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The Interdisciplinary Centre for Space Studies

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THE MILITARISATION OF SPACE: POLICY AND LEGAL ASPECTS

ICSS

Leuven Centre for Global Governance Studies

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Welcoming speech

Mr. Ludwig VAN DER VEKEN

President of the Research Centre for Military Law and the Law of War
Director-General, Ministry of Defence, Belgium

Ladies and gentlemen,
Distinguished participants,

It is a great pleasure to welcome you here in Brussels on the occasion of our international conference on the militarization of space.

As you probably know, there is a growing interest in scientific space exploration and observation as well as in commercial exploitation of space assets. At the same time however, the argument has been promoted particularly in the United States that space superiority is the future of warfare and that one cannot win a war without controlling space.

In the 21st century, space-based systems gather intelligence, are able to detect rocket launches, enable precision attacks, make possible the transmission of communications, etc. Today also, many of these space applications are of a dual use character. The best known example of such a dual use system is probably GPS. Considering the military advantages of the modern network centric-warfare, some countries have decided to or are likely to decide to invest in space-based military assets, but also in counter space-capabilities, in particular anti-satellite weapons. In its turn, the United States, fearing a 'Space Pearl Harbour' scenario, has decided to develop defensive measures against such counter space-capabilities.

This evolution makes clear that the integration of space-based assets into warfare risks to cause a major militarization of space and it may even lead to a new or additional battlefield, namely space, with all risks related to the specific environment involved. China's January 2007 test in which a Chinese missile destroyed its own satellite Fen Yun 1 while in earth orbit, illustrates the worrying nature of the evolution: Debris from the destroyed satellite and missile still is orbiting and is said to possibly pose a danger to other satellites and spacecraft.

Many questions rise in respect of this evolution. Where does space start? What are the technological possibilities and expected evolutions as to the militarization of space? What is exactly the strategic importance of space? What do US, Chinese and other national policies say about it, where does Europe stand and what's the position of NATO? Do space policies sufficiently take into account international law obligations? What about the principles of free access to space and peaceful use of space by all nations? Are there possibilities to prevent an arms race with respect to space? What does international law say about the possibility to resort to the use of force in space? And to what extent does the law of armed conflict apply to hostilities against or from space-based assets?

The aim of this conference is to address these and many related questions through presentations, comments and debates. I wish you a very fruitful conference and I thank the speakers already for being prepared to contribute to this important event.

Thank you for your kind attention.

Flying out of the Atmosphere

Em. Prof. Dr. Roland Decuypere

1. Introduction

This paper has been written on request of the organizers of the "*International Conference on the Militarization of Space: Policy and Legal Aspects*". It is intended to be a purely technical introduction to the conference, highlighting the different steps taken towards the conquest of space.

A great deal of the information used throughout the paper is based on articles found on the Internet and in particular on the Wikipedia encyclopedia.

The paper is built up in a similar order as the steps to be followed by a spacecraft during a "fly-and-return" mission: flying through the atmosphere of the Earth, accelerating and breaking the sound barrier while increasing the altitude, maneuvering into orbit, followed by a reentry into the Earth's atmosphere.

2. Layers of the Earth's atmosphere (Figures 1 and 2)

It is a miss conception that there is a boundary between the atmosphere, surrounding the Earth, and outer space. With increasing altitude the air slowly becomes thinner and thinner and fades into space. Half of the atmosphere's mass is below 5,6 km altitude, while 75% is within 11 km, 90 % below 16 km and 99,99997% below 100 km. The atmosphere is composed of several layers having a different mathematical relationship between temperature and altitude.

The Troposphere is the lowest layer, beginning at the Earth's surface and extending between 7 km at the poles and 17 km at the equator. The troposphere has a great deal of vertical mixing due to solar heating of the Earth's surface, making the lower air masses less dense resulting in an upward movement. As we learned from our courses in elementary physics, the mean temperature at zero altitude is 15 ° C, while the mean pressure is 1,01325 bar. In the so-called "*standard atmosphere*" pressure and temperature decrease with altitude.

The Stratosphere extends from the troposphere up to 50 km. Temperature increases with altitude. The stratosphere contains the ozone layer, protecting us against UV radiation from the Sun.

In the Mesosphere, extending from 50 km to 85 km, the temperature is decreasing with altitude. This is the layer where most meteors and debris from space vehicles burn up when entering the atmosphere.

The Thermosphere is the fourth layer and extends from 85 km to 690 km. In this layer the temperature is increasing with altitude.

The Ionosphere is the part of the atmosphere being ionized by solar radiation. It plays an important role in atmospheric electricity and forms the inner boundary of the magnetosphere. It influences radio propagation to distant places on the Earth. It is located in the thermosphere and is responsible for auroras.

In the Exosphere, extending from 690 km up to 10.000 km, free moving particles may migrate into and out of the magnetosphere or the solar wind.

3. Flying through the atmosphere

Fundamental equations

When taking all characteristics of the airplane into consideration, all possible atmospheric phenomena, as well as all possible flight conditions, then the real motion of the aircraft can only be understood using a set of complicated mathematical equations that can only be solved using a computer. However, engineers and physicists have developed simplified equations which are sufficiently accurate in some particular cases, as for instance in straight horizontal flight conditions.

In this case the equations for the aerodynamic lift (L) and drag (D) are expressed as:

$$L = ½\, C_L.\rho.S.V^2 \text{ and } D = ½\, C_D.\rho.S.V^2$$

where C_L and C_D are the lift and drag coefficients depending on the shape of the aircraft, S is the wing area, V the flight velocity with respect to the air, while ρ is the air density (for instance ρ = 1,225 kg/m³ at mean sea level and at 15°C).

This kind of simplification and using similar approaches for the thrust, velocity and acceleration result in the following conclusions:

- **Lift** depends on the vehicle shape, its size, the flight speed and the altitude (ρ)
- **Drag** depends on the vehicle shape, its size, the flight speed and the altitude
- **Thrust** depends on the engine, the throttle position, the altitude and the flight speed
- **Weight** depends on the vehicle, the payload, the fuel consumption**,** and in case of a space vehicle also on the **altitude** (see Section 4, Equation (2))

The sound barrier

In the early fifties wind tunnels were available demonstrating that in subsonic flow (M<1), the drag on an aircraft model increased substantially at higher flow regimes. Even before WWII, Mach and his group of researchers, developed the supersonic flow equations. One of their conclusions was that, when decelerating in the supersonic regime (M > 1), the drag rises very rapidly once the Mach number is below 1,2. This is illustrated by Figure 3. In that era, no wind tunnels were available that could produce stable transonic flow regimes (0,8 < M < 1,2). Therefore, looking at results similar to those depicted in Figure 3 (the red dots), even highly qualified aerodynamicists believed that the aerodynamic drag at the M = 1 would be infinite. This is the reason why they called it the "*sound barrier*", illustrating that no aircraft would be able to accelerate from subsonic to supersonic speed.

Breaking the sound barrier

On 14 October 1947, Chuck Yeager flew the Bell X-1 (Figure 4) through the sound barrier, at a Mach number of 1,06 and at an altitude of 13.000 m. This was the first supersonic flight. This aircraft was in principle a "*bullet with wings*" that closely resembled the shape of the Browning .50 machine gun bullet, that was known to be stable in supersonic flight. The rocket-powered aircraft was launched from the belly of a B-29 mother ship and was able to perform a sustained flight of only five minutes, after which it glided to a landing on a runway. Since its remarkable flight, the Bell X-1 is on display in the *Milestones of Flight Gallery* of the National Air and Space Museum in Washington DC, alongside the Spirit of St Lewis (flown by Charles Lindbergh) and SpaceShipOne (designed and developed by Burt Rutan).

Faster and higher (Figure 5)
The Lockheed F-104 Starfighter made its maiden flight on 4 May 1954. It was a supersonic (M = 2,5) fighter aircraft, designed for a maximum speed of 2125 km/hr and having, for that time, an impressive rate of climb of 244 m/s. Its prime mission was to fight against the MIG-15 during the Korean War, because the US pilots were unhappy with the performance of the Sabre, which was less advanced compared to the MIG-15.
Since the flight of the Bell X-1 important progress was made regarding the technologies required for supersonic performance. This is the reason why the wings of the F-104 were extremely thin with a thickness at the leading edge of only 0,41 mm. This aircraft held several world records: altitude 31,5 km, speed 2.260 km/hr and a climb performance to 20 km in only 3 min 43 sec. As a matter of fact, in the early fifties the emphasis was on speed, while nowadays the top priorities are agility, maneuverability and combat survivability.

Another key player in the race for higher altitude and still faster supersonic flight is the SR-71 Blackbird (Figure 6). It was an advanced reconnaissance aircraft which performed its maiden flight on 22 December 1964. Only 12 aircraft were built. Performances in horizontal flight were a Mach number exceeding 3 and a ceiling of 25.930 m.

Reaching the edge of space
Only three X-15 (Figure 7) research aircraft were built. This rocket-propelled plane set numerous speed and altitude records in the early 1960s, reaching the edge of space and bringing valuable data that was used in the design of later aircraft and spacecraft. One of the 12 test pilots was Niel Armstrong, who would be the first man on the Moon. During the X-15 program, 13 flights (by eight pilots) met the USAF's criteria for a spaceflight by passing an altitude of 50 miles (80,5 km) and the pilots were accordingly awarded the astronaut status. In July and August 1963 pilot Joe Walker crossed the 100 km mark twice, becoming the first person to enter space twice.

4. Spaceflight

Sub-orbital spaceflight
A first example of a vehicle with sub-orbital spaceflight capability is the sounding rocket (Figure 8). Sounding rockets are commonly used to take readings or carry instruments from 50 km to 1.500 km above the surface of the Earth. They are also used as test beds for equipment that will be used in more expensive and risky orbital spaceflight missions.
The flight time is usually very limited and between five and forty minutes.

Another vehicle performing a sub orbital space flight is the ICBM (Figure 9), designed for nuclear weapons delivery. ICBMs are vehicles with a range exceeding 5.500 km.
SpaceShipOne (Figures 10a and 10b), designed by Burt RUTAN is another remarkable aircraft that made history on June 21, 2004, performing the first privately funded human spaceflight. After its three flights it was sent to the National Air and Space Museum in Washington DC, where it is on display with neighbors as the Spirit of Saint Lewis (Charles Lindbergh's aircraft) and the Bell X-1. A breakthrough of commercial spaceflights is foreseen from 2009 on. As a matter of fact, a successor to SpaceShipOne is under construction (Figure 11). Virgin Galactic (owned by Sir Richard Branson) ordered 10 SpaceShipTwo's and 4 White Knights II (the mother ship taking the space vehicle to the altitude of 15,2 km, before firing its rocket engine). The vehicle can accommodate six passengers and two pilots and will reach an altitude of 110 km. Total duration of the flight is three hours and the estimated price of the ticket is of the order of 200.000 USD.

Circular orbit

Equations governing orbital spaceflight are easy to obtain. During a circular orbit the weight is balanced by the centrifugal force. Mathematically this is expressed in the following way:

$$m.g = m.V^2 / (R + h) \qquad (1)$$

m is the mass of the satellite, g the gravity acceleration, V the flight speed, R the Earth radius (6.378 km) and h the altitude above the Earth's surface. The left hand side of the equation is the weight, while the right hand side is the centrifugal force.

The gravity acceleration varies with the distance to the center of the Earth as:

$$g = 9{,}81.(R / (R + h))^2 \qquad (2)$$

The flight speed can be derived from Equation (1):

$$V = (g\ (R + h))^{1/2} \qquad (3)$$

and the time for one orbit is:

$$T = 2\ \pi((R + h)/V \qquad (4)$$

Examples:

1. For a satellite flying at 400 km above the Earth:
   $g = 8{,}69$ m/s^2, V = 7.215 m/s and T = 5.903 sec = 1 hr 38 min

2. At 35.786 km above the surface of the Earth:
   $g = 0{,}224$ m/s^2, V = 3076 m/s and T = 86.115 sec = 24 hr
   This example is of particular interest. A satellite travelling (in the right direction) on a circular orbit at an altitude of 35.786 km will remain over the same spot on the Earth. This is the case of the so-called geostationary .or geosynchronous satellites used for TV communication.

3. Earth's natural satellite: the Moon
   A third example is the Moon who is in a nearly circular orbit around the Earth. The distance between the Earth and the Moon is approximately 385.000 km.
   According to the equations above: $g = 0{,}002605$ m/s^2, V = 1.010 m/s, T = 2.435.422 sec = 28 days.

Elliptical orbit

Elliptical orbits are more common for artificial satellites. When $V > V_{circular}$ or $V < V_{circular}$ then the orbit becomes elliptical. In this case the equations are much more complicated as the radius of the trajectory as well as the velocity are constantly changing.

By equating the kinetic energy and the potential energy the escape velocity is obtained, resulting in $V = 1{,}41\ V_{circular}$.. At this speed you would enter the interstellar space… for ever and ever…

5. Reentry into the atmosphere

The Space race

The technology of atmospheric reentry was a consequence of the cold war. Both the Soviet Union and the United States initiated massive research programs to push forward the military capabilities of reentry technologies.

The first reason was the need, that before a missile delivery of a nuclear weapon could be practical, the problems associated with reentry had to be mastered. Simple calculations based on the well known supersonic flow equations indicated that the kinetic energy of a nuclear warhead returning from orbit was sufficient to completely vaporize the warhead before it returned to Earth. Obviously the first nation mastering this technology would have a decisive military advantage. Therefore a high priority program was initiated to develop reentry technologies.

There was a second reason why atmospheric reentry was of major importance. Also as a consequence of the Cold War, the Soviet Union saw propaganda and military advantage in pursuing space exploration. To the embarrassment of the USA, on 4 October 1957, the USSR orbited the first artificial satellite, SPOUTNIK. A series of other "t*echnological firsts*" followed very soon, culminating with Youri GAGARIN, the first human to orbit the Earth on 12 April 1961 and returning safely.

The USA saw the USSR achievements as a challenge to its national pride as well as a threat to national security. Consequently the United States followed the Soviet Union's initiative and increased its nascent space program.

In the context of this technical introduction to the conference, only two key technologies are briefly described. One is on the characteristic shape of a reentry vehicle, the other is on its thermal protection. Other equally important areas, such as stability and shock gas physics are out of the scope of this paper.

<u>Blunt body shapes</u>
It is well known that aircraft ,designed for high supersonic Mach numbers ($M > 2$), have a very sharp nose and sharp wing and tail leading edges (Figures 5 and 6). This is to insure that the shock waves remain attached to aircraft's nose as well as to the wing and tail leading edges. Attached shock waves are key to minimizing the drag created by the shock waves in supersonic regimes. An illustration of this is given by the four shadowgraph pictures obtained in a supersonic wind tunnel (Figure 12). In the upper left corner the shock waves (the dark straight lines at the nose of the missile model), are fully attached to the sharp nose. Across the shock wave the temperature is increasing considerably, which results in a very high temperature at the nose of the model. The other pictures are obtained for a blunt body model. The shock waves are pushed forward, away from the model's outer wall. As a result of the detached shock, the hot gases are no longer in contact with the surface of the model and are moved around the vehicle. This is the
reason why reentry vehicles have a blunt nose as well as blunt leading edges at the wing and control surfaces.

Three examples of blunt nose shapes are illustrated by Figures 13, 14 and 15 for respectively a Cold War weapon, the Apollo Command module and the ATLANTIS space shuttle.

<u>Thermal protection</u>
Reentry vehicles enter the Earth's atmosphere with velocities up to 9000 m/s with a corresponding Mach number of 25. For these high M values the temperature is of many thousand degrees immediately behind the shock front. Obviously there is a need for thermal protection of the vehicle. For this reason thermal protection materials and systems were developed.

Thermal protection by ablation of a heat shield is very effective when very high reentry velocities are expected associated with very high heat fluxes. This is, for example, the case when a command module, returning from the Moon, is entering the atmosphere at a speed of 11 km/s, or in future sample-return mission scenarios from Mars. Ablation causes the material of the heat shield to melt and sublime through the process of pyrolysis,
blowing the hot shock layer gas away from the surface of the heat shield. However, such an ablative technique loses most of its thermal protection effectiveness when the temperature of the outer wall drops below a minimum necessary for pyrolysis. In such circumstances the heat from the shock layer may soak into the heat shield and could eventually be conveyed to the payload.

This is the reason why the Space Shuttle was designed with a reusable heat shield based upon a thermal soak technique. The underside of the vehicle is coated with thousands of tiles made of silica foam, which are intended to survive multiple reentries with only minor repairs between missions. Fabric sheets, known as gap fillers, are inserted between the tiles where necessary. These gap fillers provide for a smug fit between separate tiles while allowing for thermal expansion. When a Space Shuttle lands, a significant amount of heat is stored in the tiles. Therefore shortly after landing, a ground support cooling unit connects to the vehicle’s coolant loop to remove the heat soaked in the tiles and the orbiter structure. The shuttle’s tiles have remarkable thermal protection properties but are relatively brittle and break easily. The next sentence illustrates the thermal protection capability of such tiles. When exposed to a temperature of 1000 K on one side, the other side will remain merely warm to the touch.

6. Conclusions

The “ Karman” line

The atmosphere does not technically end at a given altitude but the air becomes progressively thinner. There is no clear boundary between Earth’s atmosphere and space.
Nevertheless, the FAI (**F**édération **A**éronautique **I**nternationale: an international standard setting and record-keeping body for aeronautics and astronautics) has accepted a working definition for the edge between the atmosphere and space. The FAI gave it the name “Karman line”. It is located at 100 km MSL (**M**ean **S**ea **L**evel) and is accepted as the boundary between aeronautics and astronautics. This is used because Dr Theodore von Karman, a famous Hungarian-American aeronautical engineer and physicist, calculated that at the altitude of 100 km, a vehicle would have to travel faster than orbital velocity in order to derive sufficient aerodynamic lift from the atmosphere to support itself.
However, the US definition of an astronaut, which is still held today, is a person who has flown above 50 miles (80,5 km) MSL.

Some misconceptions

Outer space is not completely empty but contains a low density of particles. The pressure in space is of the order of $1 x 10^{-11}$ Pa, while the pressure at sea level is $1 x 10^{5}$ Pa.

Even at high altitude, the Earth’s atmosphere’s is very dynamic. As an example, at an altitude of 1000 km, the atmosphere’s density may vary by a factor of five, depending on the time of the day or year or on recent solar flux.

A person suddenly exposed to space would not freeze to death. Although space may be cold, the nearly vacuum is a perfect thermal insulator. The main temperature worry for space suits is how to get rid from the naturally generated body heat.

People in orbit are not weightless, they are not outside Earth’s gravity. Their weight is simply balanced by the centrifugal force created by their motion around the earth.

Flying out of the Atmosphere: Figures

Figure 1: The Earth seen from Apollo 17

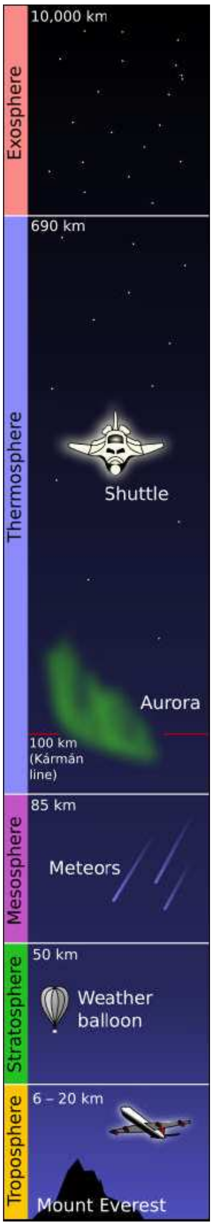

Figure 2:
The Layers of the Atmosphere

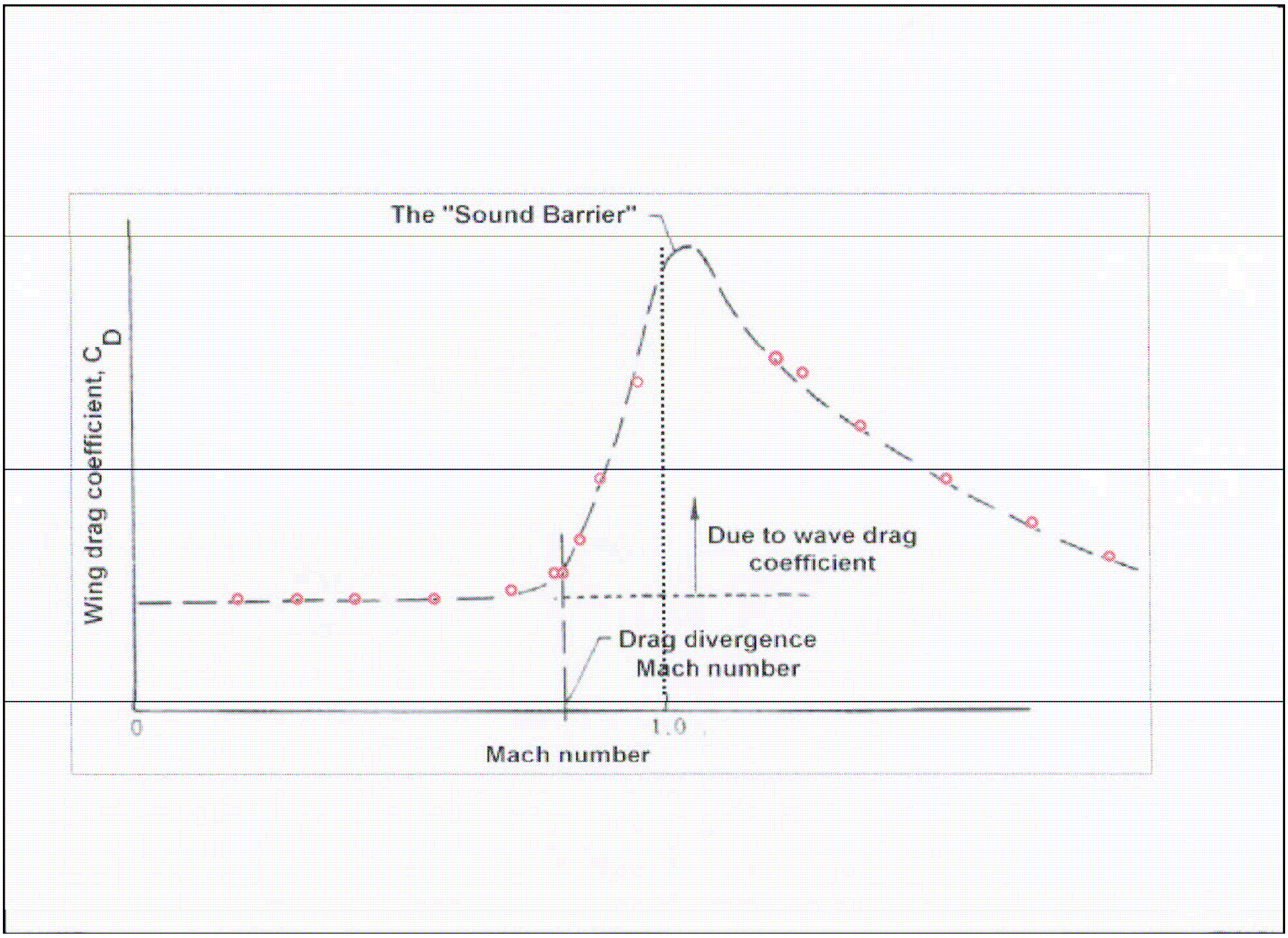

Figure 3: The Sound Barrier

Figure 4: The Bell X-1

Figure 5 The F-104 Starfighter

Figure 6: The SR-71 Blackbird

Figure 7: The X-15

Figure 8: A Sounding rocket

Figure 9: Launching an ICBM Minuteman

Figure 10a: SpaceShipOne and its Mother Ship White Knight 1

Figure 10b: SpaceShipOne on its way to space

Figure 11: SpaceShipTwo

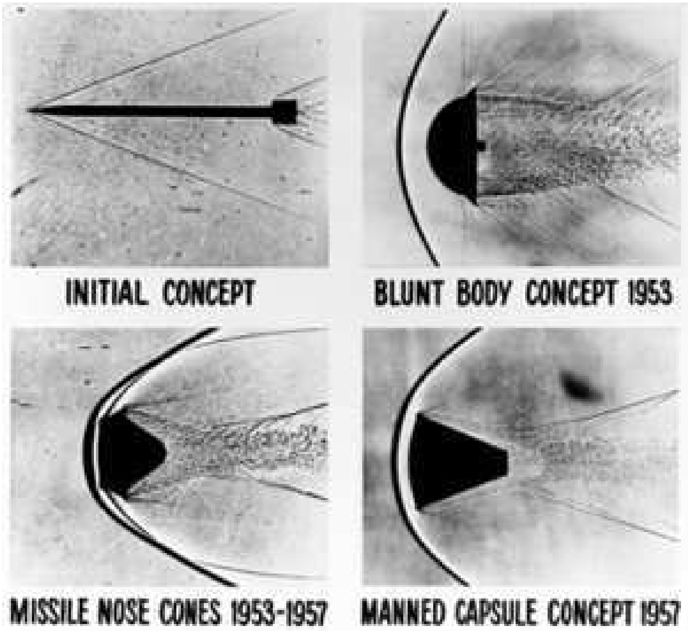

Figure 12: Shock system at the nose of a reentry vehicle

Figure 13: The nose of a “Cold War” weapon

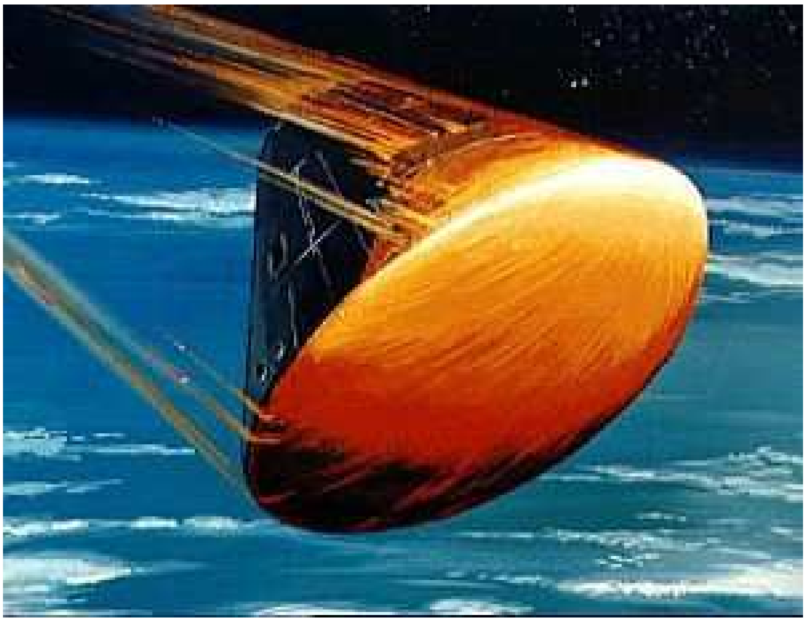

Figure 14: Reentry of a Command Module

Figure 15: ATLANTIS landing after an ISS mission

The Importance of Space from a Security and Defence Perspective, Military Applications of Space Technologies and Expected Technological Developments

