outer space. In 1990-1993, the UN Group of Governmental Experts carried out research on the applicability of confidence-building measures vis-a-vis outer space. A report by the UN Secretary-General on this issue was prepared and presented at the UNGA 48th session (A/48/305). This research was published by the UN and commended to the attention of all member countries. Besides, concrete proposals on this matter were submitted by France, Canada and other states.

III. TCBMs and the Working Paper CD/1679

16. TCBMs can play an important role in development, adoption and implementation of a new treaty on the prevention of placement of weapons in outer space, threat or use of force against outer space objects, proposed in CD/1679. As a matter of fact, the commitment by all countries not to place weapons and to prevent weaponization and arms race in outer space, per se, would be the most important confidence-building measure in outer space.

17. First, TCBMs would contribute to creation of favorable conditions for a new agreement. The development of recommendations on possible TCBMs in space is a relatively simple first step to strengthen outer space security. In case of success, it could be easier to agree on next steps. The joint endeavor on possible TCBM recommendations would, by itself, promote deeper understanding of the states' intentions, the current and prospective state of affairs in outer space. In this sense, the joint work on TCBMs would itself promote mutual confidence.

18. Second, the TCBM-based predictability of military activities in outer space would objectively reduce probability of emergence of sudden military threats in space and from space, would diminish ambiguities in the strategic situation in outer space and, consequently, would decrease the need for early preparation of states to neutralize such threats.

19. Third, the development of verification measures in relation to the treaty proposed in CD/1679 is not an easy task. Elaboration of the treaty without verification measures - which can be prepared at a later stage – may be a preferable option to start with. In this case, TCBMs could, to a certain degree, compensate for the lack of verification measures in the new treaty, the more so what is meant is confirmation of non-placement of weapons in outer space, free of any so far. TCBMs would enhance confidence of the parties to the treaty in compliance with its obligations.

20. Working out TCBMs does not impede the elaboration of a legally binding agreement on the prevention of placement of weapons in outer space, does not distract from it, but, on the contrary, serves it. Consideration of TCBMs in two bodies - the UN and the CD - would mutually enrich and stimulate both processes. After all, both target the same thing - ensuring outer space security.

21. So far, TCBMs are mentioned in CD/1679 in a sketchy way. This does not mean that the eventual set of TCBMs in outer space in the new treaty should be limited to them. The ongoing discussions show that they could be further developed. The main ideas presented in this regard are reflected in the "Compilation of Comments and Suggestions to the CD PAROS Working Paper (CD/1679)". Like some other provisions of the future agreement on the prevention of placement of weapons in outer space, articulated in CD/1679 in a general way, the final legal language on TCBMs in the new treaty should result from the joint efforts of all interested states.

IV. Possible transparency and confidence-building measures in the context of the present-day outer space activities

22. The experience gained by the UN governmental experts during their above-mentioned endeavors in 1990-1993 should be a basis for updating our perceptions of transparency and confidence-building measures. The results of their work are the source of many ideas which have not lost their relevance today.

23. Below is a possible set of TCBMs which seem practicable today. This set of measures is not inclusive and may be regarded as a starting point for further discussions.

24. Eventual TCBMs can be divided into several categories:

(a) measures aimed at enhancing more transparency of outer space programs;
(b) measures aimed at expansion of information on outer space objects in orbits;
(c) measures related to the rules of conduct during outer space activities.

25. Such measures can be carried out in various ways: exchange of information; demonstrations; notifications; consultations; thematic workshops, etc.

A. Exchange of information on:

(i) the main directions of the states' outer space policy;
(ii) major outer space research and use programs;
(iii) orbital parameters of outer space objects.

B. Demonstrations:

(i) experts visits, including visits to space launch sites, flight command and control centers and other objects of outer space infrastructure on a voluntary basis;
(ii) invitation of observers to launches of spacecraft on a voluntary basis;
(iii) demonstration of rocket and space technologies.

C. Notifications of:

(i) the planned spacecraft launch;
(ii) the scheduled spacecraft maneuvers which may result in dangerous proximity to spacecraft of other states;
(iii) the beginning of descent from orbit of unguided outer space objects and the predicted impact areas on Earth;
(iv) the return from orbit into atmosphere of a guided spacecraft;
(v) the return of a spacecraft with a nuclear source of power on board, in case of malfunction and danger of radioactive materials descent to Earth.

D. Consultations:

(i) to clarify the provided information on outer space research and use programs;
(ii) on ambiguous situations, as well as other issues of concern;
(iii) to discuss the implementation of the agreed TCBMs in outer space activities.

E. Thematic workshops:

(i) on various outer space research and use issues, organized on bilateral and multilateral basis, with the participation of scientists, diplomats, military and technical experts.

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DEFINITION ISSUES REGARDING LEGAL INSTRUMENTS ON THE PREVENTION OF THE WEAPONIZATION OF OUTER SPACE

1. During the discussions relating to legal instruments on the prevention of the weaponization of outer space, opinions are largely divided on the issue of whether to set definition provisions and how to set such provisions. This is not only because the definition issue is a complicated technical question, but also because it might reflect divergent political, military, security and diplomatic concerns of various sides.

I. Is a Definition Provision Necessary

2. Two divergent views exist on whether future outer space legal instruments should have definition provisions. One view supports making definitions, suggesting that a lack of explicit definition of such technical terms as "outer space", "space weapon", "space object" and "peaceful use", will inevitably lead to a different understanding of principal concept of outer space legal instruments. This may bring about legal divergences, and even leave room for intentional evasion of legal obligations.

3. The other view suggests that there is no need for definitions, on the ground that formulating them is both very difficult and unnecessary, due to wide differences among various sides, to reach consensus on definition of many technical terms. Lengthy discussions on the definition issue might impede reaching a political consensus on the prevention of the weaponization of and an arms race in outer space. Those who share this view cite examples of the Outer Space Treaty and the Moon Agreement to argue that a treaty without provisions on definitions may not lead to legal disputes.

II. Definitions of Major Technical Terms

4. To date, main views and positions on some major technical terms which may relate to outer space legal instruments appear as follows:

5. **Outer Space**: The issue of defining outer space is a question of demarcating the boundary between outer space and the atmosphere. Since 1959, the issue of defining outer space remains a topic for deliberation in the United Nations Committee on the Peaceful Uses of Outer Space (UNCPUOS), its Legal Subcommittee and Science and Technology Subcommittee. However, no conclusion has been reached yet.

6. One view suggests that an explicitly delimited boundary of outer space is essential to the prevention of an arms race in outer space because many weapons and military activities are, in accordance with existing treaties and norms, allowed in the atmosphere but prohibited in outer space.

7. Another view suggests that, at present, trying to draw an artificial line between the atmosphere and outer space will not only end up in vain, but also cause more legal problems, since the international community has not yet reached a consensus on delimiting the boundary of outer space. Moreover, a demarcation will involve many different political, military, diplomatic and other concerns, which makes it difficult to reach an agreement.

8. Even those who stand for defining "outer space" have different opinions among themselves on how to delimit the atmosphere and outer space. One view suggests that outer space begins at an altitude unaccessible for aircrafts with aerodinamic principles of sustaining the flight, i.e. 30-40 km above sea level. Another view suggests that it begins at 100 km or 110 km above sea level, on the ground that as the atmospheric pressure at an altitude above that level is only one ten-millionth of that at sea level, an object can move there free of atmospheric friction and, in accordance with the celestial mechanics law, can fly along the orbit around the Earth for a full round as long as its velocity reaches 7.9 km per second. Moreover, an altitude of 100 km is much closer to the lowest adapted orbit (120 km) of a satellite.

9. **Space Weapon**: No consensus has been reached so far on the definition of "space weapon". One reason for this is that as "outer space" remains to be defined, it is impossible to define space weapons. Another reason is that differences still exist on whether defining space weapons should be based on their deployment positions or on their target positions. One view suggests that space weapons are weapons deployed in outer space regardless of their target positions. Another view suggests that in addition to the above-defined ones, any weapons targeting outer space objects regardless of their deployment positions should be considered as space weapons. All this shows that the major difference between the two views is whether to take weapons deployed in areas other than outer space which target outer space objects as space weapons.

10. Some experts have defined as space weapons any devices, installations or establishments based in outer space, including the Moon and other celestial bodies, which strike and damage objects in outer space, in the atmosphere, on the ground, in the sea or disrupt their normal functions, as well as any devices or installations based on the ground, in the sea or in the atmosphere, that strike and damage space objects, impair their normal functions or change their orbits.

11. **Space Object**: Differences relating to this technical term center on two points. First, "outer space" is yet to be defined. Secondly, whether an "object" means only man-made objects or any kind of object including man-made ones.

12. **Peaceful Use of Outer Space**: The militarization of outer space has to some extent become a reality due to the wide use of military satellites since humankind launched the first man-made satellite in 1957. Currently, 70% of all satellites are used for military purposes, while part of the rest can serve both military and civil purposes. Commercial satellites may also be used for military purposes. However, in various multilateral treaties and agreements, no explicit definition of "peaceful use" of outer space has been given yet, though it is a frequently used term.

13. One view suggests that "peaceful use" means "non-military use". In other words, any activities that serve military purposes should not be considered "peaceful use", no matter whether they are directly involved in military operations.

14. Another view suggests that "peaceful use" should include "non-invasive use" or "non-aggressive use". Such non-armed activities as satellite reconnaissance (including surveillance on the implementation of arms control and disarmament treaties and agreements), communication, navigation and nuclear explosion surveillance, which are not meant for direct military use, should also be regarded as "peaceful use".

III. Possible Alternative

15. Having appropriate definitions, if agreed upon by consensus of all Parties concerned, will undoubtedly play a positive role in discussion and adoption at the Conference on Disarmament of a legal instrument on prevention of placement of weapons in outer space. Given the differences in opinions on the definition issue, currently there may be two feasible alternatives.

(i) Option one: to follow the pattern of the Outer Space Treaty and the Moon Agreement, setting no "definition" provisions in future outer space legal instrument on the issue of prevention of placement of weapons in outer space.

(ii) Option two: based on the necessity and feasibility, to define some basic terms that are crucial to the future legal instruments of the Conference on Disarmament in this field.

IV. Tentative Thinking on Some Definitions

16. The above-mentioned second option is hereby explored. On a preliminary basis, tentative thoughts on some definitions for the purposes of this non-paper are shown below, by no means exhaustive or definite. These thoughts are only food for further consideration and discussion and will evolve along with future negotiation process.

Outer Space

17. Space beyond the elevation of approximately 100 kilometers above sea level of the Earth.

Outer Space Object

18. Any man-made device being launched into the orbit around any celestial body, or being in the orbit around any celestial body or on any celestial body except the Earth, or leaving the orbit around any celestial body towards this celestial body, or moving from any celestial body towards the other celestial body, or placed in the outer space by any other means.

Weapon (in outer space)

19. Any device, based on any physical principle, specially produced or converted to eliminate, damage or disrupt normal function of objects in outer space, on the Earth surface or in its air, as well as to eliminate population, components of biosphere critical to human existence or inflict damage to them (except those devices needed by cosmonauts for self-defense.)

Military Hostilities in Outer Space and from Outer Space

20. Actions connected with the use of weapons in outer space or from outer space.

Use of Force against Space Objects; Threat of Use of Force against Space Objects

21. These terms are used in the same sense as in a number of existing international documents.

Locations of Launches (of Outer Space Objects)

22. Geographical location (area in the territory of a state) of a space object launcher.

Space Launching Pad

23. A device designed for launching preparation, launching and space object launching steering.

Information on Objects Launched in Outer Space

24. Information on objects launched in outer space is specified by 1975 Convention on Registration. (To be indicated: name of state which launched a space object including address of the body which can be contacted to obtain additional information or assistance in case of an accident; designation of the space object or its registration number; date, territory or place of launch, main parameters of an orbit including period of rotation, inclination, apogee and perigee, general purpose of the space object).

