IAC-08-E8.3.4

LEGAL ASPECTS RELATING TO DISARMAMENT, SPACE CONTROL, SPACE SITUATIONAL AWARENESS AND INTERNATIONAL SPACE TRAFFIC MANAGEMENT

Johanna Catena LLB Hons, LLM

Space Generation Advisory Council (SGAC)τ, UK
johanna.catena@dsl.pipex.com
+44 7986423450

ABSTRACT*

A major Commission, chaired by the former Secretary for Defense Donald Rumsfeld to assess security space management in 2000 to 2001, warned of future space pearl harbour. In 2003 the US Air Force published the Transformational Flight Plan detailing future capabilities such as the Hypervelocity Rod Bundles, nicknamed "Rods from God", Ballistic Missile Defense (BMD) systems, space based defense systems and directed energy weapons.

This paper will take a two-fold approach highlighting disarmament treaties, Articles I, IV, and IX contrasting Articles VI, VIII and IX of the Outer Space Treaty (OST) 1967, Liability Convention and the Conference on Disarmament to assess traditional methods of prevention. The second is a pragmatic approach, highlighting space situational awareness, recommending a collective method for alternative measures to space control. For example introducing an appropriate international system to regulate space traffic in order to safeguard space assets and maximise the use of outer space without interference from other space objects.

*τ

The Commission to Assess United States National Security Space Management and Organization was established pursuant to Public Law 106-65, the National Defense Authorization Act for Fiscal Year 2000, Section 1622, commonly referred as the Space Commission.

The Rumsfeld Space Commission of 2001 was mandated to exploit military assets in particular to analyse the relationship between intelligence and non-intelligence national security spaces. Four sectors of space were used as markers: - defense, intelligence, civil and commercial space. Each sector's capabilities were assessed and the Commission made recommendations with respect to national security. The Commission stated that by vigorously pursuing the National Space Policy and in order to deter threats and defend against any possible attack to US interests this would leave no other option but to deploy weapons in space. Also the US must have capabilities to defend its space assets against hostile acts to negate the hostile use of space against US interests.

The Commission recognized the dependency of US national security on space assets by

τ The views expressed in this paper are those of the author and do not represent the views of SGAC unless otherwise stated.

stressing that an event that would "disrupt, disable or destroy" a satellite would have potentially devastating consequences for both defense and intelligence systems. The Commission was concerned that this could make 'US an attractive candidate for a "Space Pearl Harbor"'.[:t]

Therefore, this doctrine justifies the technological developments based on a deterrence strategy that would both prevent any infringement of US sovereign rights and, should attacks happen, provide the means to negate threats temporarily or permanently. Thus according to the Commission applying cost effective technologies would assure access to space and on-orbit operations as well as defence in space with active and passive protection of satellite systems.

The Space Commission's recommendations[§] and concepts were further developed in the Transformational flight Plan of 2003 and 2004 both of which drew upon the six core competencies of Joint Vision 2020 aerospace, information superiority, global attack, precision engagement, rapid global mobility and agile combat support enabling *"global vigilance to anticipate and deter threats, strategic reach to curb crises and overwhelming power to prevail in conflicts and win America's wars."* [**]

The Transformational Flight Plan of 2003 detailed active and passive measures envisioned for space defense in particular listing future weapons that could facilitate such measures. Protection of space assets, denial of an adversary's access to space services and detection of ballistic missiles and subsequent destruction during flight phase are among 16 listed transformational goals as well as six supporting attributes. One of which was lethality, which involved the use of kinetic and non-kinetic means. The sixteen goals are organised under the competencies of Joint Vision 2020 with the addition of air and space superiority.

The 2003 plan also listed future technologies and weapons that could facilitate such measures. Under informational superiority suggested space systems included Advanced Extremely High Frequency system (AEHF) in the near term and mid term space-based radar. To protect space assets and deny adversary's access to space services suggested technologies include counter satellite communication system, counter surveillance and reconnaissance system, rapid attack identification detection and reporting system, space- based infra-red and surveillance system. Other future systems cited in the mid-term include the common aero vehicle a hypersonic glide vehicle dispenses conventional weapons, sensors, payloads from and through space, orbital deep space imager and Space Tracking and Surveillance System (STSS). In the long term suggested weapon systems include air launched anti-satellite missile, ground based laser, space based radio frequency energy weapon, Evolutionary Aerospace Global Laser Engagement (EAGLE) and hypervelocity rod bundles, commonly referred to as the "rods from gods". Other systems include the space manoeuvres vehicle and space operations vehicle to assist with space operations with regard to offensive and defensive counterpace.