Alain De Neve[1]

Disclaimer: the views expressed are solely those of the author/speaker and do not reflect the views of the Belgian Ministry of Defence.

Since the end of the Cold War and the occurrence of the wide transformation process most western military organizations have engaged, space has acquired different doctrinal meanings over time. First considered as a strategic asset in order to gather intelligence about the conventional and nuclear arsenals of the Soviet Union, space did then accede to the status of a "force multiplier". In this regard, the first Gulf War (Desert Storm, 1991) is often hailed by many analysts as the first space war. During this campaign, coalition forces gained an edge with superior intelligence, surveillance and reconnaissance assets. While the United States deployed, during this campaign, a vast array of existing satellites, the operations in Iraq also demonstrated the absolute necessity of adapting military space to the new strategic environment. This was especially the case of early warning, telecommunications and observation. These considerations led the military community, especially in the US, to adopt a "*transverse convergence architecture*". According to this concept, space systems were designed to better serve existing – that is, legacy – military systems in order to elevate the tempo of operations and to engage more precise – and thus, more discriminate – firepower. All these reflections were fueled by the "epochal change" discourse of the *Revolution in Military Affairs* (see below).

As advanced military technologies evolved, the necessity to closely integrate space assets to the new information-based armaments became critical. Indeed, in terms of military procurement strategies, one has assisted to a very clear shift away from the procurement of large platforms towards network-enabled capabilities. The wars of Afghanistan and Iraq also confirmed the advent of a new doctrinal view about the use of space for security and defence uses. Formerly deemed as a "force multiplier", space assets progressively formed an integral part of the weapons system they supported. Today, one might say that "*every weapons system constitutes a space system*".

Current Capabilities

First of all, I would like to briefly describe the main capabilities the military relies on. The aim of this chapter is not to present an exhaustive listing of existing technologies but rather to introduce this issue through an illustrative approach. Capabilities provided by current space assets can be labeled according to their operational uses. These form four main clusters.

Observation

Space-based assets (and their ground segments) provide political decision-maker and the military with *intelligence gathering and dissemination technologies*. These are mandatory for any crisis prevention and management activity. Space is ideal for observation and surveillance tasks. From their orbits, satellites can cover a far bigger area of the earth surface than can be covered by any aircraft (manned or

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unmanned) or by facilities on the ground. Intelligence gathered by satellites provides risk free access to information in denied or adverse areas. It grants political and military leaders with a near-permanent assessment tool for tracking the movement of refugees, damage assessment, search and rescue operations, planning of operations, etc. Yet, satellites do not always offer a real-time picture of the situation and must be combined with traditional ISR sensors or unmanned aerial vehicles (UAV). While there is a certain degree of competition between airborne and space-borne sensors, one might however admit that each type of systems has its own advantages. Space assets escapes the legal constraints regarding the sovereignty of states (satellites never violate air spaces). Airborne sensors are more responsive. In conclusion, it can be said that the two clusters of systems complement each other.

Satellites capabilities also offer critical tools for arms control and non-proliferation policy. As it was underlined by the European Security Strategy, "*the proliferation of weapons of mass destruction is potentially the greatest threat to our security*". To this end, ISR satellites are of great interest in order to ensure compliance with treaties.

Communications

In today's strategic environment, forces must be rapidly deployable and characterized by a high level of flexibility and interconnection, especially in the case of multinational operations. When arriving on the theatre, troops have to operate in terrain with poor or limited infrastructures and a lack of local support. Networking of the forces, if supported by the right training and the tailored doctrines, can reveal itself as a technological advantage in order to restore stability. To this end, network-enabled capabilities require interoperable C2 systems that are able to transfer and to share a large amount of information. These capabilities must rely, moreover, on robust infrastructures. These aspects will be discussed later.

Navigation

Navigation systems enable the military to have a precise idea of the position of its troops and equipments on a theatre of crisis. It must be added that most modern weapons systems rely on accurate and reliable positioning space capabilities in order to deliver their focused and effect-oriented power with minimum collateral damages. Concepts as such as *Effect-Based Operations* or *Swarming* could not be performed without positioning satellites. Positioning satellites are of particular interest regarding cruise missiles. These systems are optimized for use in pre-planned attacks against heavily defended, hardened and high-value targets whose positions are accurately known before the mission. Cruise missiles provides political leaders with a cutting-edge technology either in order to dissuade an adversary before the occurrence of a crisis or to send a clear signal to decision-making bodies by making them realize that any point of its social-economic infrastructure can be attacked. The independence of action conferred by these systems could not be ensured without space capabilities that remain under the control of the state.

Early Warning Systems

The proliferation of aerial and ballistic missiles capable of delivering weapons of mass destruction represents, today, a serious threat not only for the entire territory of NATO and the EU but moreover for troops deployed on external and distant theatres of operation. Observation satellites play a critical role in order to monitor proliferating networks or violations of non-proliferation treaties. However, in the case of a direct ballistic aggression, early warning satellites – relying on infrared sensors – are critical tools in order to (1) identify the aggressor, (2) determine the ballistic trajectory and the targeted objectives, (3) optimize intercept opportunities and (4) evaluate or minimize the risks of debris. However, early warning remains the unrivalled domain of the US and Russia.

Hyper-spectral Technology

Depending on their composition, objects emit, absorb or reflect electromagnetic radiations. Hyper-spectral technologies have the possibility to capture a radiation and thereby the hyper-spectral signature of an object. For the moment, hyper-spectral satellites are being used for civilian purposes. However, this type of sensor could offer a multitude of military applications regarding environmental information about theatres of crisis. Hyper-spectral sensors can provide the defence staffs with precious information regarding the nature of the soil, as well as its humidity, density, etc. Moreover, as far as arms control is concerned, hyper-spectral technology could detect signs of proliferation by observing the gaseous and/or liquid emissions of suspect installations.

Interferometry

Interferometry involves superposing two radar images in order to observe differences of elevation on a given large surface area. This technology is particularly helpful for detecting underground nuclear tests. However, in order to identify the change of elevation resulting from such a test, archives must contain an image of the suspect terrain prior to the explosion. The main challenge is to compile a database of images for comparison purposes.

Space in a Network-Centric Doctrine

Technologies are always socially constructed[2]. Technology development is a process in which a relevant social group embodying a specific interpretation of an artifact will try to influence the concepts of employment regarding that artifact. Since the end of the Gulf War, network-centric approaches are the main concepts of employment of space technologies. What does NCW mean? How do space technologies contribute to network-centric concepts and doctrines?

Reducing the OODA Loop3

In the aftermath of the Gulf War, western military organizations did realize the potential of space assets for operational military use. However, and in order to better fit space technologies with the realities of operations, it rapidly appeared that space would require innovative doctrines that take into account its unique physical characteristics. Proposals aimed at interconnecting information flows stemming from satellites with other ISR platforms and sensors (manned or unmanned) rapidly emerged among the Alliance and EU member states. The main objective was to reach a high level of responsiveness during crisis operations. This is the reason why recent years have seen an increasing migration of military capabilities to space through the development of weapons systems that are directly enabled by space support.

In this context, “Networked-Centric” doctrines gave a new intellectual impulse to the use of space for military and crisis response operations. Since then, space technologies have played an essential role in the fielding concept of NCW as they appeared to be the most secure and far-reaching means of communication available.

Network-centric concepts are intended to confer the military with a highly agile and more precise force. This force should be clever enough to shift from one kind of mission to another in order to, first, maximise the pressure against the enemy and, second, disrupt the cognitive process permitting the

[2] Hans K. Klein & Daniel Lee Kleinman, “The Social Construction of Technology: Structural Considerations”, *Science, Technology and Human Values*, Vol. 27, No. 1, Winter 2002, pp. 28 – 52.

[3] Observe, Orient, Decide & Act.

enemy to draw its own mental picture of the battlefield[4]. In other terms, NCW is just about the impact of kinetics on cognition. NCW paradigm proceeds, in fact, from a threefold revolution[5]:

1. A first revolution occurred in sensor technology, allowing the military to engage near-real time surveillance and observation. It is in this category that one can situate space-based assets (and, also manned and unmanned sensor aircraft, unmanned ground reconnaissance vehicles, etc.);

2. A second revolution concerns information technology. Computerised systems permit to the command and control (C^2) centres to deal with a great amount of data coming from the "integrated" battlefield. Growing performances of information systems could lead, in a middle term, to a complete evacuation of man from the tactical decision cycle, leading the military to rely on machines-to-machines or merely on "sensor-to-shooter" interfaces, much less time-consuming.

3. A third revolution induced by the network-centric paradigm lies in recent improvements in precision guided munitions.

In all of these three aspects (sensor technology, information technology and precision guided munitions), space assets play a critical role and will constitute a force multiplier in future combat operations.

Space assets are intended to guarantee a greater interconnectivity between platforms, troops and C^2 centres. Future military operations will be designed to be more responsive and more resilient in order to achieve information superiority. In this context, the main advantage of space systems is just about providing the warrior with the "*right information in the right place and in the right time*"[6]. In this sense, interconnectivity is deemed as a critical tool in order to dominate the entire battlefield thanks to a better situational awareness.

Stand-Off Operations

Space assets are also helpful in order to go across crisis theatres without sending any troops of logistics in the first phase of a conflict. They will permit to work in several theatres simultaneously in the full spectrum of violence. Added to the extraordinary performances of smart bombs and stand-off munitions (as cruise missiles), a nation dominating critical space technologies, is able to reach (and strike) any point on the surface of the planet where its interests are at stake. It is very interesting to note that during OIF, the vast majority of operations including space-based assets were conducted from the Continental United States, thus reducing, one again, the exposure of combatants and operators. For instance, UAV either employed for reconnaissance or time-critical targeting missions were piloted from afar via sophisticated communication satellites.

Expected Technological and Doctrinal Challenges

Yet, space systems provide the military with powerful and flexible tools in the conduct of modern warfare. Satellites and, more generally, space technologies give the western defence organizations critical advantages in the accomplishment of their crisis response missions. However, space

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[4] Wendy H. Burkett, *Assessing the Results of Effects-Based Operations (EBO): The Relationship Between Effects-Based Operations and the Psychological Dimension of Warfare*, Carlisle Barracks (Penn.), U.S. Army War College, April 2003.
[5] Edward A. Smith, "Network-Centric Warfare. What's the Point?", *Naval War College Review*, Vol. LIV, No. 1, Winter 2001, pp. 59 – 60.
[6] Edward T. Blair, "Actionable Intelligence", *Intelligence, Surveillance and Reconnaissance Journal*, Vol. 3, No. 7, August 2003, p. 46.

technology, like any military-oriented technology, does not only represent a "cutting-edge technology". It also constitutes a "double-edge sword". Each technological breakthrough generates new needs and unexpected challenges. Some of them have not been correctly anticipated.

Interoperability

"*Interoperability* – it is said – *is not a buzz word, it is the word*". Today, space programs are moving away from systems aimed at support for a single service and more towards systems which cut across the traditional boundaries existing not only between the army, the navy and the air force but also between agencies involved in time of crisis. Interoperability is not only a technical issue. It also is a doctrinal and organizational matter. An overriding need is the easy integration of satellites services in the existing activities without the need to re-design the interfaces for each particular system. There is an urgent need to take stock of the security related projects which will be undertaken in the coming years and ensure that an appropriate set of standards, procedures and concepts are built into the program development stages at the outset. This is especially true regarding European communications satellites.

Bandwidth

Another concerning issue is related to bandwidth. Since the Gulf War, in 1991, capacity demands have noticeably increased. For instance, the increase in capacity between Desert Storm and Iraqi Freedom (2003) has been multiplied by a factor 30. It appears today that the demand for capacities has been largely underestimated. Today's war fighter depends on space. Issues such as communication, intelligence, missile warning, weather, space control... all have contributed to an increase of bandwidth needs. It must also be underlined that the current fight against terrorism has created more demanding forms of requirements: there is now a daily requirement for space support.

Moreover, the growing use of networked platforms as such as UAVs strains bandwidth. The adding of advanced sensors, weapons capabilities and the ability to transfer high-speed, full-motion video have dramatically increased the amount of bandwidth needed. This is one of the most critical challenges for the military. Yet, it could be said that this problem finds its roots in the "point-to-point systems" approach while a more networked-approach is more and more mandatory.

Making Space Tactically Responsive: Toward A New Management Model?

As it has previously been said, there is currently a daily need for space support. This conclusion has drawn many observers to call the political-military for a new kind of doctrinal approach regarding the use of space assets. By developing their networked-enabled organizations, western militaries have gone from the strategic to the tactical arena. Commanders and soldiers are now interested in having "on-the-move" applications exploiting space assets. More precisely, some initiatives, as those engaged in the US, aim at making the space community more responsive to military needs[7]. Among the ideas developed by officials figures the building of a stockpile of small, low-cost, ready-to-go satellites. Such a project would enable the military to rely on critical capacities on short-notice in case of grave crisis. This project would also increase the operational responsiveness of space programs in order to adapt them to sudden changes in the strategic environment. Who could have thought, 10 years ago, that our forces would be today in Afghanistan?

Some observers argue that small satellites could be the answer to prayers of Ministries of Defence worldwide. Moreover, it is said, small satellites could be an interesting answer to security and

[7] Arthur K. Cebrowski and John W. Raymond, "Operationally Responsive Space: A New Defense Business Model", *Parameters*, U.S. Army War College (Penn.), Summer 2005.

independence issues. Today, 80% of the capacity being used for military operations is commercial, rather than from dedicated military systems. This poses grave risks regarding security and robustness. The more satellites are used for military communications, the more they become targets. Maybe, a cluster of smaller satellites could be potentially a lot more robust.

Making space tactically – or operationally – responsive requires a new management model for technological developments. Rather than trying to operationalize space assets, advocates of the new management model suggest to design military capabilities directly for the operational commanders. The overall objective is to closely meet the specific war fighter's needs. The proposed model is not meant to replace the existing legacy space systems. New technologies that would be developed in accordance with this model would be complementary.

Preventing Space-Based Weapons and Managing Inherent Vulnerabilities of Space Assets

Lastly, I would like to make a special emphasis on security challenges regarding recent movements toward space-based weapons. I will also evoke the vulnerabilities resulting from the dependence of most western militaries to space.

Space-Based Weapons

There is no question that outer space is already militarized. It must be however underlined that this phenomenon has become more profound and embedded. What remains unclear is if increased militarization of space will inevitably lead toward the actual "weaponization of space". The answer, however, lies less in the progress of technology and more in the realm of geopolitical calculations and of political and/or financial costs assessments. In strategic terms, one must discuss whether a decision to base weapons in space would produce an increase in military capability or serve to reduce military security. To this end, a first step is to define a "space-based weapon". We can define SBW as *a system placed in orbit or deep space that is designed for destroying, damaging, rendering inoperable, or changing the flight trajectory of space objects, or for damaging objects in the atmosphere or on the ground*.

Space-based weapons can also recover many forms:

1. laser-generating satellites, orbiting mirrors reflecting lasers for missile defence purposes;
2. space-based radio-frequency energy weapons to disrupt, disable or destroy a wide variety of electronics and command and control systems;
3. directional fragmentation warheads;
4. or hypervelocity rod bundles.

Arguments for SBW are many and diverse[8]. The most commonly heard argument is that space is a "center of gravity" that Western nations – and first of all, the US – must weaponize in order to protect. Another argument – an American one – is that moving first to weaponize space would achieve a complete dominance of space. This position is congruent with the US National Space Policy re-edited in 2006. A third argument is that weaponization of space is just inevitable.

According to some analysts, if technical and fiscal challenges are overcome, there is little doubt that a combination of airborne, terrestrial and space-based weapons will actually form a concrete constellation. One must however question the expected "pay-off" of such a solution. There is no doubt

[8]Captain David C. Hardesty, "Space-Based Weapons: Long-Term Strategic Implications and Alternatives", *Naval War College Review*, Vol. 58, No. 2, Summer 2005, pp. 45 – 68.

that placing weapons in outer space will dramatically threaten international security. Effectiveness of SBW has to be gauged in terms of the probable reaction of potential opponents. These have many countermeasures options that could take advantage of Western – and especially US – dependence on space.

Achilles' Heels

The successful Chinese ASAT test in January 2007 has created a mass of speculations on the future military and civil uses of space. This essay has clearly proved that a conventional ballistic device[9] has the potential to inflict severe damages to space systems deployed by the most technologically advanced powers, including the US[10]. There is no doubt that SBW will not be an exception. This capacity of nuisance is reinforced by the ease of access to critical information about the orbital trajectories used by satellites. These are on predictable orbits. Such information can be sometimes downloaded from specialized Internet websites. Whether future ASAT attacks (from wherever they will come from) will use similar technologies (that is, modified IRBMs or SLVs) is unclear. Other strategies of aggressions that rely either upon satellite technologies that are well understood and available or more elementary techniques represent serious sources of trouble[11]:

1. It can be possible, for instance, to place a satellite on orbit disguised by another role or as debris and activate it later as an ASAT device;

2. It is also possible for potential dissymmetrical adversaries to destroy their own space-based assets in order to generate pieces of debris in order to deteriorate other satellite systems;

3. An adversary lacking advanced space technologies could also fire high-power laser in order to try to blind satellites. In 2006, China was suspected to make such an attempt. Blinding a satellite, according to observers, is easier than launching an ASAT attack. Current satellites are large, on predictable orbits that are easy to track and have scant defences against lasers.

4. Another technique of aggression – more defensive – could rely on satellites jamming capabilities. It is useful to note that such jamming capabilities were deployed in Iraq to keep American GPS guided bombs from finding their targets;

5. A more conventional and less costly strategy could consist for an opponent in attacking ground stations by using missiles, Special Forces or terrorist organizations.

Concluding Remarks

To conclude, I would like to make some remarks regarding the use of space systems for security and defence purposes:

1. Space systems are "structural parts" of our current concepts of military interventions;

2. In geopolitical terms, space belongs to the list of the Great Commons that must be exploited in order to guarantee the security and the success of military operations ;

3. No longer is space reserved for great powers alone. Today, a nation does not need to be a space player to employ space power.

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[9] It is however unclear if the Chinese ASAT test used an adapted satellite launch vehicle of a modified IRBM.
[10] David Wright, "Orbital Debris from the Chinese ASAT Test", Security for A New Century Briefing, Senate Capitol, Washington, 9 February 2007.
[11] Duncan Lennox, "Launching Out", *Jane's Defence Weekly*, 28 March 2007, pp. 24 – 27.

The US policy regarding the military use of space compared to the emerging space powers' policies

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Panel: Geopolitical Session

Ladies and gentlemen, thank you for inviting me here today. It is my distinct pleasure to participate in this Conference on the Militarisation of Space: Policy and Legal Aspects, here in Brussels. In particular, I am privileged to contribute to this Geopolitiical panel which is addressing some of the different perspectives on the military uses of space. I am here in my "Graduate Student" role but I am also a Lieutenant Colonel in the U.S. Air Force so as I begin my presentation, let me state that the views I express are my personal views, and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U.S. Government.

The United States military has been involved in space activities since the dawn of the space age. During the Cold War military space capabilities were crucial to strategic stability between the U.S. and the U.S.S.R. Intelligence and surveillance satellite systems helped reduce the fear of surprise attack, and they were instrumental in monitoring Arms Control Treaties. Military communication satellites provided better command and control of nuclear and conventional forces, and other satellites enhanced other strategic capabilities, such as global weather monitoring. These strategic level capabilities reinforced deterrence, thereby reducing the risk of nuclear war, and contributing to peace. Hence, these type of military space activities were, and are, accepted as within the definition of the peaceful use of Outer Space.

Since the end of the Cold War, however, the U.S. has led the way in pushing the information provided by satellites down to the tactical level, and has integrated it into a vast array of military technology, doctrine, and tactics. It is not overstating it to say that today; the American way of war depends on the information provided by satellites. This has provided the U.S. military enormous advantages, but it is also evolving as a significant military vulnerability. Likewise, the U.S. economy is growing more dependent on the information provided by satellites, which may also represent a new type of economic vulnerability.

Today I will supply a simple framework for understanding military space issues. This framework is very commonly used in military space circles. I will begin by speaking briefly about U.S. National Space Policy, and identify the different space sectors. Then I will dig a little deeper into the Military space sector by explaining how Air Force Space Command implements the policy guidance it receives, and draw attention to the Military Space Missions framework. Next, I will discuss China's military use of space, and use the Military Space Missions framework to compare U.S. and China military uses of space.