Launching Activities

25. Integral part of outer space activities related to the launching of space objects.

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EXISTING INTERNATIONAL LEGAL INSTRUMENTS AND PREVENTION OF THE WEAPONIZATION OF OUTER SPACE

Existing international legal instruments are inadequate to prevent outer space from being weaponized

1. Since the 1960s, the international community has instituted a series of legal instruments on outer space, including the 1963 Limited Test Ban Treaty (LTBT), the 1967 Outer Space Treaty (OST), the 1979 Moon Agreement as well as some bilateral agreements. These instruments have played a positive role in promoting peaceful use of outer space and regulating outer space activities. They have also had a bearing on prohibiting the deployment of weapons of mass destruction (WMD) and certain military activities in outer space, but are inadequate to prevent the weaponization of outer space.

I. Limited Test Ban Treaty (LTBT)

2. Article I 1(a) of Limited Test Ban Treaty (Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, LTBT) prohibits *"any nuclear weapon test explosion, or any other nuclear explosion"* from being carried out *"in the atmosphere; beyond its limits, including outer space"*.

3. This provision can be interpreted as banning both tests and use of nuclear weapons in outer space. As the Comprehensive Test Ban Treaty has not yet entered into force, this provision is still of important realistic significance. However, LTBT addresses activities regarding only nuclear weapons in outer space and does not cover other weapons.

II. The Outer Space Treaty

4. Paragraph 1, Article IV of the Outer Space Treaty (Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies) prescribes that States Parties to the Treaty *"undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner".*

5. This provision bans the deployment of weapons of mass destruction in orbit around the Earth, on celestial bodies and in outer space, but does not deal with weapons other than WMD, such as conventional weapons and new types of weapons based on other physical principles.

6. Paragraph 2, Article IV prescribes that, *"the Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden."*

7. While this provision prohibits relevant military activities on the Moon and other celestial bodies, it does not restrict such activities in outer space where the Moon and other celestial bodies are, such as the orbits to and around the Moon and other celestial bodies.

III. The Moon Agreement

8. As an addition to and development of the Outer Space Treaty, the Moon Agreement (Agreement Governing the Activities of States on the Moon and Other Celestial Bodies) is a relatively comprehensive legal instrument on restricting military activities on the Moon and its orbit. However, only 10 States had ratified, and an additional 5 had signed the Agreement by August 2004. Hence it lacks universality. And it also has some drawbacks.

9. Article 3(2) prescribes that, *"any threat or use of force or any other hostile act or threat of hostile act on the Moon is prohibited. It is likewise prohibited to use the Moon in order to commit any such act or to engage in any such threat in relation to the Earth, the Moon, spacecraft, the personnel of spacecraft or man-made space objects."*

10. Article 3(4) prescribes that, *"the establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on the Moon shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration and use of the Moon shall also not be prohibited."*

11. The above provisions prohibit only tests and use of weapons of any kind on the Moon, and the use of such weapons from the Moon against the Earth, spacecraft and the personnel. However, activities of such kind in the Moon orbit and in outer space other than the Moon are not covered.

12. Article 3(3) prescribes that, *"States Parties shall not place in orbit around or other trajectory to or around the Moon objects carrying nuclear weapons or any other kinds of weapons of mass destruction or place or use such weapons on or in the Moon."*

13. This provision bans only the deployment of weapons of mass destruction on the Moon and in its orbit, but does not deal with weapons of other kinds.

IV. Convention on Environment

14. Article I (1) of the Convention on Environment (Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques) prescribes that it is not permitted, *" to engage in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party"*, and Article II prescribes that the term "environment" includes outer space.

15. This provision bans only the use of environmental modification techniques in outer space, but other means of strike, damage and injury to other States are not dealt with.

V. Relevant Bilateral Agreements

16. Some bilateral arms control agreements between the United States and former Soviet Union restricted, to some extend, the use and deployment of weapons of special kinds in outer space.

17. Article IX (1) of the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Strategic Offensive Arms (SALT-II) of 1979 prescribed that the two parties undertake *"not to develop, test, or deploy...: (c) systems for placing into Earth orbit nuclear weapons or any other kind of weapons of mass destruction, including fractional orbital missiles"*.

18. The provision had a positive role in forbidding the deployment and use of nuclear, biological and chemical weapons in the Earth orbit. However, it did not prohibit the deployment and use of weapons of other kinds in the Earth orbit. The Agreement expired in 1985.

19. The Anti-Ballistic Missile Treaty of 1972 required not to develop, test or deploy space-based anti-missile systems. The Treaty became null and void when the US withdrawal decision entered into force on June 13, 2002.

Conclusions

20. Although the current international legal instruments concerning outer space do prohibit and/or restrict, to some extent, the deployment of weapons, use of force as well as military activities in certain parts of outer space, the related provisions contained in them are limited in scope and thus inadequate for preventing the weaponization of outer space. This is reflected mainly in the following two aspects:

(i) First, these instruments are unable to effectively prevent the testing, deployment and use of weapons other than WMD in outer space, especially in the orbit around the Earth, on celestial bodies other than the Moon and in outer space.

(ii) Second, none of the above-mentioned legal documents is relevant to the question of use of force, or threat of use of force against objects in outer space.

21. The progress of science and technology, especially the research and development of weapons to be used in space warfare, as well as the emerging of military doctrines which include the concept of weaponization of outer space, make it necessary for the international community to strengthen the existing international legal system on outer space by overcoming its shortcomings and rectifying their defects so as to effectively prevent the weaponization of and an arms race in outer space. The best way is to enact through negotiations an international legal instrument on the prevention of the weaponization of outer space.

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VERIFICATION ASPECTS OF PAROS

I. What are the envisaged Measures for Outer Space Verification

1. Appropriate, feasible and effective verification could play an important role in ensuring faithful observance and implementation of a treaty. It could also help boost the confidence of each and every State Party to a treaty. On the other hand, whether, when and how to set up a verification mechanism for a certain legal instrument in the field of arms control and disarmament, must be commensurate with the specific nature and requirements of the instrument concerned.

2. Outer space verification measures envisaged by various sides up to now can be divided roughly into two categories:

3. Remote-sensing survey

(i) Outer space to outer space survey, which means using satellites to monitor the activities of outer space objects;

(ii) Outer space to the earth survey, which refers to, for example, using satellites to monitor the activities of space vehicles on the Earth and in the Earth's atmosphere; and

(iii) The Earth to outer space survey, which means, for example, using ground-based facilities to monitor the activities of outer space targets.

4. On-site inspections

(i) Inspections of relevant space research laboratories on the ground to find out whether or not research on weapons intended to be deployed in outer space or weapons targeting outer space objects intended to be deployed is going on; and

(ii) Verification of objects intended to be launched at space rockets launching sites to see whether they are weapons or whether there are weapons on board.

5. Specifically, the following ideas have been proposed --- of course this list is not exhaustive:

(i) Establishing an international satellite monitoring agency to verify the observance of certain bilateral arms control agreements and to monitor crisis situations (proposed by France at SSOD I);

(ii) Seeking satisfactory verification measures for the prevention of an arms race in outer space and conducting direct international verifications, including on-site verifications under any possible circumstances (proposed by Sweden in 1985);

(iii) Setting up a PAXSAT (Pax Satellite) system to conduct verifications through space based remote-sensing survey (proposed by Canada in 1984);

(iv) Establishing an international space monitoring agency (proposed by the former Soviet Union at SSOD III);

(v) Forming an international observer team to ensure the absence of deployment of weapons in outer space. The team will dispatch permanent observers to each space-launching site worldwide to ensure that no weapons will be deployed in outer space. To this end, prior to each launch, the following information should be submitted in due course to members of the observer team: the venue and timing of the launch, the type of the launching vehicle, and general information concerning launching objects (proposed by the Former Soviet Union in 1983); and

(vi) Verifying laboratories which conduct outer space research (proposed by the Former Soviet Union in 1986. In 1986, the United States tabled a similar proposal at the Conference on Disarmament).

II. Feasibility Analysis of the Verification Measures in an Outer Space Treaty

6. The inclusion of provisions on verification measures and the selection of their means in an arms control treaty is normally weighed against political acceptability, technical feasibility and financial affordability. As far as the envisaged new outer space treaty is concerned,

(i) Politically, verification touches upon the issue of the protection of a nation's advanced technology and militarily sensitive information. This is especially true with the fact that, because of the relatively profound intrusiveness of on-site verifications, few States with outer space capability will allow personnel from other States to inspect their laboratories, or to stay permanently at their launching sites (unless between capability-comparable states). What is more, only a small number of States have mastered the technology of satellite remote-sensing survey. It can hardly be expected that these countries will be willing to share their own "national technical means" with others. Nor will the latter be ready to accept such technical means not yet mastered by most countries as verification measure;

(ii) Technically, outer space verification measures would involve such cutting-edge technologies as survey, tracking and spotting. There are not yet adequate technological conditions at the moment to make an effective international verification regime possible;

(iii) Financial difficulties which may be brought about by the outer space verification regime cannot be overlooked. For instance, billions of USD will be needed to build such a verification system as the "PAXSAT".

7. For the above-mentioned reasons, many practical problems are to be solved before codifying meaningful verification provisions for the new outer space treaty.

III. Judging by the viewpoint of existing arms control treaties, verification provisions are not key elements of such a treaty.

8. Many elements will be brought into play when dealing with the verification issue. Currently, not all arms control treaties contain verification provisions. There are treaties that do not contain verification provisions under certain circumstances:

(i) In theory, it would be possible to set up verification regimes for certain arms control and disarmament legal instruments already in existence. However, owing to technical, financial and other difficulties, such verification regimes have not been established in reality. Even so, the relevant legal instruments are still effective and binding, playing their positive roles. Belonging to this category are: 1967 Outer Space Treaty, 1979 Moon Agreement, CCW, Sea-Bed Treaty, ENMOD Convention, etc. BWC States Parties concluded the Convention before beginning to negotiate a verification protocol. As a matter of fact, among the 21 legal instruments listed by the United Nations as "multilateral arms regulation and disarmament agreements", a majority do not have a verification regime so far.

(ii) Because of the nature of certain treaty obligations, it is difficult to verify their implementation, even if finance and technology for verification are not a problem. Some weapons prohibited by treaties have the same technical origin as those non-prohibited. Take blinding laser weapons (a prohibited weapon) as an example. Their functioning spectrum and power are within the same scope as laser disturbers (a non-prohibited weapon). The *Fourth Protocol to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May be Deemed to be Excessively Injurious or to have Indiscriminate Effects* (CCW) forbids the use of laser weapons specifically designed, as their sole combat function or as one of their combat functions, to cause permanent or temporary blindness to the naked eye. However, optic disturbers are not forbidden by the above Protocol or any other treaty. That is why implementation of obligations of this nature is difficult to verify.

IV. Conclusion: Possible Alternative

9. The most important thing to do at present is to reach a consensus in the form of legal commitment and legal instrument on the prevention of the weaponization of and an arms race in outer space. In order to facilitate an early achievement of such consensus, it may be advisable to put the verification, as well as other potential contentious issues, aside for the time being. With the development of science and technology, the addition of a verification protocol to the proposed treaty may be considered in the future when conditions are ripe.