In its 2004 edition, the US Air Force focused the flight plan on passive measures, omitting any proposed or future weapon systems. Some of the main changes include replacing

---

[:t] see chapter 2 of the Rumsfeld Space Commission.

[§] Historically the Space Commission's recommendations with regard to providing active and passive protection of space systems can also be found in pg v & vii 04/11/1996 Joint Doctrine 3.01-1 Aerospace Defense of North America

[**] America's Air Force Vision 2020 pg2

'denial' with negating an adversary's space system, minimizing space debris and using active space defense as a last resort instead pursing temporary and reversible means. However denying or destroying adversary's space systems is still being considered.[tt]

Negating an enemy's space system involves five elements: deception, disruption, denial, degradation and destruction.[:t:t] Deception involves misleading the enemy into acting unfavourable to their interests. Disruption and denial are temporary measures to the utility of the space system whereas degradation and destruction are permanent involving physical damage or elimination. Examples of space defense systems that are in development include[*]:- AEHF, a jam resistant satellite communications system independent from ground relay stations; counterspace systems, which includes counter communication system designed for temporary disruption; STSS; Space Based Infrared System High detection system for intelligence; missile warning and defence; Space Radar surveillance and reconnaissance capabilities; Space Test Program (e.g. XSS-11); mid-course missile defense plus space based interceptor test bed; Starfire Optical Range funded under PE 0603605 advanced weapons technology; directed energy research e.g. relay mirror (previously known as EAGLE); Multi Kill Vehicle and Autonomous Nanosatellite Guardian for Evaluating Local Space.

In light of the Commission's report and subsequent military doctrines if one analyses Article IV of The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies 1969, commonly referred to as the Outer Space Treaty, this prohibits placing "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." In the second part of Article IV the moon and other celestial bodies must be used exclusively for peaceful purposes. Also military bases, installations and fortifications, testing of any weapon or any military manoeuvres on celestial bodies is prohibited. If military personnel are used for peaceful purposes such as scientific research this not prohibited including any equipment or facility for the peaceful exploration of the moon and other celestial bodies.

Weapons of mass destruction are one of the key terms in Article IV. This was defined by United Nations Commission for Conventional Armaments Resolution dated 12 August 1948 as '*atomic explosive weapons, radio-active material weapons, lethal chemical and biological weapons and any other weapons developed in the future which have the characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above."*

Equally, the USA defines weapons of mass destruction in Title 18 Part 1 Chapter 113B §2332a (c) (2) of the United States Code. The term means A) any destructive device which is defined in §9 of Title 18 and includes "any explosive, incendiary or poison gas" for example bomb, grenade, rocket with propellant more than four ounces or a device similar to any of devices

---

[tt] see D-21/D22 with respect to space control and also destroying adversary's missile launch capabilities see for example D-15/16 Transformational Flight Plan 2004

[:t:t] These elements can also be found in the CounterSpace Operations Air Force Doctrine 2-2.1 2 August 2004.

[*] www.mda.mil / wpafb.af.mil / kirtland.af.mil/afrl_vs/ Space Weapons Spending in the FY 2008 Defense Budget Feb. 21, 2007 Theresa Hitchens, Victoria Samson, and Sam Black Space Weapons Spending in the FY 2007 Defense Budget March 6, 2006 Updated March 8, 2006 Theresa Hitchens, Michael Katz-Hyman, and Victoria Samson www.cdi.org

described. The list is not exhaustive. Also B) any weapon that is designed or intended to cause death or serious bodily injury through the release, dissemination or impact of toxic or poisonous chemicals or their precursors or C) any weapon involving a biological agent, toxin or vector or D) any weapon that is designed to release radiation or radioactivity at a level dangerous to human life. Nevertheless, these clarifications still leave important room for interpretation. For example: are the provisions mutually exclusive or is it equating a destructive device with a weapon causing death or serious injury releases a biological agent, toxin or vector or radiation? If they are exclusive terms could an anti-satellite, directed or kinetic energy weapon also be defined as a destructive device?

WMD is also defined in US Code Title 50 Chapter 40 §2302 as a function of the quantity of human casualties. There, it is equated to technologies causing death or serious bodily injury to a significant number of people through the release dissemination or impact of toxic substances, disease and radiation. A definition can also be found Joint Publication 1-02 in the Department of Defense Dictionary of Military and Associated Terms as amended 30 May 2008 describing WMD *"weapons that are capable of a high order of destruction and/or being used in such a manner to destroy large number of people"* and are *"high-yield explosives or nuclear, biological, chemical or radiological weapons."* Moreover, it is worth noting that there is no official definition in international law for WMD. One of the relevant text related to the space environment, is the Limited Test Ban Treaty which prevents any nuclear testing / explosions in space.