The United States National Space Policy states that space is a Vital National Interest to the U.S.. Space capabilities provide the U.S. Civil sector, Commercial sector, and military, significant benefits. However, satellites, and the strings of ground-based computers and communications equipment that keep everything running in the control centers and ground antenna's, are fragile, and expensive, pieces of equipment. In other words, they are vulnerable; mostly soft targets due to their fragility; and there aren't very many of them, due to the cost.

The U.S. National Space Policy says that "the U.S. will preserve its Freedom of Action in Space for peaceful purposes," which includes military uses of space.

In addition, "the U.S. will preserve its rights under international law and will oppose the development of new legal regimes or other restrictions that will seek to prohibit or limit US Access to, or use of, space." I am sure this statement of policy will generate a lot of discussion this afternoon so I won't delve into it, but my understanding is that U.S. opposition to new legal regimes rests upon few basic issues such as definitional problems, verification problems, and asymmetric power relationships.

The U.S. will also protect its space capabilities. It will dissuade or deter others from impeding its rights; dissuade or deter others from developing capabilities that are intended to impede those rights; and it will deny adversaries the use of space capabilities hostile to U.S. interests.

This policy seems very clear to me and does not differ significantly with the previous 1996 National Space Policy. Since Space is a Vital National Interest, the reasoning behind it also seems straight forward.

As you know US Space Policy is the product of a democratic, transparent process. Input to policy come from many different sources. Congress, Interest groups, and the Executive branch which has a lead role. The current administration has put responsibility for space policy with the National Security Council. The Clinton administration placed responsibility in the Office of Science and Technology Policy, and there have been other White House offices assigned this responsibility over the years.

It is useful to recognize that US Space Policy supports US National Security Policy.

The Civil Space Sector including NASA and NOAA support US National Security through science and technology development, international cooperation, international prestige, and civil application satellites such as NOAA's Earth Observation and weather satellites.

The Military Space Sector led by Strategic Command and Air Force Space Command take care of the military space mission.

The Intelligence Space Sector led by the National Reconnaissance Office involves "Black World" highly classified intelligence collection.

And the Commercial Space Sector supports national security through maintenance of the industrial base, technology, and the use of commercial space capabilities by the government.

That was a very quick overview of U.S. National Space Policy but since this conference is about the militarization of space I would like to proceed directly into a discussion on the U.S. Military Space Sector and how it frames and implements the policies provided to it by the civilian leadership.

I think it is important to understand that Air Force Space Command is responsible for the vast majority of the capabilities for the Military Space Sector in the United States. I would also like to emphasize the distinction between the Military Space Sector and the Intelligence Space Sector in the U.S.. Air Force Space Command satellite systems and capabilities are not classified nearly to the level of the "Black World" or Intelligence Space Sector activities associated with the NRO. There is a formidable bureaucratic barrier between Space Command and the NRO. With that in mind, I would like to focus in on the Military Space Missions

There are four military space missions. Space Support, Force Enhancement, Space Control, Force Application. These categories are useful means for framing a discussion about the militarization of space. I will speak about each of these in turn.

The Space Support Mission includes a variety of activities with associated capabilities that, as its name applies, support, or enable activities in space. Spacelifts refer to the launch vehicles or rockets that get satellites into orbit. Satellite Operations refers to satellite mission control activities. Air Force Space Command's, Schriever AFB in Colorado is the largest satellite operations center in the world. I would like to take a moment to point out that satellite operations require much more "hands-on" operations then many people realize. Satellite operators, depending on the type of satellite, must interact with the satellite, or "remotely control" the satellite, as often as every 100 minutes, for anywhere from 5 to 15 minutes per operation. Some types of satellites may be contacted less frequently, say once every 4 or 6 hours.

This interaction with the satellites is enabled through the AF Satellite Control Network which is a global string of strategically placed antenna stations which provide telemetry tracking and commanding relay support for satellite operations.

Other space support activities include; building and maintaining ground-based infrastructure such as launch pads, operation centers, and other facilities; providing education and training, test and evaluation, and so forth.

The Force Enhancement Mission is where things start to get more interesting. There is a strategic level component of this mission, related to deterrence, first by reducing the threat of a nuclear "first strike" due to the advanced Warning that satellites provide; and second, to the global, secure communication capability that communication satellites provide which enables more solid command and control of nuclear forces.

As I mentioned previously, in the late 80's and at an accelerating pace through the 1990's there was an effort which continues today, to provide the information provided by satellites to the operational and tactical level or as they say in the U.S. provide "Space to the warfighter." I would like to point out that most of this effort and its accomplishments are based on the information coming down from satellites which were designed for the Cold War and the strategic level mission. The satellites were not designed nor optimized for these tactical uses. Many of the advances in the use of this information can be attributed to greater ground-based computer processing and imaginative software programming.

The Force Enhancement Mission includes the use of GPS provided Positioning, Navigation, and Timing (PNT) signal which enable Land, Sea, and Air Forces. Precision guided munitions for example, have given the U.S. military an enormous advantage in battle, and significantly reducing collateral damage. Of course the use of the GPS signal has evolved into a crucial, global, civil utility.

Communication satellites enable much improved situational awareness at all levels with corresponding improvements in Command and Control.

“Missile Warning” satellites which provide data, in near real-time, that a missile launch is underway, alert missile defenses, and give people under attack time to find protection.

Environmental satellites provide data on atmospheric conditions, soil conditions, and sea surface conditions which are very important conditions to be aware of when planning or conducting military missions. The National Oceanographinc and Atmospheric Agency, (NOAA) a U.S. civilian government agency operates these satellites, providing us a good example of the dual-uses of information provided by satellites.

Most satellite imagery used by the U.S. military comes from the NRO, with corresponding security classification issues. Hence, U.S. forces at the tactical and operational level have found it useful, especially in coalition operations to use commercially available imagery which is unclassified, and quite useful militarily.

The information being provided by these satellites, much of it the same information provided by the same or very similar satellites as during the Cold War, but improved with new data processing techniques, puts these satellites and the data they are providing within the realm of the Peaceful use of Outer Space.

The Space Control Mission of the Military begins to get into a more controversial area. Let me try to give you a brief overview of U.S. thinking on Space Control. Space capabilities can be threatened. Ground stations, and command and control centers, can be attacked using conventional means, which would severely degrade satellites’ capabilities. As I previously mentioned, many satellites depend on hands-on interaction with mission controllers numerous times a day. Cyber attacks on ground-based computer systems upon which satellite operations depend are also a possibility.

Ground-based jamming or interfering with the data streams coming from or going to a satellite can disrupt their operation and deny their information to those who need it, and ground-based laser blinding can damage or destroy a satellites sensors. All of these types of potential attacks on space capabilities can be done without leaving the earth.

Obviously, anti-satellite weapons (ASATS) can take many forms, but the image I think many people hold in their mind is that of a missile intercepting a satellite in space and blasting it to pieces. The tremendous speed at which satellites orbit, that is over 17000 miles per hour, or seven and a half kilometers per second, and the lightweight construction of satellites makes a collision, even with very tiny objects, catastrophic for the satellite. It also creates many pieces of debris, throwing them into many different directions, and orbits. So destroying a satellite in orbit may create many unpredictable affects, including the chance of fratricide, if one of your own satellites, or a third party’s satellite, collides with the debris created by the attack. This may in turn create a domino or snowball affect of more and more collisions.

So there are many potential threats to orbiting satellites. This brings us to the issue of space superiority and space control.

Space superiority is “the freedom to operate in space while denying the same to an adversary.” Space Control involves gaining and maintaining space superiority.

The space control mission rest strongly on a foundation of "Space Situational Awareness" which means knowing what is in space, and what those things are doing, and why they are acting the way they act. From my experience in satellite operations, I can tell you, when something goes wrong on a satellite, all the satellite operator may have on his computer screen may be a reading that is showing a "1" rather than a "0" , and you have no idea why; you just try to fix it so it shows a "0" again. Problems also occur regularly in the very long string of computers, antennas, and communications equipment that enable you to communicate with the satellite. Lightning near a tracking station on the other side of the globe may cause you to lose track of your satellite. It is very difficult to determine if something happened to your satellite, or to your link to the satellite, due to a malicious act. So space situational awareness is fundamental.

This brings us to what is called "Defensive counter-space." This simply refers to protecting you own satellites. Air Force Space Command formed the "527th Space Aggressor Squadron" a few years ago in order to act as an adversary in Air Force exercises that is trying to degrade US military space capabilities. They deny some of the space capabilities pilots and other warfighters in the field may be taking for granted, see what the reaction is, and develop tactics to mitigate the affects. The 16th Space Controls Squadron's mission is to detect malicious interference with a satellite, which is harder to do than it may seem. If such an attack is detected, actions can be taken to mitigate it, but if you don't even know you are being attacked, you loose.

Offensive Counter space approaches the issue from a different direction. Instead of being concerned with protecting your own space assets, it concerns the adversary's space assets and how you can negate their freedom of action in space, and the advantages provided by satellites. That is, denying the adversary the freedom to operate in space. If the information from an adversary's satellite threatens U.S. lives, naturally the U.S. will try to stop that information from being gathered or disseminated. It is a matter of self-defense and would be irresponsible not to.

Denying an adversary the freedom to operate in space can be done by choosing from among the 5 D's, which represent a continuum of increasingly severe measures.

Deception: Employs manipulation, distortion, or falsification of information to induce adversaries to react in a manner contrary to their interests
Disruption is the temporary impairment of some or all of a space system's capability to produce effects, usually without physical damage.
Denial is the temporary elimination of some or all of a space system's capability to produce effects, usually without physical damage. Jamming and interference may be sufficient to accomplish this task.
Degradation is the permanent impairment of some or all of a space system's capability to produce results, usually with physical damage. A laser attack on a satellite's sensors may accomplish this task.
Destruction is the permanent elimination of all of a space system's capabilities to produce effects, usually with physical damage. A kinetic kill ASAT attack achieves this effect. This type of attack is the most severe, with the highest risk of unintended consequences, and should only be considered in extreme circumstances.

Currently, Air Force Space Command has one unit dedicated to the Offensive Counter Space mission. That is the 76th Space Control Squadron, which operates the "Counter Communications System." This is basically a jammer from what I understand.

The Final Mission Area of Military Space is the <u>Force Application Mission</u>. This means having the ability to apply force through, in, or from space. This is where the debate over weapons in space mostly occurs since it may be perceived by some as contrary to the "Peaceful Uses of Outer Space."

Most emphasis is usually placed on the force "From Space" category. Space-based ballistic missile defense fits into this category as well as the concept of direct energy weapons and space-based kinetic earth strike weapons. For example, it is feasible to build a satellite which carries large titanium rods. The satellite could dispense a rod at the right time and place to have it de-orbit over a target and be guided to hit the target very precisely. There would be no need for an explosive warhead on the rod, because the kinetic energy of the de-orbiting rod would be enough alone to destroy a target. Cost effectiveness is a major issue with such a system. None of these types of space systems currently exist.

We can see from this slide that dual-use space systems belong mainly within the Space Support and Force Enhancement Mission areas.

In the Space Support mission area, civil and commercial launch vehicles, in many cases, are derived from military missiles. Likewise, military, civil, and commercial space launches often use the same launch facilities.

Since space activities are so expensive, and civil and commercial satellites provide so much information that is useful to military forces, it is a very attractive policy choice to take advantage of dual-use space systems. Military users make great use of Commercial communication and earth imagery satellites, and civil Earth observation satellites. Likewise, civil and commercial users, worldwide, make great use of the US Air Force GPS Positioning, Navigation, and Timing information

This blurring of the lines between the civil, commercial, and military, space sectors raises many interesting and important issues, as can be seen in Europe's civil Galileo project, and the controversy surrounding the potential uses of it signals by military forces.

With that thought, I will wrap up the discussion of U.S. Military Space. We talked about how US National Space Policy supports US National Security Policy, a bit about why space is a vital national interest to the U.S., and how they are vulnerable, and a little bit about how AF Space Command fulfills its mission of operating and protecting US military space capabilities, and its mission and capability to deny the military advantages of space to it adversaries.

The "Military Space Missions" helped to frame this discussion and I think this framework is also very useful when looking at other country's military space capabilities. In this regard, I chose to look at the development of China's space program and China's Military space policy.

The 2006 Chinese White Paper on Space frames China's space policy as an integral part of their development strategy, while acknowledging that space capabilities are important in protecting China's national interest. The stress on using space to bolster economic development is also found in India's space program.

There are some important factors to keep in mind, however, when looking at China's space program, especially when comparing it to the US space program. First, China's military and economy are not reliant on space nearly to the degree that the US is. In fact, no other country is as reliant on space as the US.

Second, China sees its space program as a "cohesive force for the unity of the Chinese people." Similar sentiments are found in India's space policy, and in the new European Space Policy. We should remember that China dreads the possibility of fragmenting like the USSR did, and that internal Chinese factors may carry more weight than we realize when assessing Chinese intentions and actions.

Another important point is that Chinese intentions regarding the military uses of space must be considered in the context of its entire space program. For example, since China is a developing country with relatively scare financial resources compared to developed countries, it is reasonable for China to focus on building dual-use space capabilities.

Another important factor to consider is, since resources are so limited, why would China feel the need to spend the money on Manned space flight? The economic, scientific, technological and national defense benefits of building and launching application satellites are comparable, if not greater, than spending money on manned space missions. Therefore, manned missions must be for the prestige, but that prestige is bought at a relatively high cost.

Could China's efforts in space to be part of an effort to strategically challenge the U.S.? The questions about the motive for China's manned space program, China's ASAT test, and China's laser "painting" of a U.S. intelligence satellite lead many in the U.S. to conclude that China is indeed attempting to strategically challenge the US in space and US Freedom of Action in space.

There are other important factors to keep in mind when considering China's military space policy. First, there is really no transparency into what the Chinese are thinking, who controls their military space policy; the government, the party, the PLA? And what interests are driving their policy?

And it is difficult to categorize Chinese space activities, as well as other developing countries space activities, using categories developed in the context of U.S. space activities. The dual-use nature of Chinese space systems blurs the lines between Civil, Military, Intelligence, and Commercial space sectors. They blur the lines to the degree that we must question the usefulness of these distinctions going forward.

Presenting an overview of Chinese military space policy or doctrine is quite difficult since no formal PLA policy or doctrine has been identified. This lack of transparency means we really don't have much insight into how China plans to educate, train, equip and employ its military space forces.

Therefore, we must glean the contours of Chinese military space policy from Open Sources available within China such as Chinese military textbooks, military journals, and published papers and lectures, Chinese Capabilities, and Chinese Actions.

Open sources, show that the PLA relies mostly on dual-use Chinese civil and commercial assets for the information it gets from space. As already discussed, this is not surprising.

Open sources also discuss the evolving Chinese military theory of "Informationalized Warfare" which stresses the importance of "Information Dominance" in modern warfare, that Information Dominance cannot be separated from Space Dominance, and that Space Dominance depend on the ability to control space.

Open sources however lack credibility and reliability in the eyes of many analysts, so we must also look at Chinese capabilities and actions in order to try to gain an understanding of their policy and doctrine.

The Chinese military has a wide array of space capabilities available for its use. For Communications, Earth Observation, Remote Sensing, Weather, and Navigation they can use many dual-use systems. They also have some dedicated intelligence satellites, including imaging radar satellites, dedicated military communication satellites, and more troublesome, as you know they tested a kinetic kill Anti-satellite weapon in 2007, and used lasers to "paint" U.S. intelligence satellites.

Of course, the Chinese military also has access to commercially available information from space such as telecommunication satellites and Earth imaging satellites.

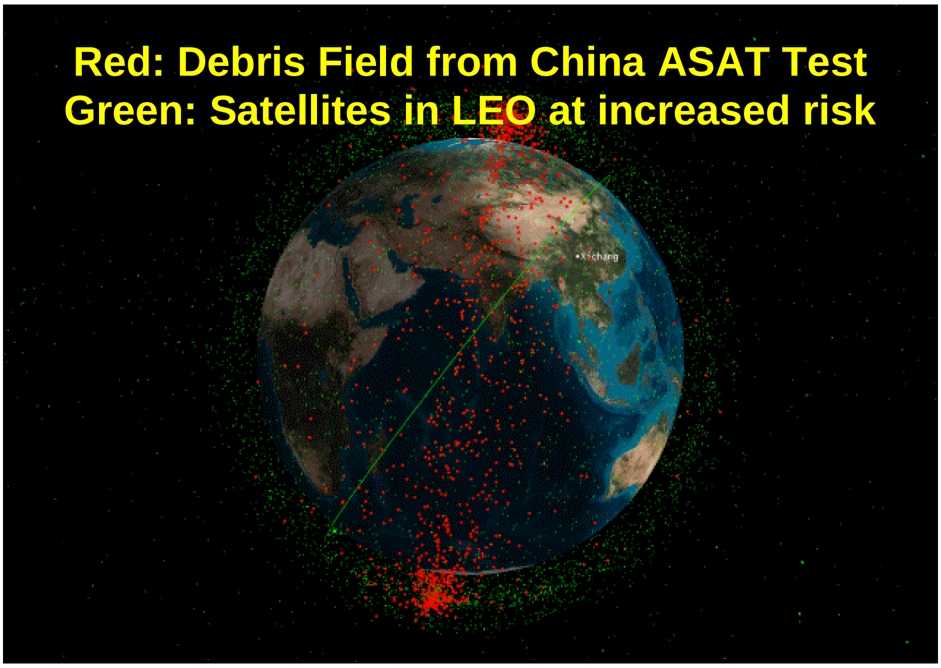
The actions that China has taken in space that possibly reveal its military space policy most forthrightly are its laser painting of a U.S. intelligence satellite in 2006, and the January 11, 2007 ASAT test

This image is a representation of the debris cloud created by the test within hours after the test.

The test was not against international law but broke a 20+ year self-imposed moratorium on "Hard Kill" ASAT testing by the US and Russia.

It also demonstrated a capability which is definitely a strategic threat to US military and intelligence capabilities, and as we mentioned, a vital US National Interest.

It also broke a developing international norm on the avoidance of creating space debris.



The image of this slide is a representation of the debris cloud, in red, a few days after the ASAT test, zipping through space at over 7 km/sec, with the green dots representing other satellites in Low Earth orbit.

The Chinese never provided an official explanation for the ASAT test. I think the most plausible explanation is that the Chinese simply wanted to test a capability that may deny the U.S. of space superiority, to demonstrate that they had the ability to target a strategic vulnerability of the US military, and to deter U.S. attacks on Chinese space capabilities in the future.

I think it is interesting when you compare US and Chinese Military space activities next to each other using the Military Space Missions Framework. In Space Support, the US has extensive state of the art capabilities, while China has been making rapid advances to increase and improve their capabilities in the last 10 years.

In the force enhancement mission category, the US Military uses many dedicated military systems and some dual-use systems and has integrated information from space into many of its military systems. China, on the other hand, relies mostly on dual-use systems, while also having some dedicated military systems. Their military uses information from and will likely increase the use of space systems as it modernizes, but currently, space capabilities are much less integrated into the Chinese military.

The Space Control Mission category raises some interesting questions. The US has a high degree of transparency in its policy and doctrine on space control, stating clearly that space is a vital national interest, the U.S. will protect its capability to operate in space, and if an adversary tries to use space to harm the U.S., the U.S. will deny the adversary that capability. Chinese policy on space control, in contrast, is not known. Although they have often called for an arms control treaty to prevent an arms race in outer space, they has not publicly released a military space policy, and relatively little is know about their intentions.

However, we do know that they have taken a couple provocative steps in the last 18 months, in the "Offensive Counterspace" category by testing a laser on a U.S. satellite, and by the kinetic-kill ASAT test of 11 months ago.

The Force Application Mission gets deeper into the space weapons debate. The nexus between the issues revolving around Ballistic Missile Defense, and the issues revolving around weapons in space, makes the policy questions in this category difficult to resolve.

On a final note there have been reports, and I don't have any way to judge there validity, that China is doing R&D into space-to-earth strike weapons. There was also an interesting RAND report that concluded that space-to-earth strike weapons were not cost effective for the US, since the US already has so many other conventional ways to project force globally, but they may provide a cost effective means for a developing country that has independent access to space, to gain an asymmetric capability for striking targets anywhere on the globe, with little or no warning. That is just food for thought.

So in conclusion:

- Basing analysis mostly on an assessment of Chinese capabilities & actions, due to the transparency issue,
- Considering China's status as a developing country with top priority being given to economic development,
- Using U.S. Military Space Mission areas as a basis of comparison i.e. space support, force enhancement, space control, and force application,
- It is reasonable to conclude that China is focused on leveraging dual-use capabilities to the utmost extent for the purpose of "Force Enhancement," and has the political will to devote the scarce resources, and take the political & diplomatic risks, to develop the capabilities necessary to deny the U.S. Space Superiority, while not necessarily seeking Space Superiority themselves.
- China has the ability to attack a vulnerable U.S. vital national interest which may impair U.S. conventional military dominance, and has the ability to deter the U.S. from attacking China's space capabilities, of which they are much less reliant on than the U.S..

I would like to express my appreciation for the opportunity to participate in this very important conference. I look forward to responding to your questions. Thank you.

"The views expressed in this presentation are those of the author and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense or the U.S. Government."

THE PEACEFUL USE OF OUTER SPACE

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How many hours did delegates, experts, representatives or lawyers spend discussing about what is "*peaceful*" and what is not ? This notion has taken much energy, thinking and time to specialists for, all in all, rather limited results. The truth is actually that no one really seeks for a definitive, intangible definition of it.

On August 26, 2006, just hours after Iran opened a new plant capable of making plutonium "*for peaceful purposes*", US President George Bush assured his Iranian counterpart that any B-2 bombers that would appear over Tehran in the near future would also serve "*peaceful purposes*". "*There's nothing like the B-2 when it comes to giving peace a chance*", Mr Bush added.

This sour ironical statement from the US President illustrates how the same concept can have quite opposite meanings according to the stakeholders' standpoint and how difficult it is to reach a common understanding, as well as a consensual interpretation of it.

With its obvious political dimension, the notion of peaceful use / purpose has undergone a remarkable evolution since its first appearance in the UN Resolution vocabulary. Moreover, the successive variations of its interpretation by space and military powers has caused several interferences or confrontations with other notions used in international policy and law.

Several Notions – A Comparative Approach

The Peaceful Use / Purposes

A chronological analysis shows the evolution, not only in the interpretation of the terms, but also in the choice of their use.

It must also be noted that the UN outer space treaties use both "*peaceful purposes*" and "*peaceful (exploration and) use*". However, it seems reasonable to consider, in both cases, the finality of the activities as much as their nature. That's why we will refer to those two wordings as one single notion.

The "*peaceful use / purposes*" notion is common to several international treaties: not only outer space, but Antarctica and the high seas as well are ruled by the peaceful purposes principle. This is also the case for the international regulation of atomic energy, as well as for the prohibition and the limitation of some kinds of weapons or military techniques.

The Principle of Non-Aggression

This principle is stated in the UN Charter[12] and can be associated to the non-aggression obligation which makes part of *jus cogens* (*ordre public international*). We will see later how its connection with the peaceful use / purpose notion has strengthened from 1958 to nowadays.

[12] Article 2, §3, UN Charter

Armament / Arsenalisation
A number of treaties and agreements deal with the limitation of weaponisation of outer space. Recently, at the end of 2006, the United Nations General Assembly has voted a Resolution on the Prevention of an Arms Race in Outer Space ("PAROS" Resolution). The United States were the only country to vote against that resolution.

The fact that outer space has been used since the early days of its conquest for armament purposes has a lot to do with the uncertainty of the notion's content.

The space sector and the defense sector have always been closely entwined, sharing the same technologies and industries, but also the same goals (see US Presidents Reagan and Bush's Strategic Defense Initiative). Nowadays, controlling the Earth necessarily means controlling outer space, at least Earth orbits.