10. This question could also be viewed from another angle. The 1967 Outer Space Treaty, although without a verification mechanism, is both important and effective. However, the 1967 Treaty does have a serious loophole in the form of not covering weapons other than WMD. Now efforts are being made towards a new outer space treaty, with the purpose of plugging that loophole. If the new treaty could have a reliable and effective verification regime, that would be ideal. Nevertheless, following the suit of the 1967 Treaty, even without verification provisions, the envisaged new outer space treaty could still serve its purpose.

11. The verification issue with regard to a new outer space treaty is very complex, involving numerous factors and elements. It certainly deserves further careful exploration and consideration.

CONFERENCE ON DISARMAMENT

CD/1783
30 May 2006

ENGLISH
Original: RUSSIAN

LETTER DATED 29 MAY 2006 FROM THE PERMANENT REPRESENTATIVE OF THE RUSSIAN FEDERATION TO THE CONFERENCE ON DISARMAMENT ADDRESSED TO THE SECRETARY-GENERAL OF THE CONFERENCE TRANSMITTING THE ADDRESS BY THE MINISTER OF FOREIGN AFFAIRS OF THE RUSSIAN FEDERATION TO THE CONFERENCE ON DISARMAMENT

I have the honour to forward to you the address by the Minister of Foreign Affairs of the Russian Federation, H.E. Sergei Lavrov, to the Conference on Disarmament.

I would be grateful if you would issue this address as an official document of the Conference on Disarmament and distribute it to all member States and non-member participants of the CD.

(*Signed*): Valery Loshchinin
Ambassador
Permanent Representative of the
Russian Federation to the
Conference on Disarmament

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RUSSIAN FEDERATION

MINISTER FOR FOREIGN AFFAIRS

To the States members of the Conference on Disarmament

Greetings to the delegations of member States of the Conference on Disarmament.

The Conference on Disarmament is a unique and irreplaceable international forum with an unparalleled intellectual and professional potential. It has made a substantial contribution to strengthening peace, security and disarmament by drafting major international legal instruments that laid the foundation for the present-day global system of security and non-proliferation of weapons of mass destruction.

Yet the past accomplishments of the Conference do not offer a comprehensive solution to the problems of arms control and disarmament. The annual agenda of the Conference clearly demonstrates that it continues to play a key role in resolving the most pressing issues of our times - nuclear disarmament and non-proliferation, security assurances to non-nuclear-weapon States, prevention of an arms race in outer space, etc. Russia advocates the fullest possible involvement of the Conference in efforts to make the world more stable and secure.

At the same time, the state of affairs in this forum, which impedes the resumption of substantive work, largely reflects the overall situation in the world. In his message to the Federal Assembly of the Russian Federation on 10 May 2006, the President of the Russian Federation, V.V. Putin, emphasized that:

> "... against the background of the acute threat of international terrorism, the key disarmament issues have all but disappeared from the international agenda, and yet it is too early to speak of an end of the arms race.
>
> "What is more, the arms race has now entered a new spiral and is attaining new levels of technology, raising the danger of the emergence of a whole arsenal of so-called destabilizing weapons."

We also come across attempts to dilute the integrity of multilateral agreements and undermine their viability. Despite the recent radical changes in the world, prejudices and bloc-based stereotypes persist in many minds, seriously hampering efforts to find appropriate and agreed solutions to common problems. Russia is determined to overcome these trends.

It is encouraging that the Conference shows no complacency, and in this complicated situation is searching for new approaches to the task of achieving consensus on its programme of work.

Each member State of the Conference has its own priorities among the items of the agenda. We believe that they can be harmonized if we agree on a balanced programme of work. Constructive proposals in this regard do exist. A number of States, including Russia, have already taken practical steps to accommodate their partners with a view to reaching compromise. We urge other countries to do likewise.

As it takes on the important responsibilities of the presidency of the Conference on Disarmament, Russia is committed to contributing in every way to progress in its activities aimed at strengthening peace and security.

I wish you successful and fruitful work.

S. LAVROV

Moscow, 29 May 2006

CONFERENCE ON DISARMAMENT

CD/1784
14 June 2006

Original: ENGLISH

CANADA

WORKING PAPER

A GAP ANALYSIS OF EXISTING INTERNATIONAL CONSTRAINTS ON WEAPONS AND ACTIVITIES APPLICABLE TO THE PREVENTION OF AN ARMS RACE IN OUTER SPACE AGENDA ITEM OF THE CONFERENCE ON DISARMAMENT

1. A vast majority of states recognise the limitations of the current legal regime for outer space as not banning all types of weapons from that domain to ensure its continued peaceful use. These states have increasingly called upon the international community to address this gap with a new legal instrument to help avoid the direct and opportunity costs of witnessing military conflict in outer space. Given the substantial information benefits for the management of terrestrial human activities by exploiting the peaceful uses of outer space - commercial, civil and military - states are naturally seeking security for their outer space activities. One requirement of this effort is that the security guarantees provided under any agreed arrangement for outer space must accord with the national security interests of the participating states. This paper considers the underlying foundations of the current security environment in outer space with a view to facilitating progress in the Conference's consideration of outer space security. In particular, the paper provides an analysis of the various possible weapon-to-target engagement scenarios thus providing an overview of areas where enhanced international controls could and should be developed.

Classification of Weapon Types

2. Weapons can be classified into one of two broad categories: weapons of mass destruction and conventional weapons. While neither term is defined per se in international law, the term

weapon of mass destruction is generally understood to apply to nuclear, chemical and biological weapons. Weapons that are not weapons of mass destruction are generally referred to as "conventional" weapons. It is interesting to note that both of these terms appear to be widely understood by both specialists and lay persons alike.

3. It is possible to divide conventional weapons into two subcategories: "mass" weapons and "energy" weapons. A "mass" weapon is a conventional weapon that primarily projects mass at its target in order to damage or destroy its quarry. A real world example would consist of an artillery shell containing high explosives to damage or destroy its quarry with fragments. A missile interceptor that simply impacts its target at high speed would be another example of a such a "mass" conventional weapon.

4. Conventional weapons that have as their primary principle of operation the projection of sufficient energy to damage or destroy their targets could similarly be assigned to an "energy" weapon subcategory. An example of such an energy weapon would consist of a high power laser that aims a focussed beam of light at its target for a sufficiently long enough interval to either damage or destroy its quarry by impulsive shock loading or by intense thermal heating. It is also possible to conceive of high power microwave weapons that do not direct radio-frequency emissions at their targets in a focussed manner but instead radiate a lot of energy in all directions in order to damage or destroy their targets at a given range.

5. The desired effects of an "energy" weapon can also be less than the permanent damage or destruction of a target. Some desired effects of an energy weapon can be secured by interfering with the normal functioning of a target or its communication links without necessarily causing permanent or irreversible harm to the target's internal components. This interference can be limited in geographical extent and applied for a limited period of time. Radio-frequency "jamming" devices for electronic links and "dazzling" lasers operating in the visible or infra-red region of the electromagnetic spectrum are examples of this type of conventional weapons. There is consequently a full spectrum of weapon effects from the temporary and reversible disruption or denial of a signal to the permanent and irreversible damage or destruction of a target available in modern warfare on the Earth. This observation applies as well to the domain of outer space.

6. It is known that all weapons have an effective range over which they can produce their desired effects. In outer space as on the Earth, it is possible that a device that can do very little permanent harm at a distant range could produce a lethal effect at a significantly closer range. However, it can often be very difficult to manoeuvre an artificial satellite from one orbit to approach another satellite in a different orbit. Weapons deployed in orbit will not be able to manoeuvre as effortlessly as their counterparts do on the Earth given the considerable quantity of fuel that must be consumed to move a satellite in accordance with Newton's laws of motion. In addition, any space debris or derelicts produced as a consequence of armed conflict in outer space with "mass" weapons could pose a very severe navigation hazard for those artificial satellites that would seek to follow in the paths of the original casualties. Armed conflict in outer space would not therefore be like the sinking of a vessel on the high seas or the downing of an aircraft from the skies. For these reasons,

were the application of military force to apply to objects in outer space, it might first take the form of electronic warfare here on Earth, and be waged by Earth-based weapons seeking effects for Earth-based targets.

Weapon-to-Target Engagement Scenarios

7. The concept of engagement scenarios pitting weapons against their targets on the basis of the environment in which they would normally operate - meaning where they would ordinarily be based - can be a very helpful aid in understanding the scope of existing prohibitions on certain weapons and activities in outer space and on the Earth. This framework can also help illustrate the gaps where future legal instruments could be negotiated to ensure the security of artificial satellites and humanity's peaceful activities in outer space. Within this intellectual structure there are Earth-based weapons and targets and there are space-based weapons and targets. Earth-based weapons are either land-based, sea-based or air-based while space-based weapons can be thought to consist of all weapons that are not Earth-based weapons. Within this framework there are four engagement scenarios possible between a weapon and its target.

8. *Earth-to-Earth:* The first engagement scenario is an Earth-based weapon that strikes at an Earth-based target. This is the realm of historical military conflict but would include a ballistic missile that is launched to strike at a distant military base or installation, a massing of military vehicles, vessels or aircraft on the Earth. The ballistic missile and anti-ballistic missile interceptor nexus in this intellectual framework is assigned to the Earth-based to Earth-based weapon-to-target engagement scenario. The rationale for this placement is that neither the flight trajectory of a ballistic missile nor the anti–ballistic missile interceptor completes at least one full orbit around the Earth. These missile and missile interceptors are also not considered to have been stationed in outer space in any other manner to qualify for a space-based designation.

9. *Earth-to-Space:* The second engagement scenario is an Earth-based weapon that strikes at a space-based object or a target in orbit around the Earth. An example engagement here would consist of a direct-ascent, anti-satellite interceptor missile that is either land-, sea- or air-launched to impact an artificial satellite in orbit around the Earth. Flight testing and deployment of such weapons have occurred in the past by the United States and the former Soviet Union but such engagements have never been known to occur in any past military conflict. There appears to be a current voluntary moratorium on the part of Russia and the United States against testing Earth-to-space and other anti-satellite weapons, especially those whose use could result in the creation of long-lived space debris. Other states should seriously consider adopting a similar moratorium.

10. The electronic jamming of downlink signals from satellites by Earth-based transmitters over a localised area of operation to interfere with Earth-based receivers, as well as the electronic jamming of uplink signals to artificial satellites by similar Earth-based transmitters to disrupt or deny signal reception by Earth-based receivers of the satellite downlink signals have occurred in the past by several nations. Some nations have also recently deployed specially designed or modified

equipment on various Earth-based platforms for such purposes. Operators of global navigation satellite service (GNSS) systems have also deliberately degraded their own signals for temporary and limited geographical regions during armed conflicts in the past while preserving the full potential of their signals for their own military use.[1]

11. *Space-to-Space:* The third engagement scenario consists of a space-based weapon that strikes at a space-based target. A conceptual example for this scenario would consist of an orbital mine that attacks an artificial satellite in orbit around the Earth. This engagement is not known to have been used in a military conflict throughout history and no space-based weapon is known to have yet been tested or deployed by any nation.[2]

12. *Space-to-Earth:* Finally, the fourth engagement scenario consists of a space-based weapon that strikes at an Earth-based target. A conceptual example here might consist of a tungsten rod that de-orbits from an orbit around the Earth to attack a subterranean military base located on the Earth. This engagement scenario has also never been used in a military conflict by any state throughout history and no space-based weapon has yet been tested or deployed in orbit around the Earth by any nation.

Existing Legal Constraints

13. Certain multilateral agreements contain provisions that either prohibit certain weapons or restrict activities involving weapons in outer space. These include the Limited Test Ban Treaty (LTBT) of 1963[3] and the Outer Space Treaty (OST) of 1967[4]. The Nuclear Non-Proliferation Treaty (NPT) of 1968, the Biological and Toxin Weapons Convention (BTWC) of 1972 and the Chemical Weapons Convention (CWC) of 1993, while they do not directly mention outer space, prohibit State Parties from developing, producing, possessing or acquiring certain types of weapons.