The question is whether one could constitute space weapons that have directed energy or kinetic energy weapon capabilities as an explosive device within the meaning of WMD in Title 18 Part 1 Chapter 113B §2332a (c) (2) of the United States Code. Regardless of the above a vacuum would still remain for example other such weapons that are designed to jam would not fall within the meaning of destructive device. Alternatively the action of the state that instigated the attack causing a "high order of destruction" through the loss of one or more state's space asset (s) whilst in-orbit, (which also contributed to the death or serious bodily injury or loss of property). Following the Liability Convention 1972 Article III the state/commercial operator that suffered the damage would have to prove that the launching state was at fault. Also supposing a fragment from the destruction accidently disabled a functional satellite owned by another state which state would be at fault?

A Launching State under Article 1 of the Liability Convention means a state that launches or procures the launching of a space object and a State from whose territory of facility a space object is launched. There can be more than one launching state. Attempted launching is also included. However what if the state no longer has operational control of the object, for example the satellite is sold or even leased, for example what if a satellite was sold by state/company A to State B and State B used the satellite to jam signals who would be the launching state that would have international liability and responsibility under Articles VI and VII of the Outer Space Treaty? Would State A and B be jointly liable under Article IV of the Liability Convention, which covers third party liability in the event of two or more launching states where the first two shall be jointly and severable liable with the burden of compensation apportioned between the first two states to the extent of their fault. Transferring registry may not

simply be enough to mitigate any international responsibility and state registries are not immediately filed which can be problematic.

A further issue to consider is whether "procuring" and "space object" include for example the state, (or the private and/or juridical persons) who owns the launch facility; manufactured and installed the launch facility; supplied or transported some of the components to the launch facility, owns the land in which the facility is on; owns the satellite to be launched; manufactured and or supplied components to the satellite; transported the satellite; arranged for the launch; supplied the launch vehicle or financed the project etc. A further clarification on procuring may be called for in the future.

Article IX of the Outer Space Treaty where space exploration should be conducted in such a way that avoids harmful contamination and also adverse changes to the environment of the Earth resulting from the introduction of extra-terrestrial matter, and if necessary measures should be adopted. The provision does not state what those measures should be. However if we apply Article IX to the failing USA-193 satellite which, if not intercepted, according to the US DoD would have deposited 453kg hydrazine fuel potentially causing an adverse change to the environment of the earth. Also, if a state has reason to believe that the activity or experiment would cause potential interference with the activities of another state in the peaceful use of outer space, appropriate consultations should be made.

A statement was made by Ambassador Christina Rocca, Permanent Representative of the United States to the Conference on Disarmament 15th February 2008 notifying plans to intercept the satellite by targeting the fuel tank. It was anticipated that debris would re-enter posing no threat to other satellites and peaceful uses of outer space, as well as choosing an engagement point that would minimise any impact to populated areas. Ambassador Rocca also stated that, *"our transparency in notifying foreign governments and the broader international community is consistent with our commitment to safe and responsible space operations,"* as well as reassuring that *"this engagement is not part of an anti-satellite development and testing program, and we do not intend to retain the technical capability resulting from the modifications required to carry out the engagement."* The Aegis BMD deployed aboard the USS Lake Erie, a sea-based to midcourse BMD system, successfully intercepted using a Standard Missile-3 the failing US 193 satellite on 21st February 2008, which Ambassador Rocca informed the Conference of Disarmament. In contrast an estimated 2,200 trackable pieces of debris plus another estimated 33, 000 objects that are too small to track from the Chinese anti-satellite weapon test, which destroyed the Fengyun-1C weather satellite on 11th January 2007. A survey was held among Space Generation members where 58% of those who took the survey had no objections to the ASAT tests.

Space weaponisation has been a cause for concern since the 1970's, although discussions did not begin until the next decade in the Conference of Disarmament with regard to preventing an arms race in outer space. A draft Treaty was submitted by Soviet Union in 1981 entitled "Treaty on the Prohibition of Stationing of Weapons of Any Kind in Outer Space " (Document AI 36/192 of 20 August 1981) citing a prohibition of weapons of any kind and not to "destroy, damage or disturb the normal functioning of space objects of other state parties." Although any missile defense or ground to

space systems appear not to fall under the draft treaty. In 1983 Soviet Union submitted another draft treaty, "Conclusion of a treaty on the prohibition of the use of force in outer space from outer space against the earth" which included broader prohibition including testing and creating anti-satellite weapons. Although a caveat for BMD was still in place. Coming full circle in 2002 Russia again introduced a draft treaty this time in collaboration with China, which has been subject to a few developments over the last years. The new draft version, entitled "Treaty on Prevention of Placement Of Weapons in Outer Space and the Threat or Use of Force Against Outer Space Objects (PPWT) was introduced 29th February 2008 to Conference of Disarmament meeting and Committee on the Peaceful Uses of Outer Space 51st session. Article I of the PPWT defines outer space as "in excess of 100km above sea level". The second part defines an outer space object, although it is very clumsy in the wording for example;

"any device designed to function in outer space which is launched into an orbit around any celestial body; or located in orbit around any celestial body, or on any celestial body, except Earth, or leaving orbit around any celestial body towards this celestial body, or moving from any celestial body towards another celestial body, or placed in outer space by any means."