Peacekeeping
After September 11, 2001, US have imposed to the World community a concept much broader than "Defense": Global Security has become a quite politically effective concern. It integrates very different kinds of actual or potential hazards, from terrorism to tornadoes, from humanitarian refugees to flood mitigation.

Among those, Peacekeeping plays an important role since this notion may justify military interventions for the sake of indigenous populations. In such missions, military forces under international mandate might recourse to the use of space technologies and applications. Earth observation, telecommunication, navigation and positioning are several examples of uses of outer space which can be enhanced or denied in the context of regional crisis management.

To that extent, "*peaceful purposes*" has to be interpreted as a proactive notion...

Civil / Military Activities
The traditional distinction between "civil" and "military" activities has lost much of its relevance after the Cold War period. It doesn't provide a reliable criterion for determining what is peaceful and what is not.

From an international law standpoint, the distinction doesn't exist: States' acts are the implementation of governmental decisions and are not considered according to the authority in charge (military or civil). It is a fact that, in some cases, international law recognises such distinction (see the 1979 UN Moon Agreement, for instance, which prohibits the military use of the celestial bodies), but such provisions are the remains of the Cold War era and are rather exceptional. Another illustration is Antarctica which is now used for research purposes by military personnel.

From a political standpoint, the distinction might provide important elements in the comprehension and the assessment of some countries' activities and positions: the anti-satellite test by China, the availability policy of the GPS by the US Government, the export control regimes (MTCR, ITAR, etc.)...

From a technological standpoint, the distinction remains valid for the design and the security protocols. Technical requirements for a military customer are not the same as those applicable for a commercial customer, even though the basic technology is the same.

All in all, the current trend shown by many civil space institutions or industries which were not traditionally active in the Defense sector demonstrates that dual-use, or even military oriented space system, are not excluded from their field of activities or their strategy. The European Space Agency (ESA) has integrated "*Space & Security*" as a key-chapter of its policy in the frame of its cooperation with the European Union. This new heading took many discussions between Member States and a remarkable evolution of minds on the concept of peaceful purposes.

The distinction between governmental / institutional applications and commercial application has, to a large extent, subrogated the one between civil and military. It is remarkable that terms such as "*security*" and "*defence*" appear in the same sentence as "*peaceful purposes*"[13].

<u>*Neutrality*</u>

There are as many definitions of *Neutrality* as countries practicing it. The Swiss neutrality is not the same as the Finnish neutrality and so on...

The interpretation of "*peaceful purposes*" by countries having developed an historical tradition of neutrality is of course basically founded on such a political status. The position of countries such as Sweden or Switzerland in the discussion within ESA has always been significant to that extent.

Historical Evolution of the Notion at the International Level

At the 792nd plenary meeting of the Un General Assembly on December 13, 1958, the Question of the peaceful use of outer space was discussed. At that time, it was obvious that, by "*peaceful*", one had to understand "*non-military*".

However, at the same time, USA and USSR were already working on military uses of outer space. In the frame of its classified programmes, the US Air Force had contracted the development of reconnaissance satellites since 1955. The interpretation according which "*peaceful use / purposes*" meant "*non-military*" was already very difficult to justify in the late 50's. US were the first to move forward by understanding "*peaceful*" as "*non-aggressive*". Such position was not followed by USSR which stuck to the initial interpretation despite the reality of space activities at that time and their non-disputed military nature.

Later on, the evolution of space activities as well as of international law led to a confirmation of the position adopted by US in the late 50's. The jurisprudence of the International Court of Justice[14] as well as the adoption of new legal instruments such as the 1969 Vienna Convention on the Law of Treaties helped in providing this interpretation with a more solid legal basis. To this day, no State has formally protested against giving "*peaceful*" the meaning of "*non-aggressive*". Of course, this opens the question : what does "*non-aggressive*" mean? But this is still a remarkable progress in defining the *peaceful use / purposes* notion since an obvious link could be made with the principle of non-aggression under general international law. The shortcut was established to make of the *peaceful use / purposes* notion a "simple" requirement of compliance with that principle of international law.

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[13] See for example The EU Presidency's statement at the 62nd session of the UN General Assembly on the item relating to the International Cooperation in the Peaceful Uses of Outer Space: "*The strategic mission of the [European Space Policy] will be based on the peaceful exploitation of outer space by all States and work will be done in the areas of security and defense needs*."

[14] See for instance the *North Sea Continental Shelf Cases*, for the question of the formation of customary law based on States' behaviour.

This interpretation was recognised by France when signing the 1979 UN Moon Agreement. The French Government added a reservation according to which the obligation provided under Article 3, §2, of the Agreement[15] must be interpreted as a reaffirmation, for the purpose of the Agreement, of the UN Charter‘s general principle prohibiting the use of threat or of force in international relations. This reservation had the merit of avoiding any discussion on the interpretation of Article 3, §2, but it also bore the risk of reducing the scope of a strong commitment from States parties. Eventually, the participation in the Moon Agreement remained too weak to consider its provisions as significant for the interpretation of other international instruments. Moreover, since France signed but never ratified the Agreement (and doesn't plan to do so), its reservation remained without any effect. But it gives an interesting clue on the political context surrounding the adoption of the five outer space treaties: some countries sought to impose a principle of non-militarisation of outer space (sometimes excluding themselves from its application) though the concept of peaceful use / purposes, while other already considered outer space as a necessary area for the development of their defense & security instruments. For the latter, it was of utmost importance that outer space remained subject to rules which were neither more nor less limitative than those governing other strategic activities.

In August 2006, the US President published the new National Space Policy. This document marks the return to the space dominance doctrine and contains a new interpretation of the peaceful purposes notion which goes far beyond the one traditionally adopted since 1958. According the 2006 US Space Policy, "*the United States is committed to the exploration and use of outer space by all nations for peaceful purposes, and for benefit of all humanity. Consistent with this principle, "peaceful purposes" allow US defence and intelligence-related activities in pursuit of national interest*". This interpretation implies that the appraisal of the peaceful character of the purpose of US activities will be made on the basis of the US national interests. Hence, it can be deduced that the peaceful character of foreign activities will also be assessed by the US according to the same national interests.

Actually, this document doesn't bring new elements with regard to the US space policy. But the fact that a presidential paper officially refers to national interest in order to interpret a principle of international law is speaking for itself. Should such interpretation become the common practice from the US and from other space fairing nations, this would mean the end of the peaceful purposes principle by total loss of its legal substance.

The Delimitation of the Peaceful Use / Purposes Principle in Outer Space

It is a fact that conceiving a legal regime under which acts lawful according to general international law would become unlawful just because they would be committed in outer space would not have been an incentive for the development of space activities. Nevertheless, if the meaning of peaceful us / purposes has been clarified (although not enough to come to a consensual interpretation by all States) during the 50 years of the Space Era, one question remains: if "*peaceful purpose*" means "*lawful purpose*", then why do we need it? This of course constitutes a recurring argument of the supporters of the special interpretation of the notion. According to them, if the international lawmaker has reaffirmed the principle of peaceful purposes so many times and in a growing number of treaties, it must be

[15] Art. 3, §2, 1979 UN Moon Agreement: "*Any threat or use of force or any 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.*"

interpreted in a way which gives the notion a wider meaning than the only respect of international law principles.

Fair enough, one cannot ignore that the peaceful use / purpose notion, especially in the UN outer space treaties and resolution features commitments and obligations which provide specification or even limitation with regard to the usual content of the general non-aggression principle.

The 1967 UN Outer Space Treaty refers the notion in several provisions and the terms used are never exactly the same.

Accordance with the UN Charter

Article III provides enlightening elements even though it doesn't expressly refers to the "peaceful use / purposes" wording. The accordance with international law including the UN Charter is of course a fundamental feature of outer space law. This direct connection between outer space law and general international law must be "*in the interest of maintaining international peace and security and promoting international cooperation and understanding*". This wording advocates a proactive vision of the peaceful purposes and not only a duty to refrain from adopting a certain behaviour. Also, maintaining peace is clearly identified as a purpose for space activities. Article III must be considered as a key-provision in the interpretation of the peaceful use / purposes notion.

Another interesting deduction which can be made from Article III is that the peaceful purposes character of the act must not only be considered with regard to the effect of the act in outer space, but also with regard to its effect on Earth. This can be illustrated by the Chinese satellite incident which happened on January 11, 2007. The destruction of an old meteorological satellite by the Chinese army served as a test, as well as a demonstration of a new anti-satellite weapon. There was a general consensus that the act could not be considered as a violation of the peaceful use of outer space principle, since there hasn't been any attack against a foreign spacecraft. However, as US Vice-President Dick Cheney declared, the message sent by the Chinese Government towards the World community was (or at least could have been seen as) in contradiction with the flaunted objective of a peaceful development of space activities. This feeling was shared by other Governments like the Government of Taiwan expressing the fear that that event could have a negative impact on peace in the Taiwanese straight and in the surrounding region.

It is obvious that the complexity of the world context obliges to consider all potential impacts of space activities and that such activities are not isolated from the rest of the international relations. A demonstration of military power in an area (outer space) where only a few States have the capacity to go and to develop capacities can affect other nations in a much harder manner than in other areas. This has been very well understood by USA and USSR when they engaged their race to the Moon: the enemy must be impressed, not threatened. This was somehow the purpose of the first Chinese human space flight. But the satellite destruction went beyond the limit of prestige and showing off. Since then, China has made step backward by stating this test was not meant to be renewed and shouldn't be considered as an aggressive demonstration or a threat.

The Moon and the celestial bodies

As already mentioned, the regime applicable to the Moon and the other celestial bodies of the Solar System is more restrictive than the regime applicable to outer space in general. Hence, the term "exclusively" has been added before peaceful purpose in Article IV of the Outer Space Treaty.

The prohibition of military use (be it for base settlement, maneuvers, training or testing) of the celestial bodies forces an objective application of the peaceful purposes principle.

Prohibition of arms in outer space
According to the Outer Space Treaty, it is not prohibited to place and to use arms in outer space, the celestial bodies excepted. Only nuclear weapons and weapons of mass destruction are prohibited (this includes notably radiological, bacteriological and chemical weapons).

On the Moon as well as on the other celestial bodies, the stationing, the use or the testing of any arms is totally prohibited.

The freedom of access to and use of outer space
Besides the provisions of the Outer Space Treaty stating the principle of peaceful use / purposes, some other principles might have an impact on the (non-aggressive) behaviour of States in the conduct of their space activities.

The principle of non-appropriation of outer space[16] prohibits any behaviour from State which would imply a claim of sovereignty on outer space or on part of it. This of course constitutes already a strong limitation for potential dispute.

Article I of the Outer Space Treaty guarantees to all States a right of access to, exploration and use of outer space, including the celestial bodies. There also, such basic principle excludes any act aiming at restricting access to some areas in outer space as being "peaceful", since they would be a direct contradiction with international law.

This, however, appears in total contradiction with the 2006 US National Space Policy (see here above). According to the document published by the US President and defining that policy, "*[The US] shall develop capabilities, plans, and options to ensure freedom of action in space, and, if directed, deny such freedom of actions to adversaries.*"

For the first time, a State party to the UN outer space treaties is officially stating the possibility of denying freedom of access, exploration or utilisation of outer space to another State and that, on a purely unilateral basis. Besides the fact that such statement raises a lot of issues under international (space) law, it constitutes another key-element in the review of the current US interpretation of the peaceful purposes notion.

The handling of outer space issues within the UN bodies
With the establishment, in 1959, of the UN Committee for the Peaceful Uses of Outer Space (UNCOPUOS), the United Nations definitely confirmed their will to offer space conquest an appropriate political, legal and technical framework without any delay. UNCOPUOS and its two sub-committees (legal and scientific) elaborated the set of treaties and resolutions which would become a considerable source of inspiration for other branches of international law.

The name of the Committee was much more than a charismatic banner for high level discussion: it indicates the clear splitting between the work entrusted to UNCOPUOS' mandate and the mandate of other UN bodies, notably in the field of disarmament. However, the paradox remains because of this denomination which seems to induce the existence of non-peaceful uses of outer space. How can such

[16] Article II of the 1967 UN Outer Space Treaty

uses be recognised and dealt with in total contradiction with the UN principles? Obviously, the peaceful uses of outer space covered by the UNCOPUOS are referring to the civil activities, in contrast with the military activities which are handled by the Disarmament Commission of the UN General Assembly. Yet, that sharing of tasks doesn't correspond to the scope of the outer space treaties provisions which do not make any distinction between civil and military activities. All are subject to the principles expressed in the instruments of outer space law.

This institutional asymmetry leads sometimes to certain redundancies which could be avoided with a better comprehension of space activities. For instance, the discussion on satellite registration practices by States took place in different groups, be it under the auspices of UNCOPUOS and of the Disarmament Conference.

Conclusion

The notion of peaceful purposes is not restricted to high philosophy considerations. It has a concrete impact in everyday's work in the world space sector. For instance, the International Space Station intergovernmental agreement expressly refers to peaceful purposes in the use of the Station.

A few years ago, ESA initiated a deep discussion on its ability, according to its founding convention, to perform dual-use activities. With Member States such as Switzerland, Sweden, UK, France or Denmark around the table, the debate was quite interesting and somehow representative of opinions in the World community on the peaceful purposes notion. The conclusion was that nothing in the ESA Convention prevented the Agency from conducting space activities dedicated to security and defense purposes. This conclusion was reached despite the fact that in its Preamble as well as in Article 2 defining the Agency's mission, the terms "*for exclusively peaceful purposes*" when talking about the cooperation between Member States. Although this conclusion is in the line of the general consensus at the international level, it must be noticed that some cooperation between ESA and other space fairing nations or organisations still raise concerns from some Member States. Most of the time, those concerns can be explained by foreign policy's considerations and are not related to the peaceful purposes character of ESA's mission. But it would be deceiving to assume that cooperation between ESA and NATO – while being not excluded – would be assessed by Member States the same way as the cooperation between ESA and the European Union or any other "civil" organisation...

The notion of peaceful purposes in international law is continuing its evolution. Whatever the interpretation that States will make of it, it will remain a principle carved in the stone of the international treaties. Each of them will feature its own elements of definition, of appraisal and of understanding. From military to civil activities, from peacekeeping to strict neutrality, the peaceful purposes notion not only plays a legal role, but also allows a more political appraisal of the situation. Outer space serves as an extension of the States' playground: after the land and the seas, outer space offers nations a wide area to demonstrate their abilities, either to make them at the others' disposal or to reserve them to their own interest.

References

Analysis

H.-J. HEINTZE, *Peaceful Uses of Outer Space and International Law, Contribution to the Conference « Space Use and Ethics », Darmstadt, March 3-5, 1999,* in INESAP Bulletin nr 17

B. BASANI (éd.), *Peaceful and Non-Peaceful Uses of Outer Space*, New York, 1991

S. KAN, *China's Anti-Satellite Weapon Test*, in Congressional Research Service Report for Congress, Washington D.C., April 2007

The Notion of "Peaceful Purposes" in the ESA Convention, ESA (not published), 2003

UN Treaties and UNGA Resolutions

Treaty on the Principles governing the activities of States in the exploration and use of outer space, including the Moon and other celestial bodies, done on 27 January 1967

Agreement on the rescue of astronauts, the return of astronauts and the return of objects launched into outer space, done on 22 April 1968

Convention on international liability for damage caused by space objects, done on 29 March 1972

Convention on the registration of objects launched into outer space, done on 14 January 1975

Agreement governing the activities of States on the Moon and other celestial bodies, done on 18 December 1979

UNGA Resolution 502 (VI) of 11 January 1952

UNGA Resolution 1348 (XIII) of 13 December 1958

UNGA Resolution 1721 (XVI) of 20 December 1961

UNGA Resolution 1962 (XVIII) of 13 December 1963

UNGA Resolution 37/92 of 10 December 1982

UNGA Resolution 41/65 of 3 December 1986

UNGA Resolution 47/68 of 14 December 1992

UNGA Resolution 51/122 of 13 December 1996

Press

Bush : B-2 Flights over Tehran for « Peaceful Purposes », in Global News, 26/08/2006

La Guerre des Etoiles, le retour, et *L'accès à l'Espace est libre, dit le droit international,* in La Libre Belgique, 20/10/2006

L'Arme antisatellite fait polémique, in La Libre Belgique, 22/01/2007

Des propos qui n'ont rien d'apaisant, in La Libre Belgique, 23/02/2007

Bibliography

S. GROUARD, *La Guerre en orbite, Essai de politique et de stratégie spatiales,* éd. Economica, Paris, 1994

International Colloquium on the Militarisation of Outer Space (Brussels, June 28-29, 1986), ed. Bruylant/ULB, Brussels, 1988

G. LAFFERRANDERIE, *The European Space Agency*, in International Encyclopedia of Laws, ed. Kluwer Law International, The Hague, 2005

Space Security 2007, ed. Spacesecurity.org, Canada, 2007

I.H.Ph. DIEDERIKS-VERSCHOOR, *An Introduction to Space Law,* ed. Kluwer, Deventer, 1993

B.C.M. REIJNEN, *The United Nations Space Treaties Analyzed*, ed. Frontières, France, 1992

Droit de l'Espace, *Aspects récents sous la direction de Jacqueline Dutheil de la Rochère*, ed. Pedone, Paris, 1988

National Security Space Actors and Issues

Peter L. Hays *

Space capabilities are essential at all
levels of military planning and operations.
--*The Honorable Ronald M. Sega*
Under Secretary of the Air Force

United States and coalition forces achieved rapid and decisive conventional military victories during Operations Desert Storm in the Persian Gulf in 1991, Allied Force overhead Serbia in 1999, Enduring Freedom in Afghanistan in 2001, and Iraqi Freedom in 2003. Figure one shows the increasing percentage of precision-guided munitions and improving communications connectivity that are key components of a new American way of war empowered by a space-enabled global reconnaissance, precision strike complex. A primary goal of the Department of Defense (DOD) since the end of the Cold War has been to achieve full spectrum dominance of the battlespace by continuing and accelerating military transformation. DOD is developing lighter and more easily deployable forces that are better able to leverage network-enabled operations and strike more precisely from greater distances in order to dominate over adversaries that may range from emerging military peers to insurgents and terrorists. Space capabilities often provide the best and sometimes the only way to pursue these ambitious transformational goals. There are, however, many difficult and fundamental issues related to space and defense policy including: the fundamental contributions of space to enabling the information revolution and the new American way of war; changes caused by growth in commercial space activity and the number of major space actors; and the role and efficacy of space capabilities in structuring options for military intervention as well as in dissuading and deterring competition from potential adversaries in the changed geopolitical environment following the end of the Cold War, the 9/11 attacks, and Operation Iraqi Freedom. These complex factors contribute to uncertainty about how space capabilities can best advance U.S. national security, the most useful organizational structures to manage and transform space activities themselves, and the utility of investments in space capabilities versus other enabling military capabilities. Moreover, the United States faces significant challenges in its current plans to modernize, improve, or replace almost all major military space systems because most of these systems are essential for future transformed forces but their acquisition has been marked by cost overruns and deployment delays. It is unclear whether the United States will be able to find and follow the best path forward for space strategy, implement the best management and organizational structures for space activities, and sustain the political will needed to continue funding the nearly simultaneous modernizations currently planned. It is also uncertain whether these new and improved space capabilities can be developed and integrated on cost and on time and whether these future systems will deliver on their promise of accelerating transformational capabilities and effects.

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The national security space (NSS) sector includes DOD activities, conducted primarily by the Air Force, to enhance national security and National Reconnaissance Office (NRO) programs to collect intelligence data from space. The NSS sector is also divided sometimes into separate sectors known as the military or defense space sector and the intelligence space sector. Following implementation of one of the recommendations of the January 2001 Commission to Assess National Security Space

* The opinions, conclusions and recommendations expressed or implied in this paper are those of the author and do not necessarily reflect the official policy or position of the United States Air Force, Department of Defense, or United States Government.

Management and Organization (Space Commission) Report, DOD now uses an accounting procedure known as the virtual major force program (vMFP) to track NSS spending.[1] According to the Congressional Research Service, the total DOD request for space spending amounted to $22.12 billion in FY 05 and was $22.66 billion for FY 06.[2] Under the vMFP baseline for NSS procurement and research and development (R&D), unclassified military space acquisition spending grew from $4.9 to $6.9 billion, or more than 40 percent, between FY 05 and FY 06, rose almost 12 percent to $7.7 billion in FY 07, and then climbed another 13 percent to $8.7 billion for FY 08.[3] Overall trends in planned major military space acquisition through 2024 are shown in Figure 2. The most alarming line in the figure, labeled Risk of Cost Growth, illustrates that space acquisition expenditures will peak at $14.4 billion in 2010 or almost double present funding if current programs follow the historic trend of an average 69 percent rise in costs for space research, development, engineering, and testing as well as an average growth of 19 percent in space procurement costs.[4] Clearly, the path ahead for currently planned United States NSS improvements and modernizations will be very difficult, if not unsustainable. This bow-wave problem along with a number of other daunting near-term challenges are discussed after an overview of conceptual frameworks for analysis, a review of major national security space actors and management structures, and introduction of current major space acquisition programs and budgets.

Analytical Frameworks for NSS

Three major analytical frameworks shape most discussions about NSS capabilities: space activity sectors, military space mission areas, and military space doctrines. There are four space activity sectors: civil, commercial, military, and intelligence; many traditional space activities fall neatly into one of the sectors, although the growing number of dual-use space systems, digital convergence, and growth in the commercial space sector makes it increasingly difficult to delineate among the sectors.[5] There are also four military space mission areas: space support, force enhancement, space control, and force application.[6] Currently, force enhancement is the most important military space mission area; due to growth in the number and efficacy of space systems, many analysts believe these capabilities now produce effects that have moved beyond force enhancement and today enable a wider range of military missions to be undertaken or even contemplated. Table1 shows the major divisions within force enhancement as well as the current and projected space systems to support these missions. Finally, building on the analysis of David Lupton, there are also four major military space doctrines: sanctuary, survivability, control, and high ground.[7] The attributes associated with these doctrines—primary value and functions, employment strategies, conflict missions, and desired organizational structures—are shown in Table 2.