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[1]An Earth-based ballistic missile or an anti-ballistic missile interceptor, when engaged with an artificial satellite would be assigned to an Earth-to-space engagement scenario.

[2]The concept of a space-based anti-ballistic missile interceptor would fall to the space-based to Earth-based engagement scenario when it is engaged against a terrestrially-based ballistic missile and would fall into the space-based to space-based engagement scenario category should it ever be engaged with an artificial satellite in orbit about the Earth.

[3] Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, Signed at Moscow August 5, 1963.

[4] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies, Signed at Washington, London, and Moscow January 27, 1967.

14. The Limited Test Ban Treaty is an agreement framed to prohibit the carrying out of any nuclear weapon test explosion, or any other nuclear explosion, except by underground means. The first paragraph of Article I of the LTBT specifically provides that:

> "1. Each of the Parties to this Treaty undertakes to prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control:
>
> (a) in the atmosphere; beyond its limits, including outer space; or under water, including territorial waters or high seas; or
>
> (b) in any other environment if such explosion causes radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control such explosion is conducted. It is understood in this connection that the provisions of this subparagraph are without prejudice to the conclusion of a Treaty resulting in the permanent banning of all nuclear test explosions, including all such explosions underground, the conclusion of which, as the Parties have stated in the preamble to this treaty, they seek to achieve."

When it enters into force, the Comprehensive Nuclear Test Ban Treaty will reinforce the LTBT's existing prohibition.

15. In 1967, the international community opened for signature the Outer Space Treaty. This treaty is commonly regarded as the cornerstone international space law convention. The OST propounds a number of fundamental principles which establish the basic framework for general space exploration and utilization. Article IV of the OST contains the only provision addressed specifically to military activities and it reads as follows:

> "States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.
>
> The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited."

Existing Coverage and Gaps

16. An examination of the existing space law infrastructure indicates that the development, manufacture, production, and deployment of weapons of mass destruction in outer space is prohibited. The deployment of a weapon of mass destruction into an orbit around the Earth, on the Moon or any other celestial body, or the stationing in outer space of such a weapon in any other manner is also prohibited, as is the testing of any type of weapon on a celestial body. While existing arms control achievements are substantial, the most important observation of a coverage and gap analysis is that there are currently no codified bans applicable to any nation for the development, manufacture, production and deployment of any conventional weapons to be placed in orbit around the Earth, or stationed in outer space in any other manner. Both Russia and the participants of the Collective Security Treaty Organization have made a voluntary pledge not to be the first to deploy a weapon of any kind in outer space. For a number of reasons, including the importance of outer space in maintaining strategic stability amongst all of the great powers for early warning, surveillance and communication purposes at all times, including de-escalation of armed conflicts whether conventional or nuclear, it would appear to be prudent for the international community to expressly address these identified gaps.

Prospects for Consideration

17. Since no conventional weapons have been deployed in orbit around the Earth, tested or used in that domain as of yet, and as the current multilateral legal regime has successfully banned the placement of weapons of mass destruction in orbits around the Earth or their stationing in outer space more generally, current international efforts might first seek to concentrate on a non-proliferation agreement concerning the test, deployment and use of all space-based weapons. This has been the basis of papers put forward by Canada in the CD in 1998 and 1999 (CD/1487 and CD/1569). More recent efforts by China and Russia in their joint working papers have promoted a ban on the application of military force against space objects not only from space-based sources but also from Earth-based sources.

18. The temporary and reversible application of military force against satellites in the form of electronic jamming of signals to and from artificial satellites by terrestrial sources appears to be a part of current state practice despite International Telecommunication Union regulations that have been designed to avoid interference with satellite signals. Based on a limited survey of open source material, it also appears that intentional interference with satellite signals from another orbital source has yet to be witnessed. The deliberate degradation of one's own signals, particularly with global navigation satellite service (GNSS) signals, also appears to be a part of current state practice. These forms of state practice could serve to hinder the immediate adoption of any proposed ban that would include the Earth-to-space engagement scenarios, either directly or indirectly.

19. Canada believes strongly that a period of discussion is needed in the CD, possibly within an Ad Hoc Committee, to agree on an appropriate scope of activity for the PAROS agenda item. A space-based weapon test, deployment and use ban would appear to be one immediate candidate for international consideration given its predominately non-proliferation focus.

CONFERENCE ON DISARMAMENT

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CANADA

WORKING PAPER

SPACE-BASED VERIFICATION: *PAXSAT A* THEN AND DEVELOPMENTS SINCE

Developments in the 1980's leading to the *Paxsat A* Study

1. In the early 1980's the former Soviet Union was deploying newly developed intermediate-range ballistic missiles armed with nuclear weapons in Eastern Europe. The United States responded with similar deployments within Western Europe. The former Soviet Union had also long been testing land-based, co-orbital anti-satellite systems with fragmentation warheads. A US air-launched, direct ascent, kinetic kill vehicle was also undergoing development for a first test flight in 1985. Concomitant with these developments were the US and Soviet efforts to research and develop space-based versions of anti-ballistic missile defences predicated on the "other physical principles" allowances provided for under the bilateral US-USSR Anti-Ballistic Missile Treaty of 1972. It appeared to many then as though the world was about to embark on another new quantitative arms race and this time it would be in outer space.

2. Multilateral arms control agreements had also been successfully negotiated by the 1980's however to deal effectively with security challenges, including in outer space. If a comprehensive arms control agreement for outer space was going to be agreed by the Superpowers in the 1980's, it was going to have to meet several conditions. Firstly, it would need to be equitable: one State Party could not possess a developed capability, such as a tested anti-satellite system, while another State Party was prohibited from developing a similar capability. Any prospective treaty for banning weapons from outer space was also going to have to be in the national security interests of all of the State Parties of the agreement, including the two most powerful nations of the era. Consequently, the verified absence of weapons in a universally subscribed treaty would have to present a less risky

proposition for national security than national reliance upon an imperfect defence of actual weapons deployed in that domain. Lastly, any treaty of the era for outer space would have had to have been effectively verifiable. Prior to the Intermediate-Range Nuclear Forces (INF) Treaty of 1987, the former Soviet Union would not accept on-site inspections as a part of any negotiated arms control agreement. Consequently, in the 1980's, any proposed space-based weapon ban would have needed to have been verified by remote sensing systems as opposed to pre-launch inspections methods - almost perfect "choke points" - to verify an arms control agreement for outer space. Thus the need originated for the concept of a space-based verification system that would use artificial satellites to determine the function of other space objects.

3. The "*Paxsat A*" concept - a contraction for "Peace Satellite" - was developed by Canadian diplomats and industrialists to verify international agreements banning weapons from outer space. The *Paxsat A* study - A Study of the Feasibility of a Spacecraft Based System to Determine the Presence of Weapons in Space - asked a fundamental question, "Can space observations determine the role or function of an object in space?" The answer was a qualified yes. To see how this conclusion came about it is first important to understand the advantages that outer space can provide for a number of useful functions and the orbits that are used to execute these specialized missions.

On Basing Weapons in Outer Space

4. Outer Space can afford platforms operating there several advantages over their terrestrial counterparts. A satellite can provide a view of the whole Earth and it is therefore said that it has a global reach. Outer space is also a domain where the freedom of access is assured by the Outer Space Treaty of 1967. The passage of military forces on the Earth require the permission of the state exercising jurisdiction or control over the territory concerned. As outer space is not subject to national appropriation, no prior permission for the use of outer space needs to be sought from any other state, on the understanding however that outer space will be used in conformity with the rules set out in the Outer Space Treaty. A third advantage for operating in outer space occurs because a platform could present a rapid response to address time critical targets of opportunity on the Earth or in outer space. Ballistic missiles, cruise missiles, aircraft, vessels and vehicles can all require a considerable amount of time to reach an intended target on the Earth from their deployed operating stations. Finally, for many orbits, outer space can provide a degree of survivability, given that most nations do not possess indigenous space launch vehicles.

5. However attractive space flight might be to perform diverse military missions, the energy, effort and cost of placing artificial satellites into outer space is such that the satellite orbits and designs must be highly optimized in terms of their functions. The result of these physical, economic and technological constraints is that all satellites are found in specific orbits defined by their specific functions. The transparency of the atmosphere and outer space for electromagnetic observation of space objects also accords all nations the opportunity to monitor the positions of such objects and to postulate plausible functions for them based on the observation of a satellite's Keplarian orbital elements.

6. Satellites placed into low Earth orbit have the most detailed view of the Earth's surface and are best positioned to detect weak electronic signals from sources on the ground, at sea, or in the air. In a near polar orbit, such artificial satellites can often have the opportunity to remotely sense the entire surface of the Earth at least once per day as it turns on its axis. Accordingly, meteorological, reconnaissance, ocean surveillance and electronic intelligence satellites are often located in low Earth orbits. When a military mission must continuously survey large areas at once, to communicate with large areas with mobile receivers, or to transfer vast amounts of data from one fixed point to another fixed point, a geostationary orbit is the preferred orbit to use. Consequently, meteorological, communication and early warning satellites are all found to be located in this special orbit.

7. The geosynchronous orbit, however, does not provide a clear line of sight for communications to ground stations in the high Arctic regions. Thus, service to these regions is often provided by spacecraft deployed in highly elliptic orbits with their apogees over the northern hemisphere for eight or more hours of their twelve hour periods. In addition to this communication function, navigation and early warning functions are also performed from these types of orbits. The Global Positioning Satellite (GPS) constellation, for example, uses circular semi-synchronous orbits to provide multiple satellite navigation signals to all four corners of the globe.

8. Newton's laws of motion severely constrain a satellite's ability to move without substantial effort to another orbit. It is as if each satellite is dropped into the bottom of a gravity well by its placement in one particular orbit and a great deal of effort must be spent to climb out of that well in order to manoeuvre into a different orbit. Once the satellite locates itself in that new orbit, however, it again finds itself at the bottom of yet another gravity well. Thus any anti-satellite weapons stationed in outer space would likely be found in the same general volume of space as their potential targets, given the amount of the rocket propellant that would otherwise be needed to perform rapid intercept manoeuvres in outer space from distant locales. Similarly, orbital bombardment systems and orbital ballistic missile defence systems would likely be deployed into low Earth orbits that would seek the regular coverage of regions of the Earth similar to those of many civil or military remote sensing satellites. All these orbits are the same orbits of interest for a *Paxsat A* verification mission.

Determination of the Function of an Object in Outer Space by Observation

9. At first glance one might expect that the determination of the exact function of an unknown object placed into outer space would be an exceedingly difficult challenge. But such is not the case upon further examination by persons skilled in the design and development of artificial satellites. Engineering is a reversible process when the laws of physics are equally well known to its practitioners. The high degree of optimization inherent in the physical design of all spacecraft in their specialised orbits and the further information made available by the nature of signals to and from satellites in relation to equipment on the Earth or other objects in outer space, provide highly significant data as to an unknown satellite's function.

10. In the field of architecture there is a tenet that "form follows function" and this same tenet is observed in the art of spacecraft design because there are so many constraints acting on a satellite's design to meet the functional requirements of any given mission. The cost of launching satellites into outer space also means that every single gram of a satellite's mass must make a contribution to an essential function. Visual images of a spacecraft are consequently highly determinative of an unknown satellite's purpose. From high resolution optical images, particularly with regard to a satellite's apertures, antennas and appendages, a skilled interpreter can ascertain the details of a satellite design. If the imagery is sufficiently fine, the dimensions of rocket thrusters required for attitude control and orbital change manoeuvres can be discerned. Identification of these features will assist in determining the potential for any space object to physically engage another satellite in any other orbit by the execution of orbital manoeuvres. The dimensions of radio-frequency apertures or electro-optical apertures together with measurements of a satellite's radiated power can similarly assess the potential that any given space object may disrupt or deny a radio-frequency signal of another space object, or further damage or destroy another space object from a stand-off range.