The one sentence provision is misleading and could be interpreted to mean that Earth is literally the exception for any device to function in space, which is launched into orbit around any celestial etc. It is probably meant to read as "or on any celestial body except earth" (minus the comma). Confusingly this celestial body suggests a particular body, but does not say which one. Is it referring to earth? The first part could read 1) any device designed to function in outer space, which is launched into orbit or is already located in orbit around any celestial body; 2) any device located on any celestial body except earth; 3) any device that deorbits and moves between celestial bodies. An alternative space object definition is offered later in the paper in the context of space situational awareness and space traffic management.

Article 1) c) defines weapons in outer space which is "any device placed in outer space, based on any physical principle which has been specially produced or converted to destroy, damage or disrupt the normal functioning of objects in outer space, on the Earth or in the Earth's atmosphere, or to eliminate a population or components of the biosphere which are important to human existence or inflict damage on them." The treaty is silent on any ground to space or air to space systems thus is it really required to include a boundary definition in this respect? Placed in outer space is defined in Article 1 (d) although it is not really needed. Also perhaps substituting "placed" for "deployed" would be more effective with respect to the terminology and meaning of launching weapons in space. The difficulty with defining a space weapon is distinguishing between offensive and defensive systems.

In a statement with regard to treaty prevention measures by George Pataki, who was nominated by President George W. Bush to serve as Public Delegate to the 62nd UNGA, at the Thematic Debate on "Outer Space (Disarmament Aspects)" in the First Committee of the General Assembly October 22, 2007, he said *"any object orbiting or transiting through outer space can be a weapon if that object is placed intentionally on a collision course with another space object."* Determining the intent of the operator was the only way to distinguish between co-orbital satellite

interceptor from non-threatening autonomous servicing vehicle and that could be achieved through transparency of each other space policies and strategies.

The last sub clause (e) defines the use of force or threat of force towards space systems which includes any hostile actions against outer space objects which will destroy, damage, temporarily or permanently disrupt their normal functioning as well as deliberately change their orbits. Article 1(c) and (e) go to the very heart of military activities in space and what constitutes peaceful and non-peaceful purposes. One school of thought is to make a distinction between military space and space weapons, given the dual nature of space systems. This must be read in light of Article I of the OST which states that outer space, moon and other celestial bodies is a province of mankind and shall be free for exploration by all states. Additionally Article III stipulates that exploration must be in accordance with international law and the Charter of the United Nations (UN). With regard to space weapons and peaceful uses Article 2 of the Charter prohibits the use of force or threat of the use of force thus 1 (e) is really elaborating on what is a space weapon. However Article 51 of the UN Charter gives "the inherent right of individual or collective self-defense if an armed attack occurs," and this has been interpreted to include space defense. If we follow the US Air Force Space Operations Doctrine 2-2 27 pg 27 November 2006, it states the traditional view that peaceful purposes do not prohibit military activities and this has continued without any significant protest. Thus activities must be non-aggressive following the UN charter except with the right of self-defense.

In a separate address Ambassador Rocca to the CD 13th February 2007 stated that they reserve the right to protect their space systems and that by maintaining the right to self-defence this does not mean that US will claim space or weaponise it. The statement also described how defining space weapon has come to no avail and efforts should be focused on deterring and dissuading the misuse of space.

However one could argue that developing and deploying offensive weapons potentially capable of an aggressive act could fall short within the meaning of the Outer Space Treaty and United Nations Charter. Additionally would it also not fall within the meaning of the Environmental Modification Convention 1980, which prohibits all hostile actions that might cause long-lasting, severe or widespread environmental effects in space, where any resultant debris could pose a significant threat to other space systems?

According to the 2001 Rumsfeld Space Commission "there is no blanket prohibition in international law on placing or using weapons in space, applying force from space to earth or conducting military operations in and through space." Anticipatory self-defence is included within Article 51 of the UN Charter. The danger is misinterpretation given the nature of the space environment how would one know an attack from an accidental collision and/or any damage that has resulted from space debris? After the Rumsfeld report the US subsequently pulled out of the Anti-Ballistic Missile (ABM) Treaty 1972 to enable the development of National Missile Defense System in December 2001.