Figure 1

A Space Enabled Reconnaissance-Strike Complex: The New American Way of War

KTO, 1991 (Desert Storm): 37 Days 1 Mbps/5K Forces	Unguided Laser/EO-guided	245,000 20,450	92% 8%
Serbia, 1999 (Allied Force) 78 Days; 24.5 Mbps/5K	Unguided Laser/EO-guided GPS-guided	16,000 7,000 700	66% 31% 3%
Afghanistan, 2001-02 (Enduring Freedom) 90 Days; 68.2 Mbps/5K	Unguided Laser/EO-guided GPS-guided	9,000 6,000 7,000	41% 27% 32%
Iraq, 2003 (Iraqi Freedom) 29 Days; 51.1 Mbps/5K	Unguided Guided	9,251 19,948	32% 68%

Figure 2

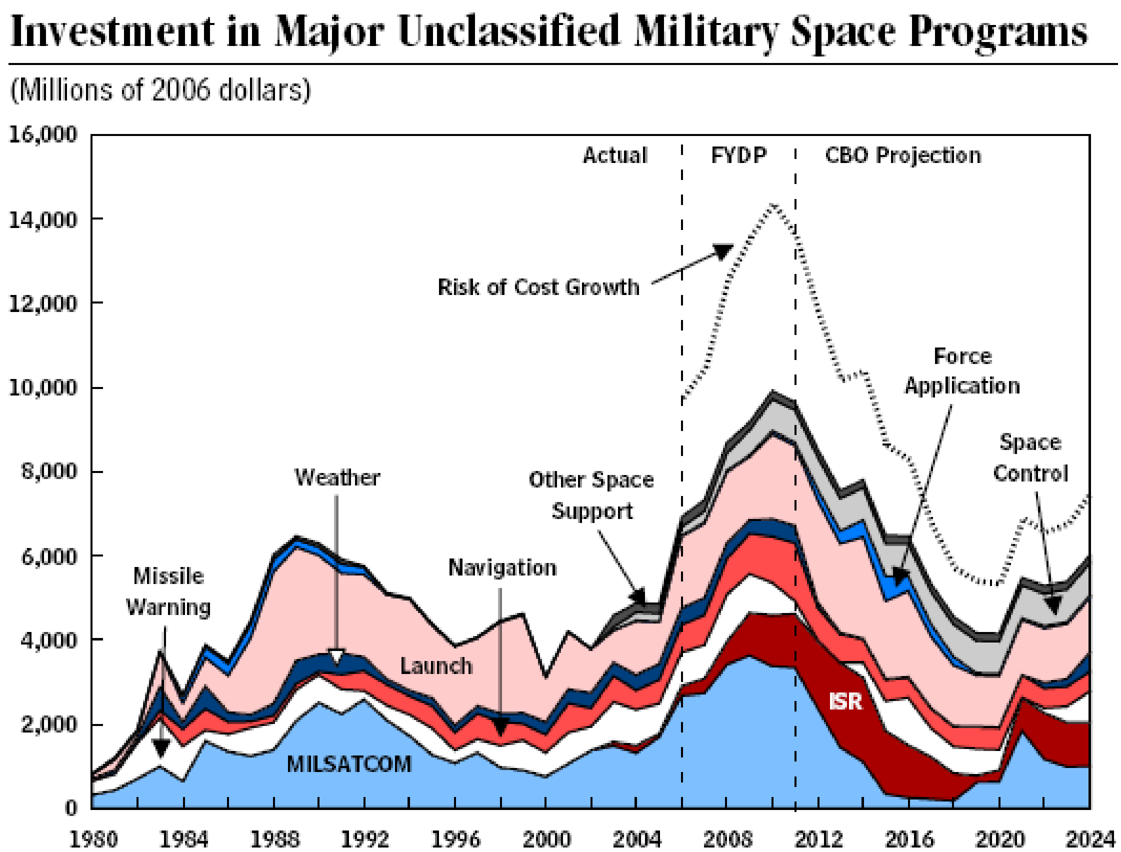

Table 1: Force Enhancement Mission Areas, Primary Orbits, and Associated Space Systems[8]

Environmental Monitoring	Communications	Position, Navigation, and Time (PNT)	Integrated Tactical Warning and Attack Assessment	Intelligence, Surveillance, and Reconnaissance (ISR)
Polar Low-Earth Orbit (LEO)	Geostationary-Earth Orbit (GEO)	Semi-synchronous Orbit	GEO and LEO	Various
Defense Meteorological Support Program (DMSP) -------------------- National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	Defense Satellite Communications System (DSCS) II, DSCS III, Ultra-High Frequency Follow-on (UFO), Milstar, Global Broadcast System (GBS), Iridium, Wideband Global System (WGS), commercial systems ---------------------------- Advanced Extremely High Frequency (AEHF), Mobile User Objective System (MUOS), Polar Military Satellite Communications System, Transformational Satellite Communications System (TSAT)	Global Positioning System (GPS) GPS II GPS IIR GPS IIR-M ---------------- GPS IIF GPS III	Defense Support Program (DSP), GPS ---------------- Space-Based Infra-Red System (SBIRS), Space Tracking and Surveillance System (STSS), Third-Generation Infrared Surveillance Program	Imaging (IMINT) Satellites, Signals Intelligence (SIGINT) Satellites, commercial systems ---------------------- Future Imagery Architecture (FIA), Integrated Overhead SIGINT Architecture (IOSA), Space Radar

Table 2: Attributes of Military Space Doctrines

<table>
<tr><th></th><th>Primary Value and Functions of Military Space Forces</th><th>Space System Characteristics and Employment Strategies</th><th>Conflict Missions of Space Forces</th><th>Appropriate Military Organization for Operations and Advocacy</th></tr>
<tr><td>Sanctuary</td><td>• Enhance Strategic Stability
• Facilitate Arms Control</td><td>• Limited Numbers
• Fragile Systems
• Vulnerable Orbits
• Optimized for National Technical Means (NTM) verification mission</td><td>• Limited</td><td>National Reconnaissance Office (NRO)</td></tr>
<tr><td>Survivability</td><td>Above functions plus:
• Force Enhancement</td><td rowspan="3">• Terrestrial Backups
• Distributed Architectures
• Autonomous Control
• Hardening
• On-Orbit Spares
• Crosslinks
• Maneuver
• Less Vulnerable Orbits
• Stealth
• Attack Warning Sensors
• 5 Ds: Deception, Disruption, Denial, Degradation, Destruction
• Reconstitution Capability
• Active Defense
• Convoy</td><td>• Force Enhancement
• Degrade Gracefully</td><td>Major Command or Unified Command</td></tr>
<tr><td>Control</td><td>• Control Space
• Significant Force Enhancement</td><td>• Control Space
• Significant Force Enhancement
• Surveillance, Offensive, and Defensive Counterspace</td><td>Unified Command or Space Force</td></tr>
<tr><td>High Ground</td><td>Above functions plus:
• Decisive Impact on Terrestrial Conflict
• Ballistic Missile Defense (BMD)</td><td>Above functions plus:
• Decisive Space-to-Space and Space-to-Earth Force Application
• BMD</td><td>Space Force</td></tr>
</table>

NSS Actors and Management Structures

Over the past decade the NSS sector has undergone considerable turmoil in terms of its major actors and organizational structure. Because so many NSS management and organizational structure changes have been implemented, undone, or modified in such a short span of time, it is unclear whether these changes have improved or hindered efforts to deliver enhanced space capabilities or foster better unity of effort. It is also unclear whether the United States is satisfied with its current NSS structure or will implement additional major changes during the next few years. Ten years ago the major NSS actors included the DOD, the Air Force, U.S. Space Command (USSPACECOM), and NRO. With the exception of USSPACECOM, all of these organizations remain key actors today but there is greater disorder and uncertainty in the interrelationships between key space policy decision making structures, both internally and among these organizations, than this single major organizational change would suggest. Overarching issues include whether there is an identifiable NSS enterprise, what elements should and should not be included within it, and how best to foster better unity of effort and more clear lines of responsibility and authority within this enterprise. Options include attempting to deepen specific expertise by construing NSS narrowly as separate defense and intelligence space sectors; working to integrate more broadly across all government space activities and between the DOD and intelligence community (IC) in particular; or emphasizing growing interdependencies across all sectors and considering in addition how best to coordinate with and protect those commercial and allied space capabilities that support NSS activities. Despite the many recommendations and changes designed to improve unity of effort and clarify lines of authority the problem of "who's in charge?" persists and today it is even less clear than it was ten years ago which major actors and structures have greatest responsibility and accountability for key NSS decisions.

Due to its sweeping charter and powerful members, the Commission to Assess United States National Security Space Management and Organization (Space Commission) has been, to date, the most important and influential examination of NSS issues.[9] Many of the most significant recent NSS changes stemmed directly from the major recommendations in the Space Commission Report released on 11 January 2001. The Air Force and DOD moved quite quickly and effectively to implement at least portions of 10 of the commission's 13 major recommendations such as making the Commander of Air Force Space Command (AFSPC) a four star billet that need not be flight rated and moving AFSPC out from underneath USSPACECOM; designating the Under Secretary of the Air Force as the Director of the NRO, Air Force Acquisition Executive for Space, and DOD Executive Agent (EA) for Space; aligning the Space and Missile Systems Center (SMC) underneath AFSPC instead of Air Force Materiel Command; and establishing a major force program (MFP) for the NSS budget.[10]

Other major recommendations were beyond the power of DOD to implement and included the need for Presidential leadership in recognizing space as a top national security priority, appointment of a Presidential Space Advisory group and establishment of a Senior Interagency Group for Space within the National Security Council structure, and the need for the Secretary of Defense and Director of Central Intelligence to work closely and effectively together on space issues. One of the most important recommendations left undone was primarily within the power of DOD to implement and called for creation of an Under Secretary of Defense for Space, Information, and Intelligence. Instead, Secretary of Defense Donald Rumsfeld made Dr. Stephen Cambone his "go to" person for space, regardless of the office Cambone held, and eventually placed him in the newly created Under Secretary of Defense for Intelligence position. Failure to institutionalize a centralized authority for NSS within the Office of the Secretary of Defense (OSD) undermined the Space Commission's vision for organization and management of NSS, helps explain why several important NSS programs lack unity of effort, and contributes to continuing unhealthy competition between OSD branches and unclear lines of authority between OSD and the DOD EA for Space.

Another very significant and probably more important change to the Space Commission's vision for NSS management and organization came on 1 October 2002 when USSPACECOM was merged into United States Strategic Command (USSTRATCOM). Although this was originally described as a merger of equals, in practice this major organizational shift quickly amounted to the absorption of USSPACECOM into USSTRATCOM and left very few vestiges of the original USSPACECOM. Instead of space being the sole focus of one of just nine unified commands, under the new structure space now competes for attention among a very wide array of disparate mission areas that include global strike, homeland defense, information operations, and missile defense. And because unified commands are the warfighters who operate systems and set capability requirements, this change has resulted in less focus on current space operations and future space capability needs. Clearly, it is very difficult to reconcile this organizational change with the Space Commission's overarching recommendation to make space a top national security priority. It is just as clear, however, that this change could not have been made without Secretary Rumsfeld's concurrence and this calls into question the strength of his commitment to the recommendations from the commission he chaired. In the coming months it will be instructive to see how NSS fares following the assumption of command of USSTRATCOM by General Kevin Chilton of the Air Force (who was previously Commander of AFSPC) from General James Cartwright of the Marines and to compare and contrast their leadership in shaping how USSTRATCOM's organization, mission areas, and priorities continue to evolve.

Two more recent internal changes in management structures have also significantly slowed progress towards better NSS integration and unity of effort: movement of milestone decision authority (MDA) for major NSS acquisitions away from the DOD EA for Space to the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)); and separation of the position of Director of the NRO from the DOD EA. Removal of MDA, or the authority to make decisions to continue, restructure, or end major acquisition programs at key decision points (milestones), took place shortly after Mr. Peter Teets left office as DOD EA in March 2005. This action was originally explained as a temporary expedient due to a lack of confirmed Air Force leadership able to exercise such authority during that time, but MDA has never returned to the DOD EA from the USD(AT&L). Lack of MDA undermines the power of the DOD EA by making it a position with responsibility but without authority and contributes to a lack of clarity over who is in charge of NSS acquisition, especially during a period when most major NSS acquisition efforts are troubled and there is not always agreement on the most appropriate corrective measures. Shortly thereafter, in July 2005 Under Secretary Cambone announced that incoming Under Secretary of the Air Force and DOD EA Dr. Ronald Sega would not, as had his predecessor, also be director of the NRO. Although very little rationale was provided, this "divorce" was a very significant organizational change that, like closing USSPACECOM, called into question Secretary Rumsfeld's commitment to some of the recommendations from his own Space Commission since the need for better DOD-IC integration was a major finding of the commission and it is difficult to understand how two people can achieve better integration than one. Moreover, the divorce revealed stark inconsistencies in the nation's approach to NSS management and organization because the argument was made that a separate NRO Director was needed to provide focused attention on that organization shortly after USSTRATCOM had absorbed USSPACECOM and created an organizational structure where space could not receive the same focused attention it previously had.

Unlike the major changes just discussed, other developments in management and organizational structures have advanced better integration and unity of effort across the NSS enterprise. These include: publication of an biannual NSS Plan and Program Assessment with resource constrained priorities specified by the DOD EA; ongoing of NSS Architecture efforts for ISR, Communications, PNT, and Space Control; and creation or reinvigoration of a number of coordination mechanisms across the NSS enterprise that include the Space Industrial Base Council, Suppliers Group Council, Space Professional Oversight Board, NSS Science and Technology Council, Space Partnership Council (meetings several times a year between the DOD EA and heads of the National Aeronautics and Space Administration (NASA), NRO, USSTRATCOM, and AFSPC); and Congressional Space Caucus. In addition, the DOD EA hosts annual meetings with the Chief Executive Officers of commercial satellite communications and remote sensing providers to discuss neighborhood watch and protection issues as well as other best practices. Finally, there is also a congressionally mandated review panel currently underway that is scheduled to deliver a reexamination of NSS organization and management issues along with an assessment of the Space Commission's recommendations and their implementation.[11]

Major NSS Acquisition Programs and Budgets

The sections below examine major national security space programs within each of the four military space mission areas: space support, force enhancement, space control, and force application. The vast majority of U.S. national security space efforts today are in the force enhancement mission area.

Space Support. The space support mission includes two main areas: satellite control programs that provide global communications systems for telemetry, tracking, and control (TT&C) of satellites (the Air Force's Satellite Control Network is one example), and launch and range programs that maintain and improve the infrastructure at DOD's two launch sites, the Eastern Range at Cape Canaveral Air Force Station and the Western Range at Vandenberg Air Force Base (AFB). Under the 2006 Future Years Defense Program (FYDP) and CBO's long-term projection, annual investment funding for those activities would average about $180 million through 2024.[12] Part of those resources would go toward modernizing the Launch and Test Range System, which provides tracking, telemetry, flight safety, and other support for space launches and ballistic missile tests.

Space Launch. NSS space launch capabilities include a number of legacy systems, the Evolved Expendable Launch Vehicle (EELV) DOD now uses to put most of its satellites into orbit, and the new Operationally Responsive Space (ORS) program that is designed to develop concepts of operations, payloads, and launchers capable of proactive space operations. Launch of the WorldView-1 satellite aboard a Delta II from Vandenberg AFB on 18 September marked the 75th consecutive successful Delta II launch and launch of Defense Support Program (DSP) 23 aboard a Delta IV Heavy EELV on 10 November 2007 was a record setting 54rd consecutive successful NSS launch since May 1999. Currently, the EELV program has two types of launchers: the Boeing Delta IV that uses RS-68 main engines and the Lockheed Martin Atlas V that uses Russian RD-180 main engines. Both EELVs are operated by United Launch Alliance, a joint venture between Boeing and Lockheed Martin that began operations in December 2006; each can carry medium-sized payloads (about 10 to 15 metric tons); but only the Delta IV family now includes an operational heavy lift variant for putting larger payloads (up to about 25 metric tons) into LEO. As of the end of November 2007, there have been 19 successful EELV launches (seven commercial, six Air Force, 3 NASA, two NRO, and one demonstration), including the first launch from Space Launch Complex 6 at Vandenberg AFB, California on 27 June 2006. Due to several factors, including a decline in commercial launch demand, the EELV program experienced a cost increase of more than 25 percent in 2004, triggering a Nunn-McCurdy certification breach.[13] The 2006 FYDP implies total funding needs of about $28 billion for approximately six to seven EELV launches each year through 2024.[14] A 2002 ORS mission needs statement established the requirement for responsive, on-demand access to, through, and from space and led to the establishment of a Defense Advanced Research Projects Agency (DARPA)-Air Force joint program office in December 2002. ORS initiatives struggled for a number of years for a variety of reasons including Congressional concerns about use of ORS for force application missions, changing organizational structures, a lack of significant funding, and ill-defined goals. A number of recent improvements including creation of the ORS Office at Kirtland AFB in May 2007, more funding, and clearer goals are likely to lead to better results. Opportunities to develop additional responsive space capabilities are discussed in the final section of this chapter.

Force Enhancement: Military Satellite Communications Systems

Military satellite communications systems provide a range of critical capabilities including assured connectivity for nuclear command and control, links between commanders and forces globally, and the foundation for network-enabled operations; they are probably the single most important military space capability. This NSS mission area has the largest number of programs and receives large investments but current projections of the growth of DOD's demand for satellite communications indicate that even with deployment of much more capable dedicated military systems over the coming years, it is likely that DOD will remain reliant on commercial satellite communications systems, especially during wartime. During Operations Enduring Freedom and Iraqi Freedom over 60 percent and over 80 percent of military communications, respectively, were carried on commercial systems.[15] Benefits of using commercial systems include lower acquisition and operations costs as well as greater flexibility; but must be balanced against drawbacks such as high cost of buying commercial services on the spot market, questionable availability of services, and less secure and protected systems. In addition, DOD has benefited recently from the widespread availability and relatively low costs of the overbuilt commercial satellite communications sector created during the dot-com bubble of the late 1990s. This market oversupply has been corrected and DOD should not rely on these conditions in the future.

The three main types of military satellite communications are found primarily on different parts of the radio spectrum: wideband on super high frequency (SHF), protected on extremely high frequency (EHF), and narrowband on ultra high frequency (UHF). CBO estimates for military satellite communications system spending through 2024 total $27 billion in Air Force funding for wideband and protected capabilities and $5 billion in Navy funding for narrowband capabilities.[16]

Wideband. Currently operational wideband systems include the Defense Satellite Communications System (DSCS), a constellation of five primary satellites plus a number of older residual-capability satellites, and the Global Broadcast Service (GBS), which consists of payloads on three Navy UHF Follow-On (UFO) satellites augmented by leased Ku-band transponders. Originally it was expected that DSCS satellites would have a service life of 10 years; however, they are lasting longer than anticipated, as is the case with many space systems. The DSCS constellation is supposed to remain operational through 2015 and the GBS through 2010 or slightly beyond. The Air Force plans to replace both systems with a constellation of six much more capable GEO satellites now known as the Wideband Global System (WGS), a joint Air Force-Army program that will augment current DSCS X-band and GBS Ka-band capabilities and establish new two-way Ka-band service. In December 2002, the Office of the Secretary of Defense (OSD) directed the addition of two more WGS satellites as part of the transformational communications architecture; the second block of WGS now includes three satellites (4-6) based on the Boeing 702 design, are scheduled for first launch in 2011, and will support increased bandwidth requirements for Airborne ISR and other missions. The first WGS launch had been delayed for over three years and was accomplished on 10 October 2007; the six-satellite constellation is due to be completed in 2013 and remain in service until 2024.[17] On 4 October 2007 Australia announced it will pay $823.6 million to purchase WGS 6 as a way to enhance the network-enabled capabilities of Australian forces and further the close ties that already exist between the United States and Australia.[18]

Protected. This capability is provided currently by five Milstar satellites that are expected to be operational at least until 2014. Like DSCS satellites, Milstar satellites are exceeding their design lifetime and may be available beyond that time. Under current plans, beginning in 2008, a constellation of four or perhaps five Advanced EHF (AEHF) satellites will be launched to begin replacing Milstar.[19]

AEHF includes cryptography necessary to provide worldwide, survivable, and anti-jam protected communications for strategic and tactical warfighting as well as much higher data rates than Milstar. Lockheed Martin is the prime contractor on the system and Northrop Grumman is developing the satellite payload. AEHF is a cooperative program with Canada, the United Kingdom, and the Netherlands as the DOD bid to provide the North Atlantic Treaty Organization (NATO) protected satellite communications. Development of new, complex information assurance products by the National Security Agency has been a difficult challenge and contributed to cost overruns of approximately $1 billion and, thereby, to a Nunn-McCurdy breach at the 15 percent threshold in December 2004, as well as a one-year launch delay for each satellite, from April of 2007-09 until the Fall of 2008-10.[20] In addition to these satellites designed to provide coverage of the globe up to about 65 degrees of latitude, the Air Force is also pursuing two programs to improve protected communications over the northern Polar Regions: the first is operational via three low-data rate Milstar packages on classified host satellites as an interim solution; an enhanced system will take advantage of AEHF technology and should be available for launch in FY 13 and FY 15.

The most important future system for both protected and wideband communications capabilities will be the Transformational Satellite Communications System (TSAT) constellation that is now scheduled for first launch in 2016. TSAT will provide DOD with both high-data-rate wideband and protected communications as the space segment of the global information grid (GIG) and key component of the transformational communications architecture. As the result of Quadrennial Defense Review (QDR) deliberations during 2005, TSAT will now be acquired incrementally with two blocks of satellites (two in the first block, three in the second, and a spare). The first block will have reduced requirements for laser communications links and Internet-like processing routers; five satellites will establish a laser cross-link ring in GEO.[21] Using these advanced technologies, TSAT will connect thousands of users simultaneously through networks rather than using limited point-to-point circuits and will enable communications- and networking-on-the-move. TSAT capabilities will be particularly important for high-data-rate connections to space and airborne ISR platforms. If technologies fail to mature, less-capable technology off-ramps can be used to preserve schedule; these off-ramps would still enhance warfighter capabilities significantly and allow advanced technology to be spiral developed into the second block. A contract to acquire operational satellites is to be awarded following the systems design review currently scheduled for 2008. GAO estimates that TSAT will have a total life cycle cost of $16 billion but Congress has expressed concerns repeatedly about the cost as well as the direction and technical maturity of the program.[22] Congress slashed the President's budget request for TSAT by nearly 50 percent in FY 06, cut funding by 15 percent in FY 07, and cut funding by another 15 percent from $963.6 to $813.6 billion in the FY 08 appropriation. These funding cuts along with the direction to purchase a fourth AEHF satellite are clear indications that Congress is not yet fully sold on all aspects of the planned TSAT program.

Narrowband. Nine Navy UFO satellites now in orbit (out of 11 launched) provide the current DOD narrowband-communications capability. Beginning in 2010, the UFO constellation is due to be replaced by five Mobile User Objective System (MUOS) satellites managed by the Navy and developed by Lockheed Martin. Three of the satellites in the UFO constellation may fail by the end of 2008, leaving little margin for slippage in the initial launch date for the MUOS constellation.

Force Enhancement: Position, Navigation, and Time (PNT)

The Space-Based PNT Executive Committee Fact Sheet issued on 15 December 2004 reiterated fundamental U.S. policy goals for PNT including: maintaining uninterrupted PNT services for all user needs, remaining preeminent in military PNT, providing civil services that exceed or are competitive with foreign PNT services, continuing as an essential component of internationally accepted PNT services, and promoting U.S. leadership in PNT.[23] One of the most difficult challenges is posed by the mandate for Navigation Warfare capabilities to operate GPS effectively despite adversary jamming; to deny use to adversaries; not to disrupt civil, commercial, or scientific uses unduly outside an area of military operations; and to identify, locate, and mitigate interference on a global basis.[24] The Air Force acquires and operates the GPS constellation that currently contains 31 satellites developed through a series of block upgrades. In September 2005, the Air Force began launching Lockheed Martin block IIR-M satellites, which incorporate two new military signals and a second civilian signal. It plans to start launching Boeing block IIF satellites, which will broadcast a third signal for civilian use, in 2008. The first block III satellites, currently scheduled for launch in FY 13, are being designed to include improvements such as better anti-jam capability and satellite cross-links for more-accurate signals. As part of the “back-to-basics” approach to space acquisition and as a result of current on orbit GPS satellites exceeding their design lifetimes, Air Force Under Secretary Sega decided not to award a GPS III contract as originally scheduled during FY 06 and the contract award may be delayed until 2008 according to current indications.[25] In May 2000, the United States stopped the intentional degradation of GPS signals and in September 2007 the White House announced that this capability, known as Selective Availability (SA), would no longer be procured as a part of future modernizations such as GPS III.[26] Based on the FY 06 President’s Budget, CBO projected that the total investment spending on the GPS would be $12.5 billion through 2024.[27]

Force Enhancement: Intelligence, Surveillance, and Reconnaissance (ISR)

Many components of the U.S. ISR network are classified but at least portions of the Future Imagery Architecture (FIA), Space Radar (SR), and commercial imagery are public knowledge.