11. The measurement of the dimensions of the size of an object's solar panels will also enable calculating an estimate of the power a space object would have available to project at another object in space or on the Earth. If a verification satellite can also acquire images in the thermal-infrared region of the electromagnetic spectrum, then additional important information can be derived regarding the energy balance and energy utilization of the unknown spacecraft. Any space-based object that is specially designed or modified to damage or destroy another object at a significant stand-off range will possess specialised characteristics for that intended mission. Recall, for example, some of the conceptual designs that had emerged from the Strategic Defence Initiative programme of the United States and the Soviet Union's counterpart in the mid to late 1980's.

12. All space-based objects that seek to attack other space-based objects from initial positions remote from their quarries, will also need to possess characteristic sensors and propulsion capabilities. Such interceptors, whether for use against ballistic missiles or other satellites, will all need to have homing sensors to provide sufficient guidance information necessary for on-board computers to calculate the required intercept trajectories. The configuration and size of thrusters, as well as the amount of internal volume available for storing great amounts of rocket propellant, will also likely result in observable features that will enable a skilled interpreter to assign a harm index for a space object's potential use against other objects. In the *Paxsat A* concept, emphasis had been given to both optical and infra-red remote sensing capabilities at a range from and in close proximity to a space object under investigation.

13. The operation of almost every type of spacecraft involves a substantial amount of communication to and from the spacecraft. The characteristics of these transmissions in terms of communication protocols, the data rates, the frequency bands of operation and bandwidths, the radiated power levels and the operating cycle of the transmitters and receivers in relation to stations on the ground or objects in outer space, are all of a highly diagnostic value to a skilled interpreter of such communication signals. Military and civil communication signals are for example assigned

different portions of the electromagnetic spectrum by international agreement. Remote sensing satellite missions similarly use radio-frequencies different from fixed satellite, navigation and mobile satellite services. The presence of encryption on these signals and its grade of protection can also help to discriminate military versus civil functions. Thus, the second major payload on the *Paxsat A* spacecraft was an electronic support measures (ESM) package to determine the parameters of all radiated emissions from the spacecraft under investigation. This ESM payload also possessed sufficient sensitivity to characterise all radio-frequency signals directed towards the unknown spacecraft as well.

14. To acquire sufficient information on a compliance investigation, the *Paxsat A* concept postulated formation flying with the spacecraft under investigation and close proximity operations with it for a period of up to one year. Thus the *Paxsat A* spacecraft was to be outfitted with on-board autonomy and relative motion sensing capabilities provided by a radar similar in capability to the one on the Space Shuttle used for rendezvous and docking. The presence of a radar on-board also gave the *Paxsat A* spacecraft an additional diagnostic capability to calculate the mass of the spacecraft under inspection. Subsequent studies added gas analysers to the sensor complement to detect materials for chemically powered lasers and the type of rocket propellants used by the satellite under investigation. Radiation detectors were also to be used to ascertain the materials associated with nuclear power sources or nuclear weapons.

15. The *Paxsat A* study showed that, to a high degree of certainty, the nature and function of an unknown spacecraft with a capability to damage or destroy another object could be inferred directly by observation or through the process of elimination. Two equations were important in this regard, the rocket equation for "mass" weapons and the effective irradiated power equation for "energy" weapons. The study concluded that some uncertainty would exist in the case of systems that were predicated on interference effects rather than damage or destruction effects, but the use of such means in outer space would certainly be determined if strategic satellites were equipped with radiofrequency or laser illumination location determination and reporting payloads.

The *Paxsat A* Concept of Operations

16. The *Paxsat A* concept for space-based verification postulated the use of four satellites: two satellites would be deployed into low Earth orbits; one satellite would be deployed in a semi-synchronous orbit; and one satellite would be deployed in a geostationary orbit. The objective was to discern objects or activities that could provide a violator with a significant military advantage. The regular pre-positioning of *Paxsat A* satellites into storage orbits was the preferred deployment scenario, since it would avoid the potential of not being able to secure a timely launch when a compliance situation developed. This strategy would also avoid escalating a delicate compliance situation with the drama of a potential launch failure for a *Paxsat A* mission.

17. Because the spacecraft was limited to carrying 3,000 kilograms of fuel, or approximately 3,400 metres per second of delta-velocity, the low Earth orbit satellites could require up to ninety days to

rendezvous with the satellite in need of investigation. Later studies would add refuelling capabilities to the *Paxsat A* satellite configuration through the use of a modular design or the in-orbit refuelling concepts then under development for space station operations. This re-fuelling ability was needed to extend the number of investigations the low Earth orbit *Paxsat A* satellites could perform. When a *Paxsat A* spacecraft was not interrogating a spacecraft, it was to perform a space object tracking mission and to take advantage of fly-by observation opportunities to collect further information on existing satellites in orbit.

18. The conduct of close proximity operations with an investigated satellite was recognised in the *Paxsat A* study as a very sensitive, if not a provocative activity. Consequently, the *Paxsat A* concept was to operate as an authorised verification method for international agreements concerning the non-weaponization of outer space. Operation of the satellites by a body charged under the treaty and in accordance with agreed rules of procedure was postulated. The study further postulated that State Parties would contribute data collected by national technical means under the treaty and that the data most sought for sharing by State Parties would be space tracking data collected by terrestrial radar and electro-optic satellite tracking installations. This information would also help to queue and support the *Paxsat A* on-orbit inspections.

19. Suspected violations of an international agreement discovered through the use of the *Paxsat A* system were to be reported by any one of the States Parties to the other States Parties. On the basis of their deliberations, decisions would be made in respect to manoeuvring a *Paxsat A* satellite to perform an interrogation and to establish an acceptable time frame for reporting its findings back to the States Parties of the international agreement concerned.

Obstacles to the Development of Systems similar to *Paxsat A*

20. In many ways the *Paxsat A* concept was ahead of its time. During the course of the study it became known that the US had postulated a similar concept in the 1960's. That project was called SAINT - a contraction for "satellite interceptor". SAINT was first to interrogate a satellite to determine whether it was a weapon or not and it was then enabled to dispose of the threat through the application of military force. That mission is not known to have ever made it off of the drawing board during the Cold War.

21. The delay until the current day in the development of proximity operation space systems for verification, however, occurred in part because of the very capable and less expensive terrestrial space monitoring systems available to the most advanced space-faring states. These types of systems also did not proceed because of the very capable reconnaissance assets the major space faring nations had already deployed into orbit. With the most recent Space Shuttle disaster it has since become public knowledge that the Space Shuttle missions could have their tiles examined by US national technical means of verification, including orbiting reconnaissance satellites. With the first launch of the Space Shuttle in the early 1980's such capabilities were the subject of much conjecture when it became known that some of the tiles had fallen off on the Shuttle's maiden flight.

22. Also constraining the development of such proximity missions during the Cold War was the inherent danger of approaching another nation's satellite without prior notice, as such actions were likely to be considered as provocative acts. *Paxsat A* would have avoided this risk by operating as an accepted means of verification within an international agreement. If the Cold War dampened these types of activities in the past, present day dual-use microsatellite developments and some military doctrines calling for offensive counter-space operations with such close proximity operation vehicles are re-kindling new sensitivities about satellites capable of operating in close proximity to other satellites. Some of these developments could one day find themselves being applied to a space-based verification role, while yet others could one day find their application to offensive counter-space activities.

Recent Developments

23. Today's miniaturization leads to new verification challenges compared to the large weapon concepts of the 1980's, but smaller satellites must carry smaller amounts of rocket propellent. Likewise, smaller satellites will have smaller apertures and less power available to apply to their main mission. Small satellites intent on harming other satellites must therefore operate in close proximity to their intended victims. These constraints on miniature space-based weapons will consequently lead to discernable operational signatures for improved space situational awareness assets.

24. A whole host of present day satellite missions are nevertheless beginning to demonstrate close proximity operations and in-orbit refuelling capabilities. Most recent notables are the XSS-11 and Global Express missions of DARPA, the DART project of NASA and the ConeXpress mission of The Netherlands. Canada is embarked on the execution of two space-based space surveillance missions over the next few years. One of these is Project Sapphire and it will operationally support the Space Surveillance mission requirements of the North American Aerospace Defence Command (NORAD).

25. What is becoming apparent from the nature of continuing developments in the field of close proximity operations for artificial satellites is the need for all nations to improve their space situational awareness capabilities - both Earth-based and space-based - in order to ascertain the potential emergence of new threats to their national security interests in a new domain.

CONFERENCE ON DISARMAMENT

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WORKING PAPER

REPORT OF THE CONFERENCE ON "BUILDING THE ARCHITECTURE FOR SUSTAINABLE SPACE SECURITY" HELD ON 30-31 MARCH 2006 IN GENEVA[1]

INTRODUCTION

1. In March 2006, the United Nations Institute for Disarmament Research (UNIDIR) continued its commitment to holding an annual discussion to explore the issue of security in space in order to further the understanding by, and the debate among, governments, academics, non-governmental experts and industry experts.

2. The meeting focused on:
   (i) The preconditions for a space regime that would provide sustainable and secure access to outer space for peaceful purposes.
   (ii) The creation of an environment which convinces space actors that it is safe not to base weapons in space.
   (iii) Increasing awareness among governments and the public of the benefits of sustainable and secure access to and use of outer space.

1 UNIDIR is grateful to the Governments of Canada, China, the Russian Federation and India and to the Simons Foundation for their financial support for this conference. Any errors or omissions in this report are the responsibility of UNIDIR.

3. The meeting was organized by UNIDIR and supported by the Governments of Canada, the People's Republic of China, the Russian Federation and the Simons Foundation and held in the Council Chamber of the Palais des Nations, Geneva. Representatives from Member States and Observer States of the Conference on Disarmament, and experts from Canada, China, France, India, Germany, Russia, the United States and the United Kingdom brought the total number of conference participants to over one hundred people. Opening remarks were delivered by: Dr Patricia Lewis, Director, UNIDIR; Mr Sergei Ordzhonikidze, Director-General, United Nations Office at Geneva; Ambassador Paul Meyer, Permanent Representative of Canada to the Conference on Disarmament; Ambassador Cheng Jingye, Ambassador for Disarmament Affairs, People's Republic of China; Ambassador Valery Loshchinin, Permanent Representative of the Russian Federation; and Dr Jennifer Simons, President, The Simons Foundation.

4. The following constitutes a summary report of the conference. The keynote speakers are identified along with summaries of their presentations. Participants in the ensuing discussions remain unidentified. As in previous years, the proceedings of the conference will be published by UNIDIR.

SESSION ONE: FUTURE AND CURRENT THREATS TO THE PEACEFUL USES OF OUTER SPACE

Threats to the Security of Outer Space: Emerging Technologies

Laurence Nardon, Institut français des relations internationales (Ifri)

5. Emerging technologies can be defined as those technologies most actively researched at present, as opposed to technologies coming on-line today. Research conducted in the United States could be the best indicator of such emerging technologies given that in 2005 the United States had a space budget of approximately US$22.5 billion.