In order to arrive at an appropriate definition of a space weapon one could consider the following justifications; 1) a space object has the potential to act as a space weapon; 2) Article 51 of the UN Charter the right to self-defense and 3) the operator's intent for

example whether it is offensive and/or aggressive.

If we then divide space weapon into four categories; potential weapon, modified in-orbit weapon, launched weapon and any other weapon. A potential weapon is an in-orbit space object that is deliberately manoeuvred into the pathway of another state's object with the intent to permanently degrade or destroy that object. A modified in-orbit weapon is any autonomous in-orbit system/object or any ground operations that modifies any space object to deny, deceit, disrupt, degrade and/or cause the destruction to another space object. A launched space weapon includes any object launched from earth or from any autonomous vehicle and/or satellite in space that is designed to deny, deceit, disrupt, degrade and/or cause the destruction to another space object. Lastly any other weapon includes any system that is designed to deny, deceit, disrupt, degrade and/or cause the destruction to another space object from any ground systems or air-launched systems. However any autonomous in-orbit system/object that is used for peaceful purposes is not a space weapon, where the autonomous in-orbit system/object services the normal functioning of a satellite and or tracks and collects space debris.

Following Article 3 of the OST one could additionally add that nothing would preclude the states right to self-defence under Article 51 of the UN Charter. However this would have to be from a direct attack as opposed to a pre-emptive or anticipatory defense action, which too problematic and could have a high probability of making costly mistake and adversely affecting international peace and security. Even if states did exercise their right under Article 51 of the UN Charter how would the state be able to distinguish between an accidental interference and accidental collision with either functional space object or space debris? Thus it could be said in order for space arms control regime to work the treaty may have to call upon states/commercial organizations to include obligatory sensors that would be able to detect and distinguish the difference. Thus on the premise that the difference can be made after a direct first strike this would then not preclude the state's right to temporarily deny or disrupt the space weapon instigating the damage in order to prevent any further or additional attacks. Also if a first strike was to occur the state would be obligated to report it to the appropriate bodies e.g. CD, Legal Sub-Committee of UN Committee of the Peaceful Uses of Outer Space (COPUOS) and the Security Council as well as any Space Traffic Management system in place. With regard to liability issues in using space weapons where collateral damage from the targeted satellite could cause the loss of another state's space object and/or the target that was hit which was not part of the initial strike, a financial burden should be placed on the state that initiated the attack for any damages caused to space objects. This is also problematic under current space law (see below).

SPACE SITUATIONAL AWARENESS

The Transformational Flight plan 2004 defines *"Space Situational Awareness (SSA) combines command, control, intelligence, surveillance, and the environment to understand space operations, threats to operations and impacts"*. Deleted from the 2003 edition was that "*SSA enables.... offensive and defensive operations to gain and maintain space superiority."*

For example the Space Surveillance Network (SSN) is part of SSA and consists of various phased array sensors and conventional radars that are distributed worldwide as well as including ground based

electro-optic deep space surveillance system. The SSN tracks operational satellites and space debris with a diameter of 10cm or more or 1 meter in geostationary orbit. All the data is transmitted to the Air Force Space Command's Joint Space Operations Center Mountain (JSpOC-Mtn) located at Cheyenne Mountain Air Station.

The Outer Space Treaty (OST) 1967 provides under Article VIII states shall retain jurisdiction and control over objects launched into outer space that are registered to that state and their presence in space or return to Earth remains unaffected. Following the definition of a space object under Article 1(d) of the Liability Convention "which includes component parts of a space object as well as its launch vehicle and parts thereof" states would retain ownership and control of any pieces of satellite that should for example fragment. The application of space debris with particular regard to establishing fault to Article III is problematic. To reiterate the state/commercial operator that suffered the damage would have to prove the other state/commercial operator was at fault, but there is no system to provide for identification of component parts and it would be difficult to prove jurisdiction and control under Article VIII of the OST.

The Space Debris Mitigation Guidelines issued by Inter-Agency Space Debris Coordination Committee (IADC) covers the environment impact of space missions by recommending the (1) Limitation of debris released during normal operations, (2) Minimization of the potential for on-orbit break-ups, (3) Post-mission disposal and (4) Prevention of on-orbit collisions. According to the guidelines space debris[:t] are all man-made objects including fragments and elements thereof, in Earth's orbit or re-entering the earth's atmosphere that are non functional. Utilizing this definition a space object could be defined as *"any "object" launched from a spaceport whilst ascending above or re-entering the transitional "airspaceway" is a space object, which includes all component parts as well as the launch or human operated vehicle and parts thereof."* Thus *"any launch pad or runway that has vertical or horizontal take-off that is designed to place one or more objects in space or coordinate the return of such objects is a "spaceport."* Transitional airspaceway is discussed further under space traffic management.