Future Imagery Architecture (FIA). In September 1999, NRO rocked the aerospace industry by selecting Boeing to build its next generation imaging satellites, bypassing Lockheed Martin, the decades-long incumbent on the program. The original design for the FIA electro-optical (EO) and radar-imaging satellites called for a constellation that split collection functions among smaller, simpler, and more numerous satellites in order to collect more imagery with more frequent revisit rates. FIA, however, soon stumbled badly due to a host of problems plaguing most government satellite programs during this period that included overly optimistic initial bids, unrealistic cost caps and lack of management reserves, and granting total systems performance responsibility (TSPR) to contractors while government oversight capabilities and responsibilities languished. In May 2002 a panel of experts reported to NRO Director Peter Teets that the program was far behind schedule and would likely cost at least $2-3 billion more than the $5 billion originally projected.[28] The EO satellites, the largest FIA problem area, soon fell five years behind schedule, with first launch delayed until at least 2009. Moreover, the price tag for FIA had grown from $6 billion to as much as $18 billion when Director of National Intelligence (DNI) John Negroponte began his first review of technical programs in the summer of 2005.[29] As the result of that review there is a new way ahead for imagery satellites: Boeing will keep developing radar-imaging satellites but, at the DNI’s direction, the EO portion of the architecture will be downscaled and will now be developed by Lockheed Martin. As a final reflection of FIA difficulties, it is also noteworthy that Edward Nowinski and Roger Roberts, the senior Boeing officials overseeing FIA, were forced to retire and that two recent FIA program managers at NRO were passed over for military promotion after their stints in the program.

Space Radar. The name of the Space-Based Radar program was changed to SR in 2005 to highlight the fundamental restructuring of this single, joint program being designed to meet the nation's needs affordably by satisfying both national intelligence and joint warfighter requirements for a global capability to detect, image, and track mobile targets in denied areas during all weather conditions. The plan approved by the Joint Requirements Oversight Council (JROC) in February 2006 calls for a constellation of approximately nine satellites with somewhat reduced capabilities that would be launched beginning about 2016; earlier plans had envisioned using at least 24 satellites in order to provide near-continuous tracking capability. The system is being designed to enhance horizontal integration through agile, responsive collections using near-real time tasking and data dissemination from an active electronically scanned array capable of providing synthetic aperture radar (SAR) imaging, surface moving target indications (SMTI), and high-resolution terrain information (HRTI). Based on the 2006 FYDP, CBO projected costs of $19 billion through 2024 for the space segment of the SR program. Congress cut the $266 million FY 07 request for SR by $80 million, SR funding levels became classified during the FY 08 cycle, and reports indicate that DOD estimates total life-cycle costs for a nine-satellite SR constellation (including the ground segment) would be $34 billion.[30]

Commercial Remote Sensing Systems. Despite post-Cold War laws and policies designed to create conditions and incentives for the development of a dominant U.S. commercial high-resolution remote sensing industry, this market has not grown as large or as quickly as had been hoped and is not dominated by U.S. industry. Partially in response to concerns with the commercial viability of the industry, President Bush signed a new commercial remote sensing policy in April 2003 intended to sustain and enhance the U.S. remote sensing industry. This policy and Congressional direction strongly encourage the National Geospatial-Intelligence Agency (NGA) to purchase commercial remote sensing products to augment classified products and for all parts of the U.S. government to rely to the maximum practical extent on U.S. commercial remote sensing products for all imagery and geospatial needs. U.S. industry in this sector consolidated in December 2005 when Space Imaging and Orbimage merged to form GeoEye. Though not as precise as military reconnaissance satellites, the four operating U.S. private sector satellites, Ikonos 2 (GeoEye), QuickBird (DigitalGlobe), Orbview 3 (GeoEye), and WorldView 1 (DigitalGlobe) can produce imagery with resolution down to 0.5 meter. Competitors include French, Russian, Indian, Canadian, German, and Israeli companies that offer optical and radar imagery with resolution as precise as one meter. Use of commercial remote sensing products has several advantages for the DOD and IC, including lower costs for acquiring these products commercially instead of building and operating their own dedicated systems, availability of wider views of more areas, and easier sharing of data with allies and coalition partners. Drawbacks include widespread commercial availability of data on ongoing U.S. and coalition military operations, as well as concerns about the veracity, reliability, and protection of these systems and their data. NGA has ClearView and NextView contracts with Digital Globe and GeoEye, each worth up to $500 million, for development of remote sensing systems and acquisition of high-resolution remote sensing data into the next decade.[31]

Force Enhancement: Integrated Tactical Warning and Attack Assessment

Currently, the Air Force maintains a constellation of GEO satellites, called the Defense Support Program (DSP), to provide warning of ballistic missile launches and some data on the type of attack and the missile's intended target. As noted above, the last DSP satellite (DSP-23) was successfully launched on 10 November 2007.

Space-Based Infrared System (SBIRS). DSP's successor is SBIRS, a program designed to satisfy operational military and technical intelligence overhead non-imaging infrared requirements, provide improved detection, and supply foundational assessment capabilities for ballistic missile defense. Lockheed Martin is the prime contractor for SBIRS. The operational SBIRS constellation was originally envisioned to include four GEO satellites, two highly elliptical orbit (HEO) payloads on classified host satellites, and one spare GEO satellite. In addition, the Missile Defense Agency (MDA) is evaluating a Northrop Grumman system formerly known as SBIRS-Low and now named the Space Tracking and Surveillance System (STSS). MDA plans to launch two research and development satellites in 2008. If these demonstrators work well in tracking missile launches and warheads, an operational system could follow, with a first launch in about 2016-17. The first SBIRS HEO payload was delivered in August 2004 and the first GEO satellite is currently scheduled to launch in 2009. Unfortunately, however, SBIRS is one of the most troubled NSS acquisition efforts. A 2003 Defense Science Board report called it "a case study for how not to execute a space program." Total cost estimates have jumped to nearly five times the original estimates, and the program has triggered four required reports to Congress for Nunn-McCurdy Act breaches.[32] In December 2005, USD(AT&L) Kenneth Krieg and DOD EA for Space Sega restructured the program significantly. The restructured program called for no more than three GEO SBIRS spacecraft and purchase of the third satellite to be contingent on performance of the first. In addition, the restructuring called for Mr. Krieg to retain milestone decision authority over the SBIRS program and for Dr. Sega to develop an alternative infrared satellite system (AIRSS). Original goals for the AIRSS program were to generate viable competition in meeting the requirements for SBIRS GEO 3, exploit alterative technologies, and be ready for launch by 2015. A GAO report in September 2007 emphasized incompatibilities between the AIRSS goals of meeting the requirements and exploiting alternative technologies and also found that delivering an operational system by 2015 was unrealistically optimistic.[33] This incompatibility in goals for the AIRSS program, along with successful operation of the SBIRS HEO payload, prompted the Air Force to shift the focus of AIRSS to developing alternative capabilities and rename it the Third-Generation IR Surveillance program. Earlier in 2007 Pentagon officials, buoyed by what they saw as recent progress on SBIRS, elected to procure the third SBIRS GEO 3, with an option on SBIRS GEO 4.[34] Other recent SBIRS developments are discussed in a 26 September 2007 memo from Air Force Secretary Michael Wynne to acting USD(AT&L) John Young that indicates the program may face a 6-12 month delay and require up to $1 billion in additional funding: "The problem is a safe hold that did not work on a current satellite, causing mission termination; and the design similarity to" SBIRS satellites.[35] Under the 2006 FYDP and CBO's projections, investment spending for DSP and SBIRS would total about $11 billion through 2024.[36]

Force Enhancement: Environmental Monitoring

DOD currently uses data from five environmental monitoring (weather) satellites that are part of the Defense Meteorological Satellite Program (DMSP) plus the data from two National Atmospheric and Oceanic Administration (NOAA) Polar-Orbiting Operational Environmental Satellites (POES). Those systems are to be replaced by three satellites of the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) and one European Meteorological Operational Satellite. NPOESS was created by a May 1994 Presidential Directive that called for a joint project by DOD, NASA, and the Department of Commerce (DOC) designed to save money by developing a single, converged system. The Air Force (DOD) and NOAA (DOC) provide equal funding for the program with Northrop Grumman as the prime contractor. The original program intent was to buy six satellites, operate three satellites at a time, and be the nation's primary source of global weather and environmental data for operational military and civil use (polar satellites currently provide 90 percent of the data used in DOD and DOC weather prediction models) through 2020. Unfortunately, development of NPOESS and its complex sensor suite has run into several significant snags in the past few years. Cost overruns of 15 percent in September 2005 and 25 percent in January 2006 triggered Nunn-McCurdy Act reports indicating the program was more than $3 billion over its total original budget of $6.5 billion and at least three years behind schedule.[37] Under a restructuring announced in June 2006, the government established new program goals that include: spending $12.5 billion for four slightly less capable satellites, launching the demonstration satellite known as the NPOESS Preparatory Project (NPP) by 2010, delaying the first NPOESS launch by about four years until 2013, and operating the system until 2026.[38] Cancellation, additional restructuring, or further delay in the NPOESS program is not likely to present many attractive options, as it is very doubtful other systems can be developed in time to avoid gaps in coverage, especially if there is a failure on launch or on orbit with any of the remaining DMSP or POES satellites. Under current plans, four DMSP satellites remain to be launched, with the last launch rescheduled for April 2012, and the last POES launch rescheduled for February 2009.[39] CBO projects that the 2006 FYDP would require a total of $3.4 billion in investment funding through 2024 for the DMSP and NPOESS programs.[40]

Space Control

Space control programs focus on developing ground- and space-based sensors to enhance space situational awareness or SSA (knowledge of activity and events in or that could affect circumterrestrial space), improving means of protecting friendly space capabilities from enemy attack, and developing ways of negating enemy space capabilities. The overarching goals of the United States in this area are to enhance deterrence and dissuade development of alternative systems by developing and disseminating high fidelity SSA data and creating an ability to attribute all activity in circumterrestrial space to natural or human causes. SSA programs include Spacetrack, which is continuing to develop a worldwide network of radar and optical sensors; the Space-Based Surveillance System, an optical tracking system scheduled for launch in 2008 that is a follow-on to MDA’s Space Based Visible sensor on the Midcourse Space Experiment (SBV/MSX) launched in 1996; and other ground systems designed to track objects of interest in space. Other space control programs—such as the Rapid Attack Identification, Detection, and Reporting System (RAIDRS) and the Counter Communications System (CCS)—focus on developing technology to protect friendly systems or to disrupt, deny, degrade, or destroy enemy space capabilities. Joint Publication 3-14, *Joint Doctrine for Space Operations*, discusses ways to gain or maintain space control by providing freedom of action through protection and surveillance or to deny freedom of action through prevention and negation.[41] Air Force doctrine, by contrast, aligns space control doctrine like air doctrine as offensive counterspace (OCS) and defensive counterspace (DCS). OCS missions would disrupt, deny, degrade, or destroy space systems, or the information they provide, if used for purposes hostile to U.S. national security interests. DCS missions include both active and passive measures to protect U.S. and friendly space related capabilities from enemy attack, interference, or use for purposes hostile to U.S. national security interests.[42] Funding for the Orbital Deep Space Imager, a space-based system designed to track objects in GEO, was eliminated from the President’s FY 07 budget request. Under the 2006 FYDP, research, development, testing and evaluation funding for space control programs would increase from $195 million in 2006 to $768 million in 2011.[43] SSA, space control, and protection have been areas of particular concern in Congress as indicated by taskings to the Secretary of Defense and Director of National Intelligence in the FY 06 National Defense Authorization Act (NDAA) to report to Congress about these topics in April and July 2006, April 2007, and July 2008.[44] In addition, following the Chinese anti-satellite (ASAT) weapon test on 11 January 2007, these issues have aroused even greater concern and the FY 08 Defense Appropriations bill added $100 million to requested funding for SSA in order to accelerate efforts such as the Space Fence and RAIDRS block 20.[45]

Force Application

Development of systems with the potential to apply force to, in, or especially from, space is the object of intense scrutiny by Congress and both domestic and international attentive audiences. These concerns are exacerbated by significant difficulties in distinguishing between concepts and technologies being developed for ballistic missile defense, protection, space control, and force application as well as the development of some systems for these missions in classified and special access programs that have less transparency and oversight. Groups opposed to space weaponization, such as the Center for Defense Information and the Stimson Center, argue that momentum created by experiments testing space control and force application concepts in space will create "facts in orbit," driving U.S. policy toward space weapons without debate by either Congress or the public.[46] It is difficult, however, to see how the United States could continue improving its space protection and ballistic missile defense capabilities without the data provided by conducting these relatively small scale experiments, how the experiments could appreciably change any facts in orbit, or how they might lead to full-scale space weaponization without triggering significant public debates, especially given all the space acquisition woes detailed above. Indeed, the cumulative effect of recent NSS acquisition problems has contributed to a small but perceptible shift in priorities away from space control and force application. Comparison of recent Space Posture statements to Congress by the Under Secretary of the Air Force shows the greater emphasis that Peter Teets placed on assured access to and freedom of action in space while his successor, Ronald Sega, did not focus on this area but emphasized consistently a "back-to-basics" approach to acquisition.[47] Following the Chinese ASAT test in January 2007, there have been a few calls for reinvigorated development of space force application systems by the United States[48] but these have been overshadowed by the clamor in Congress and elsewhere for increased attention to SSA and space control.

Common Aero Vehicle (CAV). Under the joint Air Force-DARPA program office created in December 2002, the CAV program was envisioned originally as means to deliver a variety of conventional payloads that would be launched from intercontinental ballistic missiles (ICBMs) as part of the Force Application and Launch from Continental United States (or FALCON) program. In response to FY 05 congressional language, the FALCON portion of the CAV program was restructured. Redesignated as Falcon (lower-case), the program focused on the development and transition of more mature technologies into a future weapon system capable of promptly delivering and deploying conventional payloads worldwide. Within the Falcon program, the CAV was redesignated the Hypersonic Technology Vehicle and all weaponization activities were excluded. The 2006 FYDP calls for total funding of less than $100 million per year for those programs through 2011 and CBO's projection assumes the limited deployment of 40 CAV-equipped ICBMs in about 2015, at which point the demand for investment resources would peak at $600 million.[49] The FY 08 Defense Appropriations Bill shifts funding from CAV and the Navy's conventional Trident Modification to provide $100 million for research into promising prompt global strike technologies.[50]

Improving NSS Acquisition and Management

The challenges highlighted above make it clear that continuing changes and improvements in organizational and management structures are needed to ensure that space capabilities will provide an enduring asymmetric advantage for the United States. Several areas deserve particular attention: fostering better integration among military operators and with the IC, developing the professional space workforce, improving the acquisition process, creating responsive space capabilities, rethinking export controls, and emplacing protection measures.

Few current space systems have been built from the ground up with technologies or concepts of operations designed to foster improved integration among military operators or between the military and the IC. Emphasizing space-enabled, integrative capabilities, however, has become increasingly important to the new American way of war and essential to implement the comprehensive force transformation efforts currently underway. Space capabilities provide the single most important foundation for future transformed forces but are not enough alone unless their strengths and vulnerabilities are balanced objectively against complementary terrestrial capabilities and are then integrated seamlessly and transparently into a single network and concept of operations. Space capabilities are particularly important for point-to-multipoint communications and are essential for the communications- and networking-on-the-move that must enable lighter and more mobile forces to see and strike first with great precision, such as the Army's Future Combat System. An even more advanced future global reconnaissance, precision strike complex will be built from a mix of integrated systems combining orbiting platforms with manned and unmanned aircraft, surface forces, and other systems, that cue each other automatically and employ multi-level security to allow authorized users to create user-defined operational pictures by pulling whatever information they require, whenever they need it, and wherever they are located on the network. Beyond enabling better integration between military forces, the NSS community must also work harder to improve the ties between the black and white worlds. This effort requires long-term focus and commitment, adoption of best practices in both directions, and improved cooperation and information sharing at all levels. The need for improved cooperation between the 16 agencies within the IC has been a consistent theme of DNI Michael McConnell and this topic was the primary focus of his 100-Day Plan released in May 2007. The Space Radar program with its goal of creating a single system for all users is an excellent opportunity for this type of black-white integration and should provide a clear indication of the strength of integration in practice. In addition, because it is likely that United States' dependence on commercial space services will continue to grow, the U.S. Government needs to become a more reliable and business savvy partner for the space industrial base. As part of this process, the United States needs to rethink the proper balance between the commercial and national security sectors and adopt clear, long-term, and consistent criteria for determining the NSS functions that should be performed by the commercial sector and those that should remain with government.

Developing the space professional workforce is an essential step towards improving the health of NSS capabilities and performance but is a generational process best implemented in a patient and consistent manner over the long term. Many of the most experienced space professionals in the civil and commercial space sectors are nearing retirement age and more effort is needed to develop, attract, and retain top talent to replenish these ranks. The dearth of top talent among mid-career professionals who might have chosen a space career but were instead lured into the burgeoning computer networking sector is particularly alarming and will require the space sector to work harder and develop creative ways to attract some of this cohort. The National Defense Education Program, a program that targets undergraduate and graduate students studying math, science, and engineering, is one excellent way to address this challenge; its requested budget for FY 08 of $44.4 million is more than double the $19.4 million appropriated in FY 07. Another key area, development of a more qualified and competent military space cadre has received growing attention, particularly in the Air Force. Congress has commended initiatives such as National Security Space Institute and Space Education Consortium at Air Force Space Command as well as the Joint Space Studies Center at Air University but recommended DOD be more aggressive in developing programs and partnerships across the U.S. government, industry, and academia.[51] There is also undoubtedly much more to be done to improve career development paths and to develop leadership among space officers, problems exacerbated by the Air Force's traditional and understandable emphasis on airpower and the pilots at its institutional core that, unfortunately, often comes at the expense of its stewardship over spacepower and space officers.

Improving NSS acquisition processes is probably the most important and difficult of the many challenges currently facing NSS leadership. Because the problems the United States has in this area stem from a number of sources and did not arise overnight, they cannot be resolved quickly or easily but they are not intractable. Due to the scale and pervasiveness of the problems during the past few years and the widespread recognition and attention they have received, DOD has initiated a number of changes and improvements. With recent restructurings and greater emphasis on NSS acquisition, the situation may be turning a corner; Congress, however, remains vigilant, as reflected in its close oversight and specific taskings on NSS programs:

> While the Department has taken positive steps to improve the current space acquisition system, it is not yet apparent what impact these initiatives might have on the performance of space acquisition. As a result, the conferees will maintain this issue at the forefront of congressional interests. . . . Additionally, the conferees recommend that the Department develop an alternative and complementary business model for space acquisition and system deployment that will increase the production rate of space systems and lower costs.[52]

Dr. Sega's "back-to-basics" approach to NSS acquisitions emphasized in his March 2006 Posture Statement indicated his intent focus on addressing these concerns. This approach is designed to apportion more risk to the earlier stages of the acquisition process, undertake more but smaller and more manageable projects using block buys and spiral development, and establish a more constant and predictable rhythm of designing, building, launching, and operating space systems.[53] In addition to pushing more risk into the science and technology (S&T) and technology development stages of the acquisition cycle, Sega's approach has helped to double the amount of DOD investment in space related S&T over the past four years and to bring more discipline and requirements stability into the systems development and systems production stages of the cycle.[54] Furthermore, Sega built on recommendations of previous studies and the QDR by moving the budget confidence levels for NSS programs from 50 to 80 percent, strengthening collaboration between the players in the acquisition process (especially on setting and maintaining requirements), implementing more rigorous system engineering, and improving the recruitment and training of the acquisition workforce.[55]

Developing responsive space capabilities is another key area for improving NSS acquisition and management that holds the potential for creating large, paradigm changing benefits. There are several viewpoints as well as a number of concepts associated with responsive space capabilities ranging from relatively minor changes in how quickly satellites can be launched and who controls them to sweeping transformations in the ways satellites and launchers are built; how large, complex, expensive, and reliable they should be; how they are operated and serviced on orbit; and who controls them and their potential missions. Some use the term operationally responsive space (ORS) to describe relatively minor changes in how quickly satellites can be launched and who controls them. Concepts that are more ambitious would produce standardized, simple satellites on assembly lines, quickly launch them under the control of theater commanders for specific purposes, and service them with plug and play modules or refuel them on-orbit. Paradigm changing visions for responsive space emphasize flexible distributed architectures and sparse arrays consisting of many networked microsatellites able to perform a range of missions as well or better than missions performed by constellations of single function satellites and, even more importantly, radically reduce the vulnerabilities inherent in space systems with just a few nodes. Proliferation of the wide range of current and projected threats to all orbital regimes, combined with the inherent fragility of space systems and the predictability of their operations leads inexorably to the conclusion that distributed architectures must at least supplement, if not eventually replace, current architectures if space systems are to remain operationally relevant in an increasingly contested domain. In addition, responsive space concepts might help to reduce the costs of developing and launching space capabilities; break the near monopoly of large aerospace corporations and allow small, space-focused companies to emerge; and get more states and non-state actors involved with a range of space activities including developing space-enabled confidence and transparency capabilities. For a number of years Congress expressed disappointment with progress to date and concern with DOD's lack of vision and initiative on responsive space concepts.[56] The FY 06 and 07 NDAA both indicated significant concerns with ORS and tasked DOD in several areas including establishing an ORS program office to: "contribute to the development of low-cost, rapid reaction payloads, busses, spacelift, and launch control capabilities in order to fulfill joint military operational requirements for on-demand space support and reconstitution; and to coordinate and execute operationally responsive space efforts across the Department of Defense with respect to planning, acquisition, and operations;" and assume responsibility for the Tactical Satellite (TacSat) program from the now defunct Office of Force Transformation.[57] Some congressional concerns have been allayed by DOD's delivery of a comprehensive ORS Report to Congress and establishment of an ORS Office at Kirtland AFB in May 2007. Current DOD ORS plans call for a three tiered system to deliver more responsive space capabilities by employing on-demand tasking of existing assets, launching on-call assets, and developing new or modified capabilities. Developing truly responsive space capabilities will not be easy and will require major changes in concepts of operations and ways of thinking but current difficulties in NSS acquisition and management present an excellent window of opportunity.