6. In terms of the possibilities for anti-satellite weapons (ASATs), three considerations need to be taken into account: the target; the location of the weapon itself; and the level of damage required. All three considerations combine to make many kinds of anti-satellite weapons imaginable and/or desirable, from electronic warfare equipment ('jamming' devices) and cyber warfare capabilities, to weapons that attempt to target directly the satellite itself. However, in the past, attempts at developing the latter have run aground, such as the 'hit-to-kill' Kinetic Energy ASAT (or KEASAT) programme during the Clinton Administration, as well as the direct-ascent nuclear weapons tests that took place in the 1960s (known as the 'Starfish Series'). Regarding directed energy weapons, ground-based lasers capable of attacking objects in lower Earth orbit (LEO) require a significant amount of power, making them difficult to mount on aircraft due to their size and difficult to emplace in space due to energy requirements. Although funding in the 2007 US budget for the MIRACL laser programme has been cancelled, other ASAT programmes continue.

Development and Peaceful Applications of Outer Space:
The Indian Experience
Balakrishnan Vasudevan, Indian Space Research Organisation (ISRO)

7. India currently spends US$650m each year on its space endeavours, which employ a work force of 16,500. In the past forty years India's remote sensing capabilities have gone from one-kilometre resolution to one-meter resolution and space launch vehicle capability has evolved so that India can now launch into geosynchronous orbits.

8. For India the most important peaceful applications of outer space include meteorological, surveillance, education, Earth observation and crisis management. The tsunami in December 2004 underlines the necessity of space for India's security—the value of remote imagery and space communication became clear to all. In addition to human security, space applications play an important role in the agricultural sector. Satellites identify potential fishing zones by measuring the temperature of the sea and then broadcast the information through radio transmissions to local fishermen. A number of other applications, such as remote education programmes, were also outlined. The speaker concluded by stating that enabling the peaceful application of outer space is as important for developing countries as for developed ones.

The Private Sector and the Security of Outer Space
Stephen Stott, New Skies Satellites

9. Since the early days of space exploration two basic principles have governed the use of space: right of access and freedom of navigation. Today there are many new and independent operators and space has become a truly open environment, comparable to the high seas when they were of prime importance to public, private and governmental agencies for civil, commercial and military operations. This surge in space-based activity has been met with a matching surge in irresponsible use, debris, radio frequency contamination and commercial piracy. There is a need now for the commercial sector to come to agreement on criteria that would ensure the security of space for commercial operations, i.e. mission assurance—the ability to provide a product when needed. Increasingly the line dividing the military and civil sectors in the field of space exploration is blurring, as is the distinction between strategic and commercial interests. Given the reliance of the military and the civil sector on each other, true space security requires collaboration in order to deter and protect against attacks on friendly space systems, be they military or commercial.

Terrorism in Outer Space
Jeffrey Lewis, Belfer Center, Harvard University

10. The utility of the concept of terrorism in the field of space security was questioned. First, the term 'terrorism' contains a normative connotation and is difficult to define, which poses a number of problems in and of itself. Second, the space element may not be absolutely necessary to disrupting outer space activities given that an attack by a non-state actor could be made against a ground station or a launch vehicle at time of launch. Whether such an act would be considered any different to attacking an embassy is generally considered doubtful.

11. Four challenges posed by non-state actors were examined. The threat to satellites or space stations was ruled out and the threat of an attack at time of launch was deemed highly improbable. The real challenge seems to lie in physically protecting satellite ground stations or protecting operational systems from outside interference such as computer hacking. But such protection would not entail measures unique to the realm of space. A second challenge regards the issue of signal jamming or communications interference, however Lewis questioned whether this was a challenge particular to dealing with non-state actors given that governments are involved in this activity also. The proliferation in commercial satellite use and the diffusion of technology are two further challenges, but these are not understood to be associated with malevolent non-state actor behaviour (i.e. terrorism), but more as challenges posed by commercial entities.

Space Weapons and Proliferation
Michael Krepon, The Henry L. Stimson Center

12. The central dilemma is that satellites are both indispensable and highly vulnerable. This dilemma generates a number of potential responses, such as: improving space situational awareness and intelligence, developing quick replacement parts/satellites, devising a code of conduct, drafting a new space treaty, or developing space weapons. Space weapons are defined as those weapons designed to physically attack satellites; jamming devices were excluded as space weapons, as are weapons with residual ASAT capabilities. The vulnerability of satellites is tied to the problem of space debris, a problem that space weapons are unable to counter and would only serve to make worse.

13. On the question of an arms race in outer space, the language of 'arms racing' can be unhelpful in constructing arguments against the weaponization of space because such a scenario is viewed as being highly unlikely in a time of asymmetric threats to the United States. The vulnerability of satellites to a 'cheap kill' attack on a ground station or even direct attacks in outer space could well make such competition unnecessary. The real problem lies in the proliferation of space weapons, driven by such factors as perceptions of insecurity and weakened norms. Space weapons could well make the problems of satellite vulnerability and space debris worse, which, in turn, would likely have a negative impact on proliferation. A code of conduct as discussed in previous meetings was offered as a near-term solution.

Debate

14. Following the presentations, participants exchanged views on the following issues:
(i) Civil-military collaboration;
(ii) The question of 'arms racing';
(iii) ASAT technologies and Ballistic Missile Defence (BMD);
(iv) The definition of space weapons; and
(v) Protection measures and commercial operations.

15. Referring to greater civil-military collaboration in defending space-based assets, the question was asked if members of the commercial sector advocate the emplacement of certain weapons in

space. The response from representatives in this field was that, as is generally understood, offensive weapons are not advocated but that a line needs to be drawn between what is acceptable self-defence and what is unacceptable. This led to a debate on the distinction between offensive 'weapons' and defensive 'systems'. Regarding the notion of acceptable self-defence, another question arose as to whether this includes active defences such as 'shoot-back' systems, which many regard to be a weapon. The argument, common in the BMD debate, that a system is not a weapon because its primary role was seen to be defensive was felt to be illegitimate. One strong view from the commercial sector—although not shared by all—is that shooting back in any way is offensive, and the type of defences supported, and with which collaboration with the military is hoped for, are capabilities such as redundancy measures, radiation hardening and so forth.

16. The utility of the language of 'arms racing' and the argument that space weapons deployment is unlikely to precipitate an arms race received considerable attention. On the relevance of symmetry in competition, a number of participants argued that symmetry of actors' capabilities in terms of resources and numbers was not necessary for an arms race as arms racing was not an end result, but a process. However, it was stated by one person that given the high vulnerability of satellites, any race to weaponize space was rendered unnecessary—significant capabilities are not necessary in order to compete in this area. As such, the kind of arms racing that was witnessed during the Cold War where the two superpowers developed thousands of weapons could not translate to the space arena; intelligent actors would not pursue such a course. But this was said to be a misunderstanding of what an arms race is: an arms race is not about numbers, but about perceptions of threat that lead another country to attempt similar capabilities, reinforcing perceptions, and so beginning a process of escalation. A view was expressed that arms racing is not solely a quantitative matter, but also a qualitative matter, meaning weapons development and research is just as important. However one response to this point was that the language of arms racing is not useful from a political perspective as there are those who believe an arms race in outer space could be won. Thus the language could be unhelpful and many participants felt that it should be replaced with something more apt. The withdrawal from the Anti-Ballistic Missile Treaty (ABM) was cited as case in point where, despite warnings to the contrary, an arms race has not yet ensued, thus supporting the argument that the terminology used in this debate should be made more accurate. However, as others pointed out, it could be still too early to tell what effects the ABM withdrawal might have. A closing comment on this issue was that it was unhelpful to focus on definitions of arms racing as this was not the only argument for prohibiting the weaponization of space—the existence of weapons in space is a danger in itself.

17. On the question of emerging ASAT technologies, questions were asked about research being conducted outside the United States in this area. The consensus among the experts was that very little research is being carried out in Western Europe or the Russian Federation, although it is difficult to be sure in some instances. For example, there tend to be suspicions that governments are willing to develop ASAT capabilities when they are funding research on, or the development of, micro-satellites, as such systems are susceptible to being converted into ASAT weapons. A number of countries are actively researching micro-satellites whose intentions related to ASAT capabilities development are not public. The issue as to whether space-based missile systems such as BMD fall under the auspices of ASAT weapons was debated. One view expressed was that BMD is primarily

a nuclear policy issue and not a space policy one, meaning that BMD operates according to a different logic. However this view was contested by the analysis that a weapon in space is a weapon in space, regardless of what its purpose is.

18. Concerning the definition of space weapons, one point of debate was whether a nation's nuclear-tipped intercontinental ballistic missiles (ICBMs) and space-based BMD should be considered as space weapons. Regarding weapons capable of targeting objects in outer space, such as ICBMs, it was argued that these should not be included in the definition of space weapons as only those weapons specifically designed to physically attack objects in space, weapons with latent or residual ASAT capabilities ought to be considered space weapons. However, space-based BMD should be considered as a space weapon because, as had already been expressed, a weapon in space is a weapon in space, regardless of its purpose there. It was noted that there is a difference between 'objects in space' (e.g. warheads) and 'space objects' (e.g. satellites), and that certain states are working towards a suitable definition on this front. It was generally thought that the definition needed more input from a variety of interested actors.

19. There was interest regarding what measures the Indian Space Research Organisation had taken to protect its space assets. It was asked what the chief concerns regarding vulnerability in the long-term were, and what steps had already been taken, such as redundancies or backups for example. As far as ground systems are concerned, redundancy measures are in place. Regarding the actual satellites, studies are being conducted but nothing had been implemented yet. And on the commercial aspect of India's space programme, this was said to be in its infancy and the issue of commercial satellites and their vulnerability had still to be addressed.

SESSION TWO: A RULES-BASED BEHAVIOUR APPROACH TO ENSURE SPACE SECURITY

Creating Rules-Based Behaviour to Help Space-Faring Nations Avoid Conflicts in Space

Douglas Aldworth, Foreign Affairs Canada

20. The international community needs to adopt a broadened approach on the issue of space security to include all influencing factors of the space environment on space security, be they economic, technological, environmental or political. In this way the development of rules-based behaviour could best be approached. Weapons-effects hardening, evasive manoeuvring, redundancy and electronic protection measures such as anti-jamming technologies are all alternative ways of protecting space-based assets. Concerning methods for advancing rules-based behaviour, the United Nations Committee on the Peaceful Uses of Outer Space's (COPUOS) proposed space debris mitigation guidelines are to be welcomed. This approach to the development of rules-based behaviour might also be considered in the context of other space traffic management issues and as a means of building confidence and preventing conflict in space. Cooperation between the CD and other international forums that deal with various dimensions of space was also suggested, for example with the First and Fourth Committees of the UN General Assembly, and the International Telecommunications Union as a way of fostering greater awareness of their respective activities

relating to the peaceful uses of, and sustainable access to, outer space. For the commercial sector, voluntary guidelines for the commercial industry might not be very effective, but voluntary guidelines for states to apply, as appropriate, at the national level through national mechanisms could be a feasible alternative.

Ways to Address the Security of Space Assets
Pan Jusheng, Defense Science and Technology Information Center of China

21. As an initial measure, states should strictly adhere to the current treaties and agreements governing the use of outer space, such as the 1963 Partial Test-Ban Treaty, the 1967 Outer Space Treaty (OST), the 1968 Astronaut Rescue Agreement, the 1975 Registration Convention and the 1979 Moon Agreement. As a second measure, states should negotiate and conclude new treaties preventing the weaponization of space and an outer space arms race. The fourth article of the OST, which intends to keep space free of weapons of mass destruction (WMD), but neither defines WMD nor prohibits the deployment of other weapons, has significant shortcomings. This is a strong reason to negotiate new agreements, as is the fact that the threat or use of force in outer space is not yet prohibited. As an interim measure until such agreements are formulated, a number of transitional phases or intermediate steps, including a Code of Conduct, confidence-building measures (CBMs), and unilateral measures such as the Russian no-first-deployment pledge could be made. Such initiatives, while serving as temporary measures to further secure the space environment, would also engender greater trust and cooperation and thus serve as a good foundation for a future agreement on a treaty on the Prevention of an Arms Race in Outer Space (PAROS).