"A space object is also any object that has de-orbited from its original orbital position and/or any component parts that have separated or fragmented and/or located in a graveyard orbit."

Another difficulty is that the line between the technologies used to develop space weapons could be blurred with the technology that could used to mitigate space debris. Listed in the 2003 Transformational Flight plan is the compact environmental anomaly sensor II ACTD which will help to reduce any satellite down-time through the sensor as well as providing warnings as to the space environment and assist with information as to any malfunctions that may occur, particularly as to whether it is hostile. This type of technology could be useful in a space weapon control regime and also for space debris mitigation.

The telescope at the Okno facility located in Nurek, Tajikistan and the Krona complex in

:t Most of the debris is located in LEO and picks up a electrostatic charge perhaps taking advantage of this and using a debris cloud to actuate (e.g. high temperature superconductor) a satellite in order to collect (smaller) debris using aerogel grids. Two satellites would work in a given sector. One of the satellites would, using a Polyvinylidene Fluoride (PvDF) dust sensor, first track the position and measure velocity of smaller debris within the cloud. From the initial sweep by the dust detector one should be able to calculate the direction and speed for a successful collection. The aerogel grids would be disposed of by re-entry.

Zelenchukskaya Northern Caucasus, plus nine radar stations forms Russia's own space surveillance network. The information or data generated by the network is private and not generally shared outside the Russia Government. But there could be cause for some optimism with regard to space surveillance. For example the European Parliament has adopted a resolution 10 July 2008 (2008/2030(INI)) with regard to space and security, approving the "creation of a European space surveillance system leading to space situational awareness (including, for example, GRAVES and TIRA) to monitor the space infrastructure, space debris and, possibly, other threats." But is this enough?

Under Public Law Chapter 135, Title 10 of the United States Code §2274 permits the Department of Defense (DoD) to provide satellite-tracking support to entities outside the US Government under a pilot program subject to an agreement and where the Secretary of Defense determines the service to be in the national security interests of United States. The entity agrees to pay a fee, which will be charged by the Secretary, in order to reimburse the Department for the costs of providing space surveillance data support. The entity must also agree, "not to transfer any data or technical information received under the agreement, including the analysis of tracking data, to any other entity without the express approval of the Secretary."

The Air Force Space Command initiated the CFE Pilot Program through the space-track.org website. The full Congressional pilot program has yet to implemented. The pilot study was extended to September 30 2009 through Public Law 109-364 in 2006, which amended Section 2274(i). The full program is envisioned to supply shared Space Situational Awareness to Commercial, Allied, Public and Foreign Interests. Services under the fee program include launch support, conjunction assessment, end-of-life/re-entry support, and anomaly resolution support.

However in the future could managing space traffic be equivalent to managing air transport? Could the line between air and space traffic join as one continuous flow of traffic? How can we overcome the risks the risks posed by space debris and any potential hostile interference? In the first instance working together to expand the current radar range makes sense. Secondarily introducing a robust international communication and tracking network could be a first-step solution to facilitating a space traffic management system.

SPACE TRAFFIC MANAGEMENT

Using rules enshrined within civil aviation a roadmap can be formed for a basic framework, which could have the potential to operate in the near-term. Two other major studies have been conducted on Space Traffic Management one by the International Space University (ISS) and the other by International Academy of Astronautics (IAA) providing even more solid grounding in taking the responsibility for safeguarding both the space and earth environment. There is not enough space to make a descriptive analysis of these studies however this paper draws upon the ISS and IAA reports to propose a model framework.

During shuttle missions NASA is informed of any space objects that come within theoretical safety box that measures 40 by 40 by 10 kilometres orientated along the flight path of the Joint Space Operations Center (JSOC) at Cheyenne Mountain Air Station. JSOC also co-ordinate any rendezvous manoeuvres, for example docking with ISS. Thirty-six hours to seventy hours ahead a flight plan is submitted to JSOC, which is

analysed for any possible close approaches to the spaceflight mission. Co-ordination of the Shuttle and the ISS are the only STM services currently provided by SSN. Infact there are no formal international procedures or system for designating, identifying, routing and re-routing space traffic or international organisation to implement such measures.

Establishing rules for managing the space highway could help safeguard both the space and earth environment.

A new model framework for a "Space Traffic Management System" was introduced by the author on behalf of the Space Generation Council, at the United Nations Committee on the Peaceful Uses of Outer Space 51st session. The proposed model draws upon principles established in air traffic management and International Civil Aviation Organization annexes as well as a range of ideas and concerns from young students and professionals regarding the space environment.