Rethinking export controls might not at first seem an important issue for improving NSS acquisition and management; however, U.S. export control policies are particularly important for the NSS enterprise because they affect the competitiveness of U.S. aerospace corporations and currently run counter to other space policy goals that call for U.S. companies to dominate certain space activities. Present U.S. space export control policy stems from developments during the past 20 years and has been shaped primarily by the executive branch department controlling these exports. Between October 1992 and October 1998, the Department of Commerce (DOC) had export licensing responsibilities for most communications satellites and DOC supported these exports strongly. After Hughes and Loral worked with insurance companies to analyze Chinese launch failures in January 1995 and February 1996, a 1998 congressional review (Cox Report) determined these analyses communicated technical information to the Chinese in violation of the International Traffic in Arms Regulations (ITAR) and the 1999 NDAA transferred all satellites and related items to the Munitions List administered by the State Department.[58] Since the return of export controls to State, the U.S. aerospace industry has clamored incessantly for a loosening of these restrictions and has blamed ITAR for business downturns and a decline in market share.[59] European and other satellite manufacturers, including Alcatel Alenia Space and EADS, have replaced all U.S.-built components from their communications satellites to make them "ITAR-free" and avoid these restrictions.[60] Thus, United States export controls have clearly created incentives for development of an indigenous foreign high-technology space sector—a perverse and counterproductive outcome. There is also considerable merit in the U.S. industry's claims that the current restrictions cost them market share in this strategic sector and do not make common-sense distinctions between exports to allies and others or necessarily keep dual-use technologies thought to be dangerous out of the wrong hands. At the same time, however, slowing the diffusion of technologies with considerable military potential is a legitimate national security concern and a range of factors beyond ITAR have contributed to the decline in the competitiveness of the U.S. aerospace industry. Clearly, U.S. export control policy must find a better way of balancing these conflicting objectives. Problems that are even more difficult arise when U.S. export controls stifle other space policies designed to create incentives for U.S. industry to dominate certain market sectors. U.S. commercial remote sensing policy is probably the best example of this but there are a number of other areas such as communications satellites and commercial imagery where there are obviously conflicting policy objectives. The United States should reevaluate, on a case-by-case basis, which of these conflicting objectives should predominate and then readjust its policies and regulations accordingly. Another excellent starting point for rebalancing export control priorities would be to implement key recommendations from the recently completed Center for Strategic and International Studies (CSIS) study on this topic such as removing from the Munitions List commercial communications satellite systems, dedicated subsystems, and components specifically designed for commercial use.[61]

Finally, and perhaps most critically, the United States must move more expeditiously to emplace and institutionalize a range of protection measures to ensure space will continue to provide an enduring asymmetric advantage. The United States must not design its future transformed forces to be reliant on space-enabled capabilities unless it can ensure those capabilities will be available when needed most—during combat operations. The basic problem is current U.S. space architectures were optimized for performance rather than built to provide mission assurance despite the types of interference and attacks that are becoming increasingly common and within the capability of more actors. In the past, for a variety of reasons including the widespread perception that space was a sanctuary, each incremental investment almost always went to providing more capabilities rather than better protection of existing capabilities. This must change. It is unclear if space was ever a sanctuary; but, as highlighted by the January 2007 Chinese ASAT test, it is becoming an increasingly contested military domain like land, sea, or air where operations face a variety of threats. As the most important first step in implementing specific protection measures, the United States should ensure critical infrastructure protection and continuity of operations by eliminating critical single points of failure on the ground and hardening LEO satellites against total radiation dose failures following high altitude nuclear detonations. A second essential step is to implement and institutionalize the protection standards for all future NSS systems called for in the NSS Protection Strategy Framework signed by DOD EA Peter Teets in March 2005. As discussed in the responsive space section above, microsatellite distributed architectures and sparse arrays should be the foundation for building future architectures that are better protected and more survivable. Increased effort towards this goal is urgently need now and it is particularly important that the Air Force Space and Missile Systems Center (SMC) and the NRO adopt this approach but moving these organizations toward this approach will be a difficult challenges since they are the centers of current NSS acquisition efforts that have evolved, with good reasons, towards larger and more capable but very small numbers of satellites in most current architectures.[62] Given all the other NSS acquisition and management problems, it will not be easy to find and sustain the resources required to institutionalize protection but the NSS community must step up to its responsibilities to ensure space capabilities are at hand when needed most. Finally, because the United States is becoming increasingly reliant on commercial space services, such as communications and remote sensing, it must also work harder and in more creative ways to assure protection of these services. Better dialogue between the NSS and commercial sectors and long-term policy consistency are keys to improving protection of commercial services. Wherever possible, the U.S. Government also should attempt to shape this sector through favorable licensing decisions or giving commercial benefits, such as long-term leases or priority in purchasing, to those companies doing the most to ensure protection of their services but keeping decisions about risk and market forces within the commercial sector.

ENDNOTES

[1]Unfortunately, programs within the vMFP have to date been readjusted each February, have not remained constant from year to year, and have not always covered all major space systems. This approach reduces the utility of the vMFP as a consistent measure of NSS expenditures over time and undercuts the primary rationale of the Space Commission in recommending creation of this measure. Section 8111 of Public Law 110-116 (Fiscal Year (FY) 08 Department of Defense (DOD) Appropriations) calls for DOD to create a hard rather than a virtual MFP for space.

[2]Marcia S. Smith, "U.S. Space Programs: Civilian, Military, and Commercial," (Washington: Congressional Research Service, 9 August 2005).

[3]Congressional Budget Office, "The Long-Term Implications of Current Plans for Investment in Major Unclassified Military Space Programs," (Washington: Congressional Budget Office, 12 September 2005), 1; and Marshall Institute Policy Outlook, "National Security Space FY 2008 Budget: Overview and Assessment," (Washington, D.C.: George C. Marshall Institute, November 2007).

[4]CBO, "Investment in Major Military Space Programs," 5.

[5]Most U.S. Government documents list three rather than four space sectors. See, for example, the 2006 National Space Policy's discussion of civil, national security (defense and intelligence), and commercial sectors. Office of Science and Technology Policy, "Fact Sheet: National Space Policy" (Washington, D.C.: The White House, 6 October 2006). For discussion emphasizing four sectors see *Report of the Commission to Assess National Security Space Management and Organization* (Washington, D.C.: Commission to Assess National Security Space Management and Organization, 11 January 2001), 10-14.

[6]Joint Publication 3-14, *Joint Doctrine for Space Operations* (Washington D.C.: Joint Staff, Department of Defense, 9 August 2002). Joint Publication 3-14 is currently being rewritten, as is required for all joint publications every five years.

[7]Lt Col David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, Ala.: Air University Press, June 1988).

[8]Satellites in Low-Earth Orbit (LEO) can operate from less than 100 miles to several hundred miles altitude and complete each orbit in approximately 90 minutes. Polar LEO is ideal for many spysat and weather applications because it overflies all parts of the Earth several times each day as the Earth rotates and it also can be aligned in Sun Synchronous Orbits that arrive overhead the same location at the same time each day. Satellites in Semi-Synchronous Orbit are located at approximately 12,500 miles altitude and complete an orbit every 12 hours. Geostationary-Earth orbit (GEO) is located approximately 22,300 miles above the equator, a location where the satellites' orbital velocity matches Earth's rate of rotation and the satellite appears to remain motionless above the same spot—a very valuable attribute for communications and some SIGINT satellites.

[9]The most important previous NSS related committees and their key policy recommendations include the following: the 1954–55 Technological Capabilities Panel (TCP) (establish the legality of overflight and develop spy satellites); the President's Science Advisory Committee (PSAC), led by Science Advisor James Killian in 1958 (create NASA); the group led by Science Advisor George Kistiakowsky in 1960 (create the NRO); the review led by Vice President Lyndon Johnson in April 1961 (race the Soviets to the Moon for prestige); Vice President Spiro Agnew's 1969 Space Task Group (establish NASA's post-Apollo goals); the Air Force's 1988 Blue Ribbon Panel led by Maj Gen Robert Todd (integrate spacepower into combat operations); NASA's 1991 Augustine Commission (emphasize scientific exploration over shuttle operations); and the Air Force's 1992 Blue Ribbon Panel, led by Lt Gen Thomas Moorman (emphasize space support to the warfighter and establish the Space Warfare Center).

The Space Commission was chaired by former and future Secretary of Defense Donald Rumsfeld and included 12 other members with a broad range of very high-level NSS expertise (listed with the top "space" job formerly held): Duane Andrews (Deputy Under Secretary of Defense for Command, Control, Communications, and Intelligence); Robert Davis (Deputy Under Secretary of Defense for Space); Howell Estes (Commander, US Space Command); Ronald Fogleman (Air Force Chief of Staff); Jay Garner (Commander, Army Space and Strategic Defense Command); William Graham (President's Science Advisor and acting NASA Administrator); Charles Horner (Commander, U.S. Space Command); David Jeremiah (Vice Chairman, Joint Chiefs of Staff); Thomas Moorman (Air Force Vice Chief of Staff); Douglass

Necessary (House Armed Services Committee staff); Glenn Otis (Commander, Army Training and Doctrine Command); and Malcolm Wallop (Senator). See John A. Tirpak, "The Fight for Space," *Air Force Magazine* 83 (August 2000): 61.

The legislation authorizing the commission was action-oriented:

> The Commission shall, concerning changes to be implemented over the near-term, medium-term, and long-term that would strengthen United States national security, assess the following: (1) the manner in which military space assets may be exploited to provide support for United States military operations. (2) The current interagency coordination process regarding the operation of national security space assets, including identification of interoperability and communications issues. (3) The relationship between the intelligence and nonintelligence aspects of national security space (so-called "white space" and "black space"), and the potential costs and benefits of a partial or complete merger of the programs, projects, or activities that are differentiated by those two aspects. (4) The manner in which military space issues are addressed by professional military education institutions. (5) The potential costs and benefits of establishing any of the following: (A) An independent military department and service dedicated to the national security space mission. (B) A corps within the Air Force dedicated to the national security space mission. (C) A position of Assistant Secretary of Defense for Space within the Office of the Secretary of Defense. (D) A new major force program, or other budget mechanism, for managing national security space funding within the Department of Defense. (E) Any other change to the existing organizational structure of the Department of Defense for national security space management and organization. Section 1622 of National Defense Authorization Act for Fiscal Year 2000 (Public Law 106-65; 113 Stat. 814; 10 U.S.C. 111 note).

In October 2000, Congress added an amendment directing the commission to study:

> (6) The advisability of—
>
> (A) various actions to eliminate the de facto requirement that specified officers in the United States Space Command be flight rated that results from the dual assignment of officers to that command and to one or more other commands in positions in which officers are expressly required to be flight rated;
>
> (B) the establishment of a requirement that, as a condition of the assignment of a general or flag officer to the United States Space Command, the officer have experience in space, missile, or information operations that was gained through either acquisition or operational experience; and
>
> (C) rotating the command of the United States Space Command among the Armed Forces.

Sec. 1091. Additional Duties for Commission to Assess United States National Security Space Management and Organization. Section 1622(a) of the National Defense Authorization Act for Fiscal Year 2000 (Public Law 106-65; 113 Stat. 814; 10 U.S.C. 111 note).

There were two other major congressionally mandated space studies during 2000: A review of the National Imagery and Mapping Agency (NIMA), *The Information Edge: Imagery Intelligence and Geospatial Information in an Evolving National Security Environment* (Washington, D.C.: December 2000); and a review of the NRO, *The NRO at the Crossroads* (Washington, D.C.: National Commission for the Review of the National Reconnaissance Office, 1 November 2000).

[10]General Accounting Office, Report to Defense Committees, DEFENSE SPACE ACTIVITIES: Organizational Changes Initiated, but Further Management Actions Needed," (Washington, D.C.: GAO, GAO 03-379, April 2003), 25-27. Secretary Rumsfeld signed a memo on 18 October 2001 directing DOD to undertake 32 changes to implement a new and comprehensive approach to NSS management and organization.

[11]The NSS Review Panel consists of Thomas Young (chairman), Edward Anderson, Lyle Bien, Ronald Fogleman, Lester Lyles, Hans Mark, and James Woolsey. The Panel currently plans to deliver an interim assessment to Congress in March and their final report in September 2008. Their charter is in Section 913 of the FY 07 National Defense Authorization Act: INDEPENDENT REVIEW AND ASSESSMENT OF DEPARTMENT OF DEFENSE ORGANIZATION AND MANAGEMENT FOR NATIONAL SECURITY IN SPACE.

(a) INDEPENDENT REVIEW AND ASSESSMENT REQUIRED.—

(1) IN GENERAL.—The Secretary of Defense shall provide for an independent review and assessment of the organization and management of the Department of Defense for national security in space.

(2) CONDUCT OF REVIEW.—The review and assessment shall be conducted by an appropriate entity outside the Department of Defense selected by the Secretary for purposes of this section.

(3) ELEMENTS.—The review and assessment shall address the following:

(A) The requirements of the Department of Defense for national security space capabilities, as identified by the Department, and the efforts of the Department to fulfill such requirements.

(B) The future space missions of the Department, and the plans of the Department to meet the future space missions.

(C) The actions that could be taken by the Department to modify the organization and management of the Department over the near term, medium-term, and long-term in order to strengthen United States national security in space, and the ability of the Department to implement its requirements and carry out the future space missions, including the following:

(i) Actions to exploit existing and planned military space assets to provide support for United States military operations.

(ii) Actions to improve or enhance current interagency coordination processes regarding the operation of national security space assets, including improvements or enhancements in interoperability and communications.

(iii) Actions to improve or enhance the relationship between the intelligence aspects of national security space (so-called "black space") and the non-intelligence aspects of national security space (so-called "white space").

(iv) Actions to improve or enhance the manner in which military space issues are addressed by professional military education institutions.

(4) LIAISON.—The Secretary shall designate at least one senior civilian employee of the Department of Defense, and at least one general or flag officer of an Armed Force, to serve as liaison between the Department, the Armed Forces, and the entity conducting the review and assessment.

(b) REPORT.—

(1) IN GENERAL.—Not later than one year after the date of the enactment of this Act, the entity conducting the review and assessment shall submit to the Secretary and the congressional defense committees a report on the review and assessment.

(2) ELEMENTS.—The report shall include—

(A) the results of the review and assessment; and

(B) recommendations on the best means by which the Department may improve its organization and management for national security in space.

[12]CBO, "Investment in Major Military Space Programs," 17.

[13]Government Accountability Office, "DEFENSE ACQUISITIONS: Assessment of Selected Major Weapon Programs," Report to Congressional Committees, GAO-06-391, March 2006, 54. Under the Nunn-McCurdy Act (10 U.S.C. 2433), Congress must be notified when a major defense acquisition program experiences a cost increase of 15 percent or more. If the increase is greater than 25 percent, the Secretary of Defense must certify to Congress that the program is essential to national security, adequately managed, no feasible alternatives exist, and the new cost estimates are reasonable. A comprehensive analysis of EELV issues is provided in National Security Space Launch Requirements Panel, *National Security Space Launch Report* (Washington, D.C.: RAND National Defense Research Institute, 2006).

[14]CBO, "Investment in Major Military Space Programs," 14.

[15]Honorable Ronald M. Sega, Under Secretary of the Air Force, Space Posture Statement to Strategic Forces Subcommittee of House Armed Services Committee, 16 March 2006, 9.

[16]CBO, "Investment in Major Military Space Programs," 5.

[17]Each Block I WGS satellite can route up to 3.6 Gbps of data; the first WGS on orbit will provide more throughput than the entire current DSCS constellation. GAO, "Assessments of Major Weapon Programs," 119-20; and "America's Wideband Gapfiller Satellite System," *Defense Industry Daily*, 23 October 2006.

[18]Turner Brinton, "Australia to Fund Sixth Wideband Global Satcom Satellite: $823.6 Million Commitment will give Australians Access to Entire WGS Constellation," *Space News*, 8 Oct 07, 15.

[19]Turner Brinton, “Senate Appropriators Direct Air Force to Buy 4th AEHF Satellite,” *Space News*, 24 September 2007, 12. The FY 08 Defense Appropriations Bill provides $728.2 million for AEHF ($125 million more than requested) and directs the Air Force to buy a fourth AEHF and maintain an option to buy a fifth satellite. In the FY 08 budget request the Air Force had planned to buy only three AEHFs.

[20]GAO, “Assessments of Major Weapon Programs,” 27-8; “First Advanced EHF Launch Slips to Fall of Next Year,” *Space News*, 19 November 2007.

[21]Sega, Posture Statement, 13.

[22]Government Accountability Office, “DOD is Making Progress in Adopting Best Practices for the Transformational Satellite Communications System and Space Radar but Still Faces Challenges,” GAO-07-1029R, 2 August 2007, 1.

[23]Office of Science and Technology Policy, “Fact Sheet: U.S. Space-Based Positioning, Navigation, and Timing Policy,” (Washington, D.C.: The White House, 15 December 2004), 3.

[24]Ibid., 6-7.

[25]Breanne Wagner, “Aerospace World,” *Air Force Magazine*, Vol. 89, no. 7 (July 2006): 21-22; and Janice Partyka, “The System—Oct 2007,” *GPS World*, 1 October 2007.

[26]”Statement by the Press Secretary,” (Washington, D.C.: White House Office of the Press Secretary, 18 September 2007).

[27]CBO, “Investment in Major Military Space Programs,” 9.

[28]Philip Taubman, “Failure to Launch: In Death of Spy Satellite Program Lofty Plans and Unrealistic Bids,” *New York Times*, 11 November 2007.

[29]Ibid.; *Wall Street Journal*, 11 February 2006 asserts that the restructuring of FIA will add $8 billion to the program costs and raise the total above $20 billion.

[30]CBO, “Investment in Major Military Space Programs, 9-11; and Marshall Institute, “NSS FY 08 Budget.”

[31]“Israeli Space-Based Radar Set For Indian Launch As Pentagon’s New Commercial Recon Poised For Vandenberg Flight,” *Aviation Week & Space Technology*, 17 September 2007, 28; and “DigitalGlobe launches its newest spy satellite,” *Denver Post*, 19 September 2007.

[32]Report of the Defense Science Board/Air Force Scientific Advisory Board Joint Task Force on Acquisition of National Security Space Programs (Washington, D.C.: Defense Science Board, May 2003), 6; GAO, “Assessments of Major Weapon Programs,” 101-02. To date the SBIRS program has triggered four reports to Congress under the Nunn-McCurdy Act; the program breached its cost estimates by 25 percent in 2001, by 15 percent in 2004, and by 25 percent twice during 2005.

[33]Government Accountability Office, “Space Based Infrared System and its Alternative,” (Washington, D.C.: GAO-07-1088R, 12 September 2007), 2-4.

[34]Jeremy Singer, “DoD Mulls Missile Warning Options Amid Latest Travails with SBIS,” *Space News* 8 Oct 2007, 1 and 18.

[35]Ibid.

[36]CBO, “Investment in Major Military Space Programs,” 12.

[37]Jeremy Singer, “NPOESS Restructuring Plan Trims Satellites, Capabilities,” *Space News Business Report*, 12 June 2006.

[38]Ibid.; and Government Accountability Office, "POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES: Restructuring Is Under Way, but Challenges and Risks Remain," Statement of David A. Powner, Director Information Technology Management Issues, Testimony before the Subcommittee on Energy and Environment, House Committee on Science and Technology (Washington: Government Accountability Office, GAO-07-10T, 7 June 2007).

[39]Powner 7 June 2007 testimony, 11; and Government Accountability Office, "POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITES: Cost Increases Trigger Review and Place Program's Direction on Hold," Statement of David A. Powner, Director Information Technology Management Issues, Testimony Before Subcommittee on Disaster Prevention and Prediction, Committee on Commerce, Science, and Transportation, U.S. Senate, GAO-06-573T, 30 March 2006, 3-4.

[40]CBO, "Investment in Major Military Space Programs, 14.

[41]Joint Publication 3-14, pages IV-5 through IV-8.

[42]Air Force Doctrine Document 2-2.1, *Counterspace Operations* (Maxwell AFB, Ala.: Air Force Doctrine Center, 2 August 2004), 25-34.

[43]CBO, "Investment in Major Military Space Programs," 16.

[44]Section 911 of the FY 06 NDAA, SPACE SITUATIONAL AWARENESS STRATEGY AND SPACE CONTROL MISSION REVIEW and Section 911 of FY 08 NDAA, SPACE PROTECTION STRATEGY:

SEC. 911. SPACE PROTECTION STRATEGY.

(a) Sense of Congress - It is the Sense of Congress that the United States should place greater priority on the protection of national security space systems.
(b) Strategy - The Secretary of Defense, in conjunction with the Director of National Intelligence, shall develop a strategy, to be known as the Space Protection Strategy, for the development and fielding by the United States of the capabilities that are necessary to ensure freedom of action in space for the United States.
(c) Matters Included - The strategy required by subsection (b) shall include each of the following:

(1) An identification of the threats to, and the vulnerabilities of, the national security space systems of the United States.
(2) A description of the capabilities currently contained in the program of record of the Department of Defense and the intelligence community that ensure freedom of action in space.
(3) For each period covered by the strategy, a description of the capabilities that are needed for the period, including --

(A) the hardware, software, and other materials or services to be developed or procured;
(B) the management and organizational changes to be achieved; and
(C) concepts of operations, tactics, techniques, and procedures to be employed.

(4) For each period covered by the strategy, an assessment of the gaps and shortfalls between the capabilities that are needed for the period and the capabilities currently contained in the program of record.
(5) For each period covered by the strategy, a comprehensive plan for investment in capabilities that identifies specific program and technology investments to be made in that period.
(6) A description of the current processes by which the systems protection requirements of the Department of Defense and the intelligence community are addressed in space acquisition programs and during key milestone decisions, an assessment of the adequacy of those processes, and an identification of the actions of the Department and the intelligence community for addressing any inadequacies in those processes.
(7) A description of the current processes by which the Department of Defense and the intelligence community program and budget for capabilities (including capabilities that are incorporated into single programs and capabilities that span multiple programs), an assessment of the adequacy of those processes, and an identification of the actions of the Department and the intelligence community for addressing any inadequacies in those processes.
(8) A description of the organizational and management structure of the Department of Defense and the intelligence community for addressing policy, planning, acquisition, and operations with respect to capabilities, a description of the roles and responsibilities of each organization, and an identification of the

actions of the Department and the intelligence community for addressing any inadequacies in that structure.

(d) Periods Covered - The strategy required by subsection (b) shall cover the following periods:

(1) Fiscal years 2008 through 2013.

(2) Fiscal years 2014 through 2019.

(3) Fiscal years 2020 through 2025.

(e) Definitions - In this section --

(1) the term "capabilities" means space, airborne, and ground systems and capabilities for space situational awareness and for space systems protection; and

(2) the term "intelligence community" has the meaning given such term in section 3(4) of the National Security Act of 1947 (50 U.S.C. 401a(4)).

(f) Report; Biennial Update -

(1) REPORT - Not later than six months after the date of the enactment of this Act, the Secretary of Defense, in conjunction with the Director of National Intelligence, shall submit to Congress a report on the strategy required by subsection (b), including each of the matters required by subsection (c).

(2) BIENNIAL UPDATE - Not later than March 15 of each even-numbered year after 2008, the Secretary of Defense, in conjunction with the Director of National Intelligence, shall submit to Congress an update to the report required by paragraph (1).

(3) CLASSIFICATION - The report required by paragraph (1), and each update required by paragraph (2), shall be in unclassified form, but may include a classified annex.

(g) Conforming Repeal - Section 911 of the National Defense Authorization Act for Fiscal Year 2006 (Public Law 109-163; 119 Stat. 3405; 10 U.S.C. 2271 note) is repealed.

[45]Conference Report to Accompany H.R. 3222, "Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2008, and for Other Purposes," Report 110-434 (Washington, D.C.: GPO, 6 November 2007), 320. Three of the best analyses of Chinese counterspace capabilities and the rationale for and implications of their January 2007 ASAT test are Larry M. Wortzel, "The Chinese People's Liberation Army and Space Warfare," (Washington, D.C.: American Enterprise Institute, October 2007; Ashley J. Tellis, "China's Military Space Strategy,' *Survival* 49, no. 3 (Autumn 2007): 41-72; and Philip C. Saunders and Charles D. Lutes, "China's ASAT Test: Motivations and Implications," (Washington, D.C.: National Defense University, Institute for National Strategic Studies Special Report, June 2007). For an outstanding proposal on how Congress should respond see Terry Everett, "Arguing for a Comprehensive Space Protection Strategy," *Strategic Studies Quarterly* 1, no. 1 (Fall 2007): 20-35.

[46]Theresa Hitchens, Michael Katz-Hyman, and Victoria Samson, "Space Weapons Spending in the FY 2007 Defense Budget," (Washington, D.C.: Center for Defense Information, 8 March 2006). Programs of greatest concern to these groups include the MDA's Space Test Bed, Near Field Infrared Experiment (NFIRE); Kinetic Energy Interceptor (KEI), Multiple Kill Vehicle (MKV), and Airborne Laser (ABL); as well as the Air Force's Experimental Satellite System (XSS), Autonomous Nanosatellite Guardian for Evaluating Local Space (ANGELS), and Starfire Optical Range.

[47]See the Space Posture statements presented to Congress by the two Under Secretaries of the Air Force in March 2005, March 2006, and March 2007. Mr. Teets resigned in March 2005 and was replaced by Dr. Sega in July 2005. Dr. Sega resigned on 31 August 2007 and no replacement has been nominated as of this writing.

[48]See, for example, presentation by Senator John Kyl, "China's Anti-Satellite Weapons and America's National Security," (Washington, D.C.: Heritage Foundation, 29 January 2007).

[49]CBO, "Investment in Major Military Space Programs," 16.

