

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 1963³ and the Outer Space Treaty (OST) of 1967⁴. 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.

¹An 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.

²The 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.