What would be the organisational structure to set up a STMS?

The framework calls for the creation of an international (regional) communication ground Telemetry, Tracking and Control (TT&C) network, consisting of all Launch Mission Control Centres (MCC) and Satellite Control Centres (SCC). This would be organized under the nine regionally designated Mission-Telemetry, Tracking and Control (M-TTC) Centres' located in the following regions

Africa- Indian Ocean (AFI)
Asia (ASIA)
Caribbean (CAR)
European (EUR)
Middle East (MID)
North America (NAM)
North Atlantic (NAT)
Pacific (PAC)
South America (SAM)

What is Space Traffic?

Space traffic includes space objects ascending and descending (including re-entry) between Initial Sub-Orbital/Orbital Launch Phase and Spacecraft Sub-Orbital/Orbital Approach Phase.
The term space object is defined in the Convention on International Liability for Damage Caused by Space Objects 1972 Article 1(d), which includes component parts of a space object as well as its launch vehicle and parts thereof. Alternatively the definitions proposed on pg 9 of this paper.

How would traffic be identified and designated under a STMS?

Following the nine air navigation regions set out by ICAO an identical network is envisioned separating 'space equivalent' operational traffic and general air traffic. The framework provides for non-civil traffic, which would be identified under "Military Operational Space Traffic" and "General Space Traffic" could encompass any Civil (CIVST) or Commercial Space Traffic (COST). The owner/operator would be responsible for designating their space objects. Designating an appropriate regional Centre would be based on the location of launch site/provider.

The Initial Sub-Orbital/Orbital Launch Phase incorporates the term 'launching', which includes attempted launching. Launching also incorporates all flight phases from stage separation to coasting. The Framework introduces a method to achieve a continuous STM system across border by establishing an international 'transitional airspaceway', which could be located within the

Mesosphere layer of the atmosphere from 50km to 90/100km above the Earth's surface.

The Spacecraft Sub-Orbital/Orbital Approach Phase includes payload separation and orbit injection/insertion. Also transfer from Spacecraft Approach Phase to Final Graveyard Orbit. Under this segment the GST orbital parameters and status including any planned orbital manoeuvres in particular re-orbiting would be made available to the M-TTC Centres.

How would the STMS work?

The MTT&C would facilitate a communication network whereby all State Mission Control Centre's, (who co-ordinate all space launches) and Satellite Control Centre's, (who after the launch take over in-orbit operations) would report to their appropriate regional centre. The MCC would co-ordinate any space launches through their regional Centre. Taking into account that the MCC who provided the launch service may be of different geographical location to that of the owner/operator then the regional centre that provided mission control analysis and launch clearance would transfer TT&C services to the appropriate regional centre, which is again determined by the location of the owner/operator's Satellite Control Centre (SCC).

Prior to launch the framework calls for international spaceflight plan to be filed, which would be made available to all regional M-TT&C Centres. For example the information provided on a spaceflight plan could consist of the; launch date and time; launch provider / spaceport; space launch vehicle / spacecraft; operator; payloads; the designated regional M-TT&C Centre; pre-launch Keplerian Elements (if applicable and is not MOST); MOST Identification Code; descending/re-entry information and any astronauts and/or civilian passengers onboard if it is a human spaceflight mission. The M-TT&C should be immediately informed if the launch date and time should change or is postponed by the state MCC. A single automated tracking software and graphical user interface must be utilised and networked between all Centres.

Regional M-TT&C Centre under Mission Control services will be responsible for launch and re-entry clearance. A pre-launch safety assessment will be performed ensuring that the flight/mission path is clear after the spaceflight plan has been filed. With regard to re-entry clearance all Regional M-TT&C Centres' will adhere to Air Defence Identification Zones, providing information and identification of any space object re-entering the Earth's atmosphere.

Tracking Telemetry and Control services include providing orbit screening, which will also form part of the launch clearance. Other services include maintaining minimum distances for the safe separation of space objects and guiding any planned orbital manoeuvres. Advanced notification of any planned manoeuvres, satellite fragmentation and de-orbit information should be provided by the owner/operator to their regional centre. The information would be treated with confidentiality amongst the nine regional centres.

How would space traffic be co-ordinated with air traffic?

The flexible use of airspace concept is used is civil aviation where the airspace is viewed as one continuum providing for flexible usage on a daily basis to all users, i.e. both civil and military users. The same principle according to the framework could be applied to any space launch from any launch pad or

commercial spaceport. Thus after the spaceflight plan is filed the airspace is reserved for the duration of the launch and/or re-entry. Regional M-TT&C Centres' would co-ordinate with Air Traffic Control Services to ensure notification and re-direction of traffic, including maritime traffic.