Activities or Types of Space Assets to be Monitored and Verified
Laura Grego, Union of Concerned Scientists (UCS)

22. The current threat is primarily from activities related to ASAT weapons, such as jamming devices, ground-based lasers and kinetic energy weapons. Regarding jamming devices, signal interference is easily monitored; the only real difficulty remains in finding the appropriate diplomatic and legal channels to resolve the problem. Laser technology, such as that for 'dazzling' and 'blinding' satellites, is prolific and difficult to monitor, although there is no great utility in using such weapons. Regarding ground-based lasers that physically damage satellite integrity, the technology is not widespread and such lasers are generally at fixed sites and very difficult to transport. However, as far as kinetic energy weapons are concerned, the only technology really needed for an effective capacity in this area is satellite manoeuvrability in orbit and the ability to conduct close proximity operations with another object in orbit. In case of such an attack it would be unlikely that ground-based surveillance could detect the event happening in time to prevent it. Pre-launch inspections, though controversial, would have some value here. There are about twenty-two active launch sites at present, giving space launch a potential 'bottleneck' advantage in terms of verifying and monitoring space-related activities. However, as satellites get smaller and the technology improves, mobile space launch vehicles will become a greater possibility, thus making this task more difficult. There is also the possibility of using space launches in a fashion similar to the 'atoms for peace' element of the Nuclear Non-Proliferation Treaty (NPT).

Verification Measures Applicable to Future Outer Space Instruments
Richard Bruneau and Scott Lofquist-Morgan, Canadian Centre for Treaty Compliance

23. A verification framework or blueprint designed to apply to any potential treaty proposal on preventing the weaponization of space was outlined. Knowing which tools are technically available, financially feasible, and credibly effective could force negotiators to be more specific about any proposed treaty's terms and scope, thereby helping to progress and shape negotiations. In designing the blueprint, four considerations need to be taken into account:

(i) Flexibility, in order to apply to multiple treaty designs;
(ii) Details of intrusiveness levels and confidence issues to facilitate decision-making;
(iii) Reliable estimates of costs associated with each verification method; and
(iv) Possible synergies between verification methods to increase cost-effectiveness.

24. With these considerations in mind, the optimal way to structure a verification system is a layered approach. Six layers were outlined: on-site verification; launch detection and post-launch confirmation; space situational awareness; on-orbit inspection; detecting the use of laser and other directed energy weapons; and re-entry vehicle detection and characterization. The possibility of designing verification systems according to desired cost, whereby one could demonstrate what a verification system might look like at US$100 million, US$150 million and so on, can provide a concrete tool for negotiators. In addition, outsourcing is always a possibility, for example the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO Preparatory Commission) has such potential.

Debate

25. Following the presentations, participants exchanged views on the following issues:

(i) Verification;
(ii) CD–COPUOS collaboration; and
(iii) ASAT weapon use.

26. The central topic of discussion arising from the speakers' presentations in this session concerned verification aspects following the presentation of the verification blueprint concept. Participants were quick to note the utility of the blueprint concept and felt that perhaps it would function better if it were designed as a 'pick and mix' option, giving it even greater flexibility. However, the blueprint model was criticized for relying on more traditional verification measures when the current trend is moving away from such systems and their associated high management costs. An alternative is to think of verification as a system of collective sharing and information analysis.

27. How the commercial sector could be integrated into any proposed verification regime was raised as a potential obstacle that needed due consideration. The problem of commercial secrets being exposed to external bodies or personnel is a significant concern. This was tied to the issue of vulnerability—the more advanced a company, the more vulnerable it felt, making it less likely to concede vital areas of research and development to verification measures. This was compared to the

age-old problem faced by governments concerned with questions of national security, which often has the effect of limiting a treaty's level of intrusiveness and thus effectiveness. This led to the question of who would carry out inspections for any proposed treaty. The general feeling among participants was that commercial actors needed to put more thought into the verification issue at both the research and policy levels.

28. An effective verification and compliance system would provide credibility to any chosen enforcement mechanisms. Disaggregating the issues of enforcement and compliance, as some states do, was said to constitute a misperception of how the two activities interact with each other.

29. With any proposed treaty, the capabilities under surveillance would all be dual-use—this applies across the board, including space-based interceptors. The crux of the matter is in verifying acts of non-compliance, not capabilities that could be used to contravene a treaty. This points to the importance of space situational awareness in monitoring activities and thus acting as a means of verifying events that had already occurred or were in the process of occurring. It was proposed that this should be the purpose of any proposed verification model given the problem of dual-use technologies. International space surveillance systems could be used to pool information.

30. How to promote more effective partnership between the CD and COPUOS on space-related issues was of considerable interest. The space environment is changing: the artificial barriers between civil and military activities in space are already dissolving and in turn will effect how the UN operates in this area. One idea is to see which activities of the CD and COPUOS are in concert and cooperate on those. But simple factors, such as the fact that the Russian Federation will hold the presidency of the CD in June, at the same time the CD is planning to discuss the PAROS agenda item, which also coincides with COPUOS's annual meeting, could act as a mechanism for examining common thinking and activities and deciding where to go from there.

31. Regarding ASAT technologies: who would be in a position to use these devices? Signal jamming and communication disruption could be the key here, for example the jamming of Global Positioning System (GPS) signals, which has a short-term impact. Such incidents are increasing and pose a significant threat. Incidents of television and Internet content signal jamming in certain countries in 2005 were noted.

SESSION THREE: LEVERAGING EXISTING INSTRUMENTS TO ENHANCE SPACE SECURITY

Framing the Debate: the Space Security Index
Sarah Estabrooks, Project Ploughshares Canada

32. The annual Space Security Index (SSI) provides a comprehensive approach to the issue of space security so as to frame the debate for policy makers. The index incorporates eight indicators of space security that highlight current trends and developments. The eight indicators are: the space environment; laws, policies, and doctrines; civil space and global utilities; commercial space; space

support for terrestrial military operations; space systems protection; space systems negation; and space-based strike weapons. A brief summary of developments in 2005 was given to the conference using these eight indicators. The space environment increased by 195 objects in 2005 bringing the total number of identified trackable objects in space to 9428. Twenty-four civil spacecraft were launched and budgets increased everywhere except in Japan. The United States continued to be the single largest commercial space client, with 60% of the commercial satellite sector. There were significant cutbacks to a number of US military space programmes in addition to the cancellation of the US NFIRE Kill Vehicle test, although the United States successfully tested its GPS 'pseudolite'. A number of occurrences of jamming incidents had been reported. In the policy realm, 2005 also saw the first opposition to the PAROS resolution in the UN General Assembly by the United States and Israel.

Leveraging the Existing UN Space Machinery for Sustainable and Secure Access to Outer Space
Gérard Brachet, incoming COPUOS Chairman, Sic Itur SARL

33. COPUOS is a body composed of 67 states and 30 observer organizations. It could contribute to developing the architecture for sustainable space security by:

(i) Raising awareness among its members and community of observers that space security is a major issue.
(ii) Building on the experience gained from the discussions on space debris mitigation. Beyond the guidelines more work is needed. A report on space traffic management will be officially presented in June 2006 at the COPUOS plenary meeting.
(iii) Contributing to confidence building via its current work on the application of the 1975 Registration Convention. In 2004 COPUOS established a working group on registration, reporting to the legal Sub-Committee, whose work plan should lead to a set of recommendations in 2007.
(iv) Promoting open communications on PAROS issues with the Conference on Disarmament. The incoming chairman of COPUOS is committed to facilitating and encouraging such communication.

34. In February 2005 the COPUOS Scientific and Technical Sub-Committee proposed a set of guidelines on space debris mitigation. These guidelines will be officially submitted to COPUOS member states before the Sub-Committee's next meeting in February 2007. If approved at the COPUOS plenary in June 2007, they will then be submitted to the UN General Assembly in the form of a resolution later that same year.

Outer Space Treaty Review Conference: Progress and Possibilities?
Joanne Gabrynowicz, University of Mississippi

35. In terms of international law, the OST is relatively rare because it created an interrelated framework with other space treaties. The OST is 'quasi-constitutional' in that it functions like a constitution. This means that if the OST were to be opened for amendment of one particular article

or to clarify a certain issue, the entire treaty would then be open for discussion. A thorough risk analysis of what could be lost as well as gained if an OST Review Conference was convened (with the intention of amending the treaty), is needed. This means asking some difficult questions regarding whether the provisions the OST presently contains could be achieved today. For example, an agreement banning nuclear weapons and WMD might not be possible to achieve in the current climate, nor perhaps an agreement on limiting military activity to peaceful or scientific purposes. The status of the OST during such negotiations would also be uncertain. There is a fear that some states could potentially move into the legal vacuum and create new types of practices. On the question of the treaty's status in international law in the case of an outbreak in hostilities, the presumption is that the treaty would not be suspended. This presumption is based on the similarity of the OST principle of non-interference with the neutrality principle in the law of war, which is maintained during conflict. Participants were warned to watch what they wished for in reviewing the treaty's operation as this could increase the lack of clarity on certain issues.

Debate

36. Following the presentations, participants exchanged views on the following issues:
(i) Re-framing the debate—the environmental aspect;
(ii) The purpose of an OST Review Conference;
(iii) Launch registration obligations; and
(iv) The OST's principle of non-interference and the neutrality principle.

37. The use of terminology commonly associated with environmental issues to apply to space, for example 'pollution' and 'debris', was postulated as a useful way of approaching the notion of outer space security in that such language could serve as an alternative paradigm for promoting objectives. The quality of the space environment is directly connected to the ability to operate in a secure manner. Today the problem or threat is not yet space weapons but space debris, which is primarily an environmental issue. In addition to the discussion in COPUOS there are people already looking at how the environmental approach could complement the arms control approach. The concern, however, is that although space weaponization has not taken place, serious pollution already is having a major effect. Yet the focus of the international community is still on the former and not the existing problem.

38. A Review Conference of the OST could be convened to review the treaty's status without the intention of amending the treaty, like the review conference processes of other arms control treaties. It was generally felt that there could be a lot of utility in assessing the OST's performance at this stage. It was asked whether there would be value in negotiating a protocol to the treaty that could further the international community's understanding vis-à-vis Article IV, with the intention of extending its prohibition to the emplacement of all weapons in space. A Review Conference was suggested as a possible means of establishing a working group to look at such a possibility. In that regard, the very first UN General Assembly resolution (dated 24 January 1946) defines WMD as all weapons adaptable to WMD. Had this definition been included in the treaty, the Article IV problem would not exist. It was suggested that instead of a Review Conference an anniversary meeting could be held in 2007 timed to coincide with the OST's 40th anniversary (noting too that 2007 was also

the 50th anniversary of the first Sputnik mission). It was asked who would call for such a meeting. As the UN Secretary-General is the treaty's depositary, it was suggested that a meeting could be established via a UN General Assembly resolution.

39. Regarding the 1975 Registration Convention concerns were expressed as to whether this is a voluntary or political commitment, whether it is a requirement for all UN Member States, and whether it applies to both military and commercial satellites. One participant gave the example of the European Space Agency's Ariane launch programme that launches from French Guiana. In this case it was asked whether the host country is responsible for registering launches or if this is the responsibility of the owners of the satellite. One problem is that some commercial satellite bodies that were once intergovernmental organizations have since privatized. States in which a company's headquarters were located do not take responsibility for being the launching state. A COPUOS working group is currently reviewing this situation in relation to the Registration Convention and it was felt by a number of participants that both the owners of the satellite and the launch hosts should share responsibility in this matter.