[50]Conference Report to Accompany H.R. 3222, 240-41.

[51]House of Representatives, Conference Report on National Defense Authorization Act for Fiscal Year 2006, H.R. 109-360, H13100.

[52]Ibid.

[53]Sega, Posture Statement, 10-12.

[54]Ibid. Prior to becoming Under Secretary of the Air Force, Dr. Sega was Director of Defense Research and Engineering (DDR&E).

[55]Ibid., 13-14.

[56]House of Representatives, Conference Report on National Defense Authorization Act for Fiscal Year 2006, H.R. 109-360, H13100.

[57]Section 913 of the FY 06 and 07 NDAA, OPERATIONALLY RESPONSIVE SPACE.

[58]The January 1995 failure was a Long March 2E rocket carrying Hughes-built Apstar 2 spacecraft and the February 1996 failure was a Long March 3B rocket carrying Space Systems/Loral-built Intelsat 708 spacecraft. Representative Christopher Cox (R.-Calif.) led a six-month long House Select Committee investigation that produced the "U.S. National Security and Military/Commercial Concerns with the People's Republic of China" Report released on 25 May 1999. The report is available from http://www.house.gov/coxreport. In January of 2002, Loral agreed to pay the U.S. government $20 million to settle the charges of the illegal technology transfer and in March of 2003, Boeing agreed to pay $32 million for the role of Hughes (which Boeing had acquired in 2000). Requirements for transferring controls back to state are in Sections 1513 and 1516 of the FY 99 NDAA. Related items are defined as "satellite fuel, ground support equipment, test equipment, payload adapter or interface hardware, replacement parts, and non-embedded solid propellant orbit transfer engines."

[59]Satellite builders claim that their exports dropped 59 percent in 2000 and that since March 1999 their share of the global market declined sharply (from 75 percent to 45 percent). Evelyn Iritani and Peter Pae, "U.S. Satellite Industry Reeling Under New Export Controls," *Los Angeles Times*, 11 December 2000, 1. According to *Space News*, 2000 marked the first time that U.S. firms were awarded fewer contracts for GEO communications satellites than their European competitors (they show the Europeans ahead 15 to 13). Peter B. de Selding and Sam Silverstein, "Europe Bests U.S. in Satellite Contracts in 2000," *Space News*, 15 January 2001, 1 and 20.

[60]Peter B. de Selding, "European Satellite Component Maker Says it is Dropping U.S. Components Because of ITAR," *Space News Business Report*, 13 June 2005; and Douglas Barrie and Michael A. Taverna, "Specious Relationship," *Aviation Week & Space Technology* (17 July 2006): 93-96.

[61]"Briefing of the Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls," (Washington, D.C.: Center for Strategic and International Studies, February 2008).

[62]An outstanding and comprehensive technical evaluation of the prospects for moving toward distributed architectures is provided in: Gregory A. Orndorff, Bruce F. Zink, and John D. Cosby, "Clustered Architecture for Responsive Space," AIAA-RS5 2007-1002, (Los Angeles: American Institute for Aeronautics and Astronautics, 5th Responsive Space Conference, 23-26 April 2007).

A Legal Exploration of Force Application in Outer Space

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I. Introduction

The ascent into space of man-made objects has made it possible to use space as a medium for military purposes. Space militarisation can be described as any activity in space which is executed by a man-made object that is incorporated *de jure* or *de facto* in the military organization of a State. Satellites, for instance, may perform a number of tasks for military purposes, including communications, weather information, remote sensing and navigation (*e.g.* GPS and missile guidance). Along the continuum of space militarisation, one also finds space weaponisation. Space weaponisation denotes the introduction of operational weapons systems in outer space. Examples of dedicated space weapons include Kinetic Energy Weapons (KEWs) and Directed Energy Weapons (DEWs). The concept of Kinetic Energy Weapons is a quite simple one: a 'kill' is being executed through high velocity impact (hit-to-kill). Directed Energy Weapons include a broad variety of technologies, such as lasers, particle beams and signal interference technologies like high-powered microwaves or high power radio frequencies. Electromagnetic and Radiation Weapons (ERWs), another subcategory of DEWs, operate through the emission and/or creation of electromagnetic pulse or radiation. The device that brings about both consequences at once is a nuclear weapon. Lastly, Explosive Proximity Weapons (EPWs), also referred to as space mines, explode upon contact or in proximity.

Despite the technological development, political realities have prevailed to the extent that space faring States, the US being an exception, are cautious to include the use of (defensive) space capabilities as viable means to secure their national interest in their national (military) space doctrines and policies. Nevertheless, the weaponisation of space by those and other nations looms just as large. This paper will focus on whether and to what extent force application by space weapon systems in space is regulated under existing international law, in particular the Outer Space Treaty, the Charter of the United Nations and the law of armed conflict. It will start, however, with an inquiry into the legal-historical context of the militarisation and weaponisation of outer space.

II. The Ascent into Space and the International Community

The military significance of space had been acknowledged right from the start of space activity. In fact, it provided the incentive to go into space in the first place. The technological advances of the 1950s, in particular the development of the Intercontinental Ballistic Missile (ICBM), started off a space race between the US and the Soviet Union with the launch of the first man-made satellite, the Sputnik 1, by the latter on 4 October 1957. It was only three months later in January 1958 that the US sent their first satellite into space, the Explorer 1. Though the 1960s are generally seen as a softening of the Cold War, space exploration marked another chapter of the continuous search for military dominance by the world's leading powers at the time.

The international community, however, has been quick to respond to even the earliest rhetoric in the direction of space militarisation. The United Nations General Assembly (GA) adopted a series of resolutions relevant to the disarmament or rather the non-armament of outer space. The first resolution in this context, GA Resolution 1148 of 14 November 1957 on 'regulation, limitation and balanced reduction of all armed forces and armaments' called for a common study of a system of inspection to ensure that objects sent through outer space were used "*exclusively for peaceful* and scientific *purposes*". The second resolution of major importance towards the regulation of space activities recommended States to be guided by the principles that international law applies to outer space and celestial bodies and that those are not subject to national appropriation. However, the landmark resolution was Resolution 1962 (XVIII), adopted unanimously by the General Assembly on 13 December 1963. This so-called 'Principles Declaration' aimed at providing guidance on how to use space for peaceful purposes in the interest of all mankind. The imperative drive to negotiate this Principles Declaration was to embed space activities within an arms control regime. It spurred the superpowers to cooperate and to lay down legally binding norms with regard to military activities in outer space. The increasing activity in space by the US and the Soviet Union and the concern thereof on the part of the international community led to the negotiation and adoption of the 1967 Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty or OST). This document constitutes the first legally binding instrument in the regulation of space activities and is considered to be the *Magna Charta* of space law.

III. Space Warfare in Sight?

By the time the 1967 OST was signed, space-based military assets were already an integrated part of both superpowers' defence systems. Satellite systems of reconnaissance and surveillance would serve the threefold purpose of technical intelligence gathering, arms control monitoring and verification. These space-based systems were, by way of tacit agreement between the US and the Soviet Union, accepted as legitimate means of confidence-building and information-exchange. It is undeniable that, ever since the first satellite was put into orbit, space has seen an ever increasing development in quantity and quality of militarisation. The 1991 First Gulf War demonstrated for the first time the practical advantages of force enhancement space capabilities in war; a phenomenon that is known as passive military use of outer space. Satellites provided indispensible services, such as communications, weather information, remote sensing and navigation (*e.g.* GPS and missile guidance). This even led some experts to say it was "the first 'space war', since it was the first occasion on which the full range of modern military space assets were applied to a terrestrial conflict." The dependence on satellite systems has been demonstrated once more in the 1999 Kosovo campaign and even more so during the 2003 Iraq war. It is, therefore, to be expected that the inclusion of satellite systems in military planning as force enhancers will undoubtedly further develop in support of future warfare.

Space warfare capabilities, *i.e.* force application capabilities, have been researched, developed and tested almost exclusively by the US and the Soviet Union since the late 1950s, of which most importantly air-launched anti-satellite weapons (ASATs) were explored to counter ICBM attacks. This active development of ASATs continued until the political climate shifted to a period of *détente* in the early 1970s in which the Anti-Ballistic Missile Treaty (ABM) and the Strategic Arms Reduction Treaties (START I & II) were signed. However, this was quite quickly taken over again by increasing rivalry in the late 1970s and would come to a new height during Ronald Reagan's presidency. Reagan was the first US president who overtly advocated the weaponisation of outer space. In his third year of presidency, he handed down his famous 'Star Wars Speech' and announced his 'Strategic Defense Initiative' (SDI). The SDI was a program to ensure national security by raising a defensive non-nuclear missile shield with space-based components to counter a (nuclear) Soviet missile attack. Confronted with some initial successful tests with ASAT capabilities, the international community tried to counter what it saw as space arms race initiatives. One of these counter-initiatives came from the sole multilateral disarmament forum, the Geneva-based Conference on Disarmament (CD). From 1982 onwards, this intergovernmental body has included in its agenda to work towards negotiations of a Treaty on the Prevention of an Arms Race in Outer Space (PAROS).[62] No such agreement has been reached yet, in spite of the repetitious and explicit affirmation of the UN General Assembly that outer space "must not become an arena for a new arms race."

IV. A Call for Legal Appraisal: Recent Developments in US Space Policy

As international concerns remained, the US continued its search for space protection. In 1998, President Bill Clinton and his administration released a National Security Strategy (US NSS), which strongly aimed at further development of military programs to protect US national security interests in outer space. When George W. Bush took office in 2001 it did not take long before the new administration adopted its own version of Reagan's SDI for a national or ballistic missile defence (BMD). Following the catastrophic events of '9/11', 2001, the Bush administration made it a priority to defend itself against missiles from rogue States. Subsequently, it announced its withdrawal from the ABM Treaty in order to be freed of legal restraints and to work on a BMD. Moreover, in 2001 a congressional commission chaired by later to be Secretary of Defense Donald Rumsfeld evaluated that the 600 US satellites on which the US military relied were easy targets for hostile adversaries and had to be able-bodied. The Rumsfeld Report stated:

> [W]e know from history that every medium-air, land and sea-has seen conflict. Reality indicates that space will be no different. Given this virtual certainty, the U.S. must develop the means both to deter and to defend against hostile acts in and from space. This will require superior space capabilities.

This recommendation was given a follow up five years later. In 2006, the Bush administration, including then Secretary of Defense Rumsfeld, released its National Space Policy (US NSP). The 2006 US NSP is noticeable for a number of things. In particular, it ventilates a unilateral approach toward arms control matters. It explicitly opposes the development of new legal regimes limiting US access to space. Strikingly, it places the importance of freedom of action in space on an equal footing with that of air and sea power. Moreover, given the wording of the US NSP, weaponisation of outer space looms large:

> In order to […] enhance the national security, the Unites States must have robust, effective, and efficient space capabilities.
> […]
> Enable unhindered U.S. operations in and through space to defend our interests there.
> […]
> Develop and deploy space capabilities that sustain U.S. advantage and support defense and intelligence transformation.

Bearing in mind that the controversial Bush doctrine of pre-emption promulgated by the 2002 US National Security Strategy also extends to outer space, the 2002 US NSS in combination with the 2006 US NSP warrants close scrutiny. Even more so as it is expected that space-based assets will increasingly form part of military structures all over the world. This necessitates an assessment of the legality of military uses of space, particularly space weapons and force application in space.

V. Obligations Arising from Article IV of the 1967 Outer Space Treaty

In 2007 the 50th anniversary of the space age which began with the launching of the Sputnik I on 4 October 1957 and the 40th anniversary of the first treaty to regulate space activities comprehensively, the 1967 Outer Space Treaty, were commemorated. Article IV of the OST has significant bearing on military activities in outer space. It reads as follows:

> 1. 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.
> 2. 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.

V.1 Article IV(1): Weapons of Mass Destruction

The first paragraph prohibits putting nuclear and any other weapons of mass destruction in orbit or in outer space. However, the treaty leaves crucial terms undefined, such as ‘outer space’, ‘orbit’ and, not surprisingly, ‘weapons of mass destruction’ (WMD). It is generally understood that ‘outer space’ comprises celestial bodies, including the Moon, and all space in between, the so-called outer void space. ‘Orbit’ is generally understood to comprise at least one full orbit around the Earth in order to exclude from the scope of the provision (nuclear laden) ICBMs passing *through* space.

Furthermore, the object of the prohibition is *objects* carrying weapons of mass destruction, not the weapons *per se*. This strict interpretation can be explained by reference to the technological state of art at the time of conclusion. It would, however, be a misreading and against the spirit of the OST, to cling to such a strict reading. Be that as it may, the question still stands: what are weapon of mass destruction? Although weapons of mass destruction are not defined in any agreement, the UN General Assembly in its very first Resolution has employed the definition that they are “atomic weapons and […] all major weapons *adaptable* to mass destruction.”[62] Two years later, the UN Commission for Conventional Armaments defined WMD as: “[…] atomic explosive weapons, radio active material, lethal chemical and biological weapons, and *any* weapons developed in the future which have characteristics comparable in destructive effect […].”Thus, according to Gorove, the question may be a relative one in relation to new weapons, in particular, those developed to be deployed in space: “their capabilities of mass destruction must be evaluated with each technological advancement”.

Moreover, some have argued that any weapon which uses atomic energy for whichever purpose should be regarded as a nuclear weapon and thus a WMD; this would particularly be true for DEWs. However, it is submitted that, at least for the purposes of the OST, nuclear weapons that do not have the characteristics of a WMD and *a fortiori* nuclear material not intended to be used as a weapon are excluded from the prohibition. Thus, space weapons that use nuclear energy, but do not possess the characteristics in effect or design as WMD, like some DEWs, fall outside the scope of Article IV(1).

V.2 Article IV(2): The ‘Peaceful Purposes’ Debate

Article IV(2) is concerned only with the demilitarisation of ‘the Moon and other celestial bodies’. It is important to keep in mind that in 1967 neither the US nor the Soviet Union attempted to bring about a complete demilitarisation of the *whole* of outer space comparable to the regime established by the 1959 Antarctic Treaty. The omission of any reference to outer space *sensu lato* is therefore a deliberate one. Nevertheless, Article IV(2) bears significant resemblance with the Antarctic Treaty and, arguably, has the same effect of establishing a regime of complete demilitarisation, albeit spatially limited to celestial bodies.

The main debate focuses on the interpretation of the term ‘peaceful’ in the context of the use of outer space for ‘peaceful purposes’. Though this notion appears to have its own functional meaning, if at all, discussion generally runs through two other terms, namely ‘non-aggressive’ and ‘non-military’. Initially, following the events of the Sputnik and Explorer, both the US and the Soviet Union aimed at a complete demilitarisation of outer space. However, the availability, use and potential of satellite systems prompted the US already in 1958 to change its interpretation of ‘peaceful’ from ‘non-military’ to ‘non-aggressive’. It is argued that the interpretation of ‘peaceful’ meaning ‘non-aggressive’, as supported by the US, is erroneous. Replacing ‘peaceful’ by ‘non-aggressive’ in Article IV(2) would *a contrario* mean - if one accepts the limited spatial application of Article IV(2) - that outer void space may be used for aggressive purposes. This conclusion cannot be warranted, particularly as Article III OST makes the UN Charter and its provisions on the prohibition of the use of force applicable to outer space. In other words, it would make Article IV(2) redundant.

On the other hand, the interpretation of ‘peaceful’ meaning ‘non-military’ is a more likely one. ‘Peaceful’ should be seen distinct from terms like ‘offensive’ or ‘aggressive’ and ‘defensive’ or ‘non-aggressive’. Cheng aptly summarizes the parallel with Article I of the 1959 Antarctic Treaty as follows:

> (i) ‘peaceful’ means non-military;
> (ii) references to military installations, military manoeuvres and so forth in the provision are exemplificative and not exhaustive;
> (iii) the possibility of using military personnel and equipment or scientific research or other peaceful purposes in no way invalidates point (i) above.

According to the customary rules of treaty interpretation, treaty terms shall be interpreted according to their ordinary meaning in their context and in the light of the object and purpose of the treaty. First of all, the ordinary (sociological) meaning of ‘peaceful’ implies more than the mere absence of violence at a given moment. It entails a state devoid of force. Secondly, in the context of the OST, there are several references to ‘peaceful purposes’ hinting at a non-military meaning. Thirdly, other treaties with a similar nature can be referred to for interpretative purposes, as the practice of the ICJ has shown. There are a number of treaties that, according to their object and purpose, point to ‘peaceful’ as ‘non-military’. Admittedly, none of these treaties provide a definition of ‘peaceful’. Yet, there is no indication that the parties to the Outer Space Treaty intended to attach a special meaning to it in the sense of Article 31(4) of the VCLT. Hence, the meaning of ‘peaceful’, *i.e.* ‘non-military’, should then also be applied to Article IV(2) OST.

V.3 Military Space Activities in Outer Void Space

The US and the USSR only accepted Article IV of the Outer Space Treaty as it stands to gain maximum freedom to protect their national interests. The 1967 Outer Space Treaty regulates specific military activities in differentiated regimes: one addresses the Moon and other celestial bodies (Article IV(2)) and the other the outer void space (Article III). This differentiation begs the question whether the legal consequences for the use of force remain nevertheless equal for both regimes. It is argued that this is not the case.

VI. The Use of Force in Outer Space

Any interference, including the use of force, against a space object is prohibited. This stems from the exclusive jurisdiction over space objects, which as a matter of principle, is spelled out in Article VIII of the Outer Space Treaty. However, it does not tell us whether such interference amounts to a prohibited use of force for the purposes of the *jus ad bellum* or rather *jus contra bellum,* as reflected in particular in the Charter of the United Nations. The cornerstone provision on the regulation of the use of force between States is the well-known Article 2(4) of the UN Charter prohibiting the use of force in international relations. Article 2(4) is declaratory of customary international law and even considered to be *jus cogens*, thus binding upon all States in all their international relations, including those in outer space. Article II of the OST excludes appropriation in outer space *sensu lato* and, thus, negates the possibility of the use of force against the territorial integrity. Without an associated terrestrial attack, the political independence of a State cannot be threatened either. As Article 2(4) contains an absolute prohibition, all uses of force in outer space are necessarily subject to the prohibition to act in 'any other manner inconsistent' with the UN Charter.

Furthermore, it is generally accepted that 'force' denotes *armed* force. However, signal interference weapons, for instance, are not considered to apply force in the 'classical' sense, *i.e.* using kinetic energy. To make Article 2(4) applicable, Brownlie argues that new types of force application devices would be covered if "the agencies concerned are commonly referred to as 'weapons' and forms of warfare" and if "these weapons are employed for the destruction of life and property." Thus, a re-interpretation of the notion 'force' along these lines seems justified to incorporate space weaponry within the prohibition.

VII. Chapter VII of the UN Charter

The generally accepted exceptions to the prohibition on the use of force are a Security Council (SC) authorisation and forcible measures taken in the lawful exercise of the right of self-defence. Though the Drafters of the Charter may not have been concerned with the inclusion of space limitations in the Charter, its application to outer space should not be disregarded. As concerns the first exception, the United Nations system provides the Security Council with coercive tools under Chapter VII of the Charter.

Prior to applying these means, however, the Security Council has to determine that a situation falls within the scope of Article 39 UN Charter. The qualification that has been given the most to situations in recent decades is that of a threat to international peace and security. Applied to situations in space, this could involve either a threat to mankind (*e.g.* WMD, space debris, or theoretically even space weaponisation as such) or a threat to another State's national security (*e.g.* the threat or use of force against a State's space assets). Interestingly, Article 41 UN Charter, dealing with non-military measures, provides for the possibility to interrupt "telegraphic, radio and other means of communication" with the State(s) involved. This could encompass space-based assets, like communication and GPS satellites. Lacking any reference to space or space forces, Article 42 UN Charter would not automatically bar military measures to be taken from or in outer space. Even if such an approach were adopted, that is the exclusion of military space measures by Article 42, there is nothing to assume that the UNSC could not change this interpretation by subsequent practice. In support of this argument with regard to military space activities, one may claim that this has already been achieved. Moreover, the technological advances in space are undeniably a great asset to UN peacekeeping missions. Space assets may, thus, not only be called upon to support Earth-based measures, but force application in or from outer space may come within the purview of the actions envisaged by the Charter as well.

VIII. Self-Defence

Article 51 UN Charter does not conclusively define the right of self-defence, it mainly sets out the conditions under which measures in self-defence are lawful. Basically, it requires an armed attack and prescribes a temporary response, *i.e.* "until the Security Council has taken measures necessary to maintain international peace and security". Article 51 calls on States to report immediately to the SC once measures in self-defence are taken. Furthermore, customary international law places two additional constraints upon the lawful exercise of the right of self-defence, namely necessity and proportionality. Consequently, the statutory and customary requirements do not deter the application of this right in outer space. This conclusion is widely accepted today.

VIII.1 Self-Defence in Outer Void Space

Undoubtedly, the right of self-defence is activated once an attack takes place against a military space asset wherever it may be located in outer void space. There is, however, considerable controversy as to whether the right of self-defence extends to the protection of nationals and property owned by either own nationals or a third State's nationals outside the territory of their nationality or the territory where they are registered. The 1974 *Definition of Aggression* states that force amounts to aggression when marine or air fleets are attacked. Though the meaning of aggression does not necessarily coincide with the meaning of armed attack, the traditional view is that what amounts to aggression amounts to armed attack as well. Thus, in light of the spirit of Article 3 *sub* d of the *Definition of Aggression*, the interpretation that space fleets or space systems could be taken as the object of attack is plausible. Attacks on individual assets being part of such fleet or system may thus fall within the right of self-defence as well.

There are other long held lines of reasoning that go a step further and dangerously push the limits of international law. The first argument is that due to the obliged registration of military and civilian space assets in a particular State, these assets may profit from diplomatic protection by that State of registry. This would result in an affirmative approach to include the nationals and property in question within the right of self-defence. However, to jump from diplomatic protection to self-defence is a circular argument. States are foremost under the obligation to settle their disputes peacefully as established in Article 2(3) of the UN Charter.The circularity inserted here is that while forcible protection may be effectuated, it may only be done so according to the conditions set out under the right of self-defence. The question whether these nationals or assets fall within that right is exactly the point in case.

In addition, two arguments have been raised that relate to matters of forcible self-help. Firstly, it is argued that States may use force to protect their space assets, notwithstanding their nature, on the basis of their jurisdiction and control as expressed in Article VIII OST and secondly, that through the operation of registration, States may forcibly protect the sovereign rights and interests of these assets. If this forcible protection in the former case is invoked to enforce the international obligation not to use force, this act is forbidden as a measure of forcible self help. Regarding the second ground of forcible protection, just because nationals or assets carry the nationality of a State, it simply does not mean they are permeated with sovereignty, with the exception of the acts of a State's nationals that are attributable to it. Both arguments fall back into the same circular reasoning as the previous argument. Accordingly, these arguments cannot be accepted.

It suffices to note here that, although the concept of self-defence has been accepted to apply to outer void space, the 'terrestrial' discussions about the parameters of the exercise of self-defence in space are just as vigorous. Any such discussions should, however, be held with the particular context of space operations in mind.

VIII.2 Self-Defence on Celestial Bodies

The issues related to the interpretation of 'peaceful purposes' can be put in the context of the place of self-defence in the regulation of a demilitarised zone in general, and of celestial bodies in particular. A 'non-aggressive' approach argues in favour of military installations on celestial bodies for the purpose of self-defence. In addition to the objections mentioned in section V.2, this argument cannot be accepted from a *jus contra bellum* perspective. The demilitarisation of celestial bodies can be seen as a collective act precisely tailored to prevent threats to the peace. Celestial bodies are *res communis* denoted for exactly that purpose as demilitarised zones. It is this situation that makes the analogy with the Antarctic regime even more pertinent. The Preamble of the Antarctic Treaty clearly