How would a STMS take into account national security aspects to space traffic?

The military agency responsible for the space object would direct their own traffic, which would be co-ordinated in co-operation with GST M-TT&C as well as with civil and commercial operators. An identification system for MOST traffic without revealing orbital parameters (due to national security requirements) should be provided by the responsible agency in order to facilitate co-ordination with GST.

Under air traffic services co-ordination between civil and military operators is provided for under Annex 11 of ICAO. Following similar terminology for the framework whereby arrangements can be made: -

"To permit information relevant to the safe expeditious conduct of GST to be promptly exchanged between regional M-TT&C Centres and appropriate military units." Thus "Regional M-TT&C Centres shall, either routinely or on request provide appropriate military units with pertinent spaceflight plan and other data concerning GST."

Providing a spaceflight plan and data concerning GST to appropriate military units will help to preserve national security by eliminating the need to provide information from military to military units regarding potential collisions with respect to MOST and with GST.

The STM framework outlined is a first step of many that is intended to naturally develop that will enable future generations to safely continue the exploration and use of outer space, including the moon and other celestial bodies, following the Article I of the Outer Space Treaty 1967 as new purposes and endeavours are utilized by both Governmental and commercial operators.

CONCLUSION

This paper has identified three parameters based on international and US legal and strategic frameworks, with regard to initiating a space weapon treaty:- for any space object operating potentially as a space weapon, the right to self-defence under Article 51 of the UN Charter as well as distinguishing the operator's intent. Each of which must be considered in order to initiate renewed discussions within the Conference of Disarmament. This study also identified remaining problematic areas, in particular liability and collateral damage that could harm other space objects due to the difficulty to identify the origin of the object causing the damage.

The four proposed categories of space weapons: potential weapon, modified in-orbit weapon, launched weapon and any other weapon could be a method for initiating further discussions with regard to a treaty. However if one considers traditional treaty banning methods within the Conference of Disarmament, one must recognize that they have been fraught with difficulties. For this reason, alternative measures and methods need to be considered. Space Traffic Management Systems, for example, would enable deterring and dissuading the misuse of space by working together through the proposed

regional centres to ensure the safe passage of traffic.

The model framework facilitates a communication and cooperation network that is designed to protect space assets. It is a passive defense measure that will help to foster further international peace and security as well as promote international co-operation and strengthen international relations.

Specific examples of future goals of the STM framework include; developing debris liability and arbitration system which is a protocol to the Liability Convention; equivalent flexible use of airspace policy with regard to MOST and GST; transition between ATC and STM with an ultimate end goal; a single flexible use of the airspaceway.

Ultimately it is method of safeguarding the resources of outer space, and human explorations for future generations, as well as ensuring a safe space and earth environment for all users whether that is civil, commercial or military space.

BIBILIOGRAPHY

1. The Commission to Assess United States National Security Space Management and Organization January 11 2001 - http://www.dod.mil/pubs/space20010111.html
2. U.S. Air Force Transformation Flight Plan November 2003 & 2004 www.af.mil/library/posture/AF_TRANS_FLIGHT_PLAN-2003.pdf www.oft.osd.mil/library/library_files/document_385_2004_USAF_Transformation_Flight_Plan.pdf
3. CounterSpace Operations Air Force Doctrine 2-2.1 2 August 2004.
4. Joint Vision 2020 and America's Air Force Joint Vision 2020 www.dtic.mil/jointvision/jvpub2.htm www.army.mil/thewayahead/afvision.pdf
5. Space Weapons Spending in the FY 2008 Defense Budget Feb. 21, 2007 Theresa Hitchens, Victoria Samson, and Sam Black
6. Space Weapons Spending in the FY 2007 Defense Budget Updated March 8, 2006 Theresa Hitchens, Michael Katz-Hyman, and Victoria Samson http://www.cdi.org
7. UN Commission for Conventional Armaments Resolution dated 12 August 1948
8. The Office of the Law Revision Counsel http://uscode.house.gov
9. United States Mission to the Conference on Disarmament http://geneva.usmission.gov/CD/statements.html
10. International Space Law & the UN- Nandasiri Jasentuliyana –Kluwer Law International 1999
11. The Space Debris Mitigation Guidelines - Inter-Agency Space Debris Coordination Committee
12. European Parliament http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2008-0365+0+DOC+XML+V0//EN
13. 2006 International Academy of Astronautics COSMIC Study on STM http://iaaweb.org/iaa/Studies/spacetraffic.pdf
14. STM International Space University Summer Session Program 2007