40. In regard to the similarity between the OST's principle of non-interference and the neutrality principle in the laws of war, both are concerned with protecting peaceful activities in an area or region from non-belligerents. The OST codifies the right of all states to peacefully use and explore space. If two or more states were in conflict, it is presumed that this would not affect the rights of access of others. Thus the treaty would be maintained during conflict, following the reasoning that the neutrality principle is not suspended in times of war.

SESSION FOUR: DEVELOPING CONFIDENCE-BUILDING MEASURES (CBMs)

The Potential for Outer Space Confidence-Building Measures
Phillip Baines, Foreign Affairs Canada

41. Confidence-building measures (CBMs) are not designed to address the capabilities of others, rather they address perceptions of intent; thus they succeed best when they lead to a transformation in perceptions. Some previous CBMs in outer space have worked well, such as the 1975 Apollo Soyuz Test Project, concerning the use of compatible docking systems that led to the first international handshake in space. Pre-launch notification is an area of space utilization in which CBMs could be effective today. A cooperative monitoring process referred to as '3D' (Declare, Do, Demonstrate) could be a suitable practice to apply to pre-launch CBMs. A 3D process would consist of three steps: declare what you will do, do what you had declared, and demonstrate that you did what you had declared. Such cooperative monitoring, which places the onus on compliance demonstration, could be less adversarial than challenge inspections or invitations to observers. Infrasound technology could well be an applicable technology—it is possible to detect Space Shuttle launches at the Kennedy Space Center from a distance of 1,200km away. Applying the 3D cooperative monitoring system initially to pre-launch notifications and then to in-orbit satellite manoeuvres, as well as to guided vehicle re-entry, could take the international community to the next level of CBMs: a space traffic management system. Taking a 'system of systems' approach, akin to air-traffic control, is one way of achieving this system.

Confidence-Building in Outer Space
Anton Vasiliev, Permanent Mission of the Russian Federation to the Conference on Disarmament, and Alexander Klapovsky, Ministry of Foreign Affairs of the Russian Federation

42. The Russian Federation's resolution on transparency and confidence building in the sixtieth session of the UN General Assembly was a significant event. A simple first step in securing outer space and engendering confidence could be for interested parties to develop recommendations on possible CBMs together. In this way CBMs could contribute to favourable conditions for a new agreement or treaty. Disagreements over verification measures could pose a considerable obstacle to agreement. These, however, could be prepared at a later stage and CBMs could compensate for a lack of verification measures in a new treaty for the time being. Transparency is the key for any specific CBM. A number of ways in which CBMs could be implemented were outlined, including: information sharing; demonstration; notifications (of launches, satellite manoeuvres, re-entry of guided spacecraft, re-entry of nuclear powered craft); consultations; and thematic workshops. Such a proposal is not new but builds on what has already been done to build confidence among space-faring nations. The Russian Federation's no-first-space-weapon-deployment pledge is a good example of how states could take unilateral measures to build confidence. Such CBMs could be of a voluntary nature initially with the possibility that they might form part of a future treaty.

The European Space Agency Space Situational Awareness (SSA)
Gerhard Brauer, European Space Agency (ESA)

43. Space surveillance or space situational awareness systems need to be able to provide: characteristics of satellites, in particular orbit parameters and activity status of satellites; characteristics of potentially threatening debris, in particular trajectory data and physical parameters; and information related to space weather and near Earth objects. Other data could be included to provide up to date space situational awareness needed for threat assessments, as well as alert cues to avoid collisions. From the European view, the cost-effectiveness of any system would depend on its use.

Confidence-building Measures: Help or Hindrance in Achieving a Space-Based Weapons Ban?
Theresa Hitchens, Center for Defense Information (CDI)

44. CBMs are a stepping-stone to an eventual legal mechanism and as such they should not be skipped. As discussions on a PAROS treaty are currently at a standstill, states have a number of other options before them. One option is for dedicated nations to pursue a weapons ban treaty outside formal processes and structures, as was successfully done through the Ottawa Process used to achieve the Mine Ban Convention. Another answer could be for interested nations and parties to continue to work to define a possible treaty approach, creating draft legal instruments, verification protocols, etc., until the time was ripe for negotiations to occur in the traditional setting of the CD. The crux of the situation is that some states remain unconvinced that a weapons-free space environment is either achievable or necessarily in their interests. In this regard CBMs are of value.

They are a way of dampening national threat perceptions and establishing consensus on mutual interests. Space debris is the most immediate area relevant to CBMs. COPUOS's proposed guidelines need development, such as better data sharing across the gamut of space stakeholders, international practices and protocols for collision avoidance, and joint research to combat problems such as ways to remove space debris. While CBMs are no substitute for a treaty, a combination of transparency regimes, CBMs, codes of conduct and strictures against debris-creating weapons, could, taken together, go almost as far as a total weapons ban.

Debate

45. Following the presentations, participants exchanged views on the following issues:
(i) Transparency issues;
(ii) CBMs and BMD;
(iii) The 'dual use' problem;
(iv) The objective behind CBMs;
(v) Existing reporting requirements; and
(vi) The view from the United States.

46. The need for greater transparency within existing transparency measures was expressed. None of the pre-launch notifications or reports of ballistic missile tests required in the existing arrangements and agreements or submitted to the Hague Code of Conduct (HCOC) are made available to the public. This information is important and its lack of transparency could undermine the ability of the HCOC to further build confidence. The 3D concept could contribute to increasing transparency of those CBMs already in place.

47. On the question of BMD it was suggested that states should think ahead as to what possible CBMs could be applied for the deployment of such systems. Some felt that when states begin testing in space, regardless of whether the system worked, it would erode the norm against weaponizing space and therefore needed to be addressed. The issue is not whether the system is effective but what perceptions such deployment or potential employment engenders in others—which is precisely the point of CBMs, to build confidence in one state's perceptions of another state's intentions and activities. Another participant added that while BMD systems might not function as a whole, elements of BMD have latent ASAT capabilities, which have been tested by directing missiles at particular targets in space; hence the relevance of the CBM question.

48. The dual-use problem related to space situational awareness was raised—in the sense of the same asset being used by both civilian and military enterprises. So far there has not been sufficient discussion on how a system could be developed for both the civilian and military communities. It was thought that if the military contributed to any such system it could demand to own it at certain times, for example in times of crisis. The space-faring community's discussion on this issue is still in its early stages and there is currently only one agreement in existence, the Turin Agreement, between France and Italy. Legal research is being conducted on what a satellite sharing agreement that satisfied both communities would look like.

49. Undue fixation on a treaty or on the necessity of agreeing to negotiate a treaty before other measures are discussed could be a mistake. It is important to remember first principles: the central issue is outer space security and how to establish it. Negotiating a treaty is a lengthy process, one the international community had yet to agree to. Interested actors now need to think about their goals and not become enslaved to the process. Some participants felt that a treaty might not be the best solution in any case. Often people regard treaties as the optimum way to shape state behaviour, but the custom and practice that arises out of CBMs was proposed as another way. However, as one participant mentioned, it is important to remember that CBMs would not prevent the weaponization of space but should be understood as a transitional measure or part of a more realistic way to achieve this goal. Although CBMs are not a panacea, they would be worthwhile if they could command consensus and strengthen or create trust.

50. The prospects for consolidating the present reporting requirements under the various arrangements and agreements, such as the HCOC and the 1975 Registration Convention for example, with a view to using these reports to monitor compliance with current obligations were discussed. Consolidation could develop transparency and build confidence on the basis of existing arrangements and agreements. A space traffic management system could serve this function. An important question is how the existing reporting requirements could best be interfaced and who should be responsible for coordinating this, as well as which department at the national level should handle the information.

51. There was uncertainty expressed as to the United States view of CBMs. The United States voted against a Russian-sponsored resolution in 2005 that concerned preliminary discussions on CBMs. The internal debate was said to be on transparency/CBMs versus what might be risked. The United States Air Force is interested in transparency but apparently the intelligence agencies are not as keen. However, there are two areas where internal bureaucracies in the United States could move toward positions that could be expanded into CBMs. The first is regarding the protection of commercial satellites. There is increasing recognition that private companies are not national entities and so discussions concerning the protection of commercial satellites would need to include actors from outside government. A level of transparency would be needed to have these discussions. The second area concerns space debris, a problem that possesses no national allegiance. There is increasing recognition that mutual interests are apparent on these two issues. A way to start a dialogue that recognizes these mutual interests is now needed.

SESSION FIVE: INTERACTIVE DEBATE ON PUBLIC AWARENESS AND ADVOCACY IN POLICY MAKING

Strategies for Raising Public Awareness and Influencing Political Decision Making
Rebecca Johnson, Acronym Institute for Disarmament Diplomacy

52. Much had changed since the first Geneva seminar on space security was held in November 2002, with a main focus on educating, informing and raising awareness. A range of proposals and initiatives that have come to the fore since then, including: the space security index; codes of

conduct; the guidelines for mitigating space debris; initiatives for reviewing and strengthening the Outer Space Treaty in its fortieth year (2007); and treaty approaches, including the Russian–Chinese draft treaty tabled in the CD.

53. But, however good the ideas might be, without public awareness and effective strategies they remain in the realm of thought, not action. There are various drivers for raising public awareness, including: fear of weapons or war in space; self-interest not to lose vital space applications on which we are now so dependent; commercial investments and interests; opposition to BMD; and the romantic or moral appeals associated with space exploration and notions of keeping the heavens safe and peaceful.

54. Resolutions in both the UN First and Fourth Committees in 2007 could be tabled calling for support for and universal adherence to the Outer Space Treaty, and for a Review Conference to be held to commemorate and review its forty years of operations, and consider ways to strengthen implementation and progress towards universality. It could also be possible to bring the 1967 Treaty up to date (without opening it for amendment, which would not be desirable) by adopting a more space-relevant interpretation of the term 'weapon of mass destruction' in the Treaty: that in view of the particular circumstances of outer space, any weapon used in or from outer space would result in unpredictable and potentially mass destructive effects.
The discussion on this presentation returned to the proposed Review Conference of the Outer Space Treaty, specifically linking it to the 50th anniversary of the launch of Sputnik (4 October 2007), and holding it at the United Nations in October 2007.

55. The idea was proposed to invite commercially interested parties to the discussion table: Boeing, as a part owner of the pioneering Sea Launch Company, was singled out as one such entity that could be worthwhile to include. The idea of convening a specific forum whereby those in the business and academic communities could come together to share their views was also suggested.

56. The possibility of creating an Internet network for exchanging ideas as a useful way of facilitating and developing ongoing discussions was raised. It was noted, however, that such a network already exists although it remains under-utilized due to lack of awareness. Participants were informed of the Pugwash Internet Discussion and Information Sharing Forum an initiative borne on the sidelines of the Pugwash conference "60 years after Hiroshima and Nagasaki" held in Hiroshima, Japan in 2005. The Forum was created to stimulate ideas and overcome the various existing boundaries to such interaction.

57. Rebecca Johnson concluded that:

(i) There is still a need to forge alliances and communicate better with commercial and military players, including in the United States, to ensure sustainable space security.
(ii) We now need to engage parliamentarians much more effectively, to raise the level of debate in different countries and regional institutions such as the European Union, and to provide legislators with the information and questions to ask governments, defence ministries and regional alliances such as NATO.

(iii) We need to do more to break down the institutional and political barriers so as to address both the civilian and military aspects of space security more coherently.

(iv) In order to adapt a principle of political strategy (think globally but act locally), we need to think comprehensively, but build the space security architecture incrementally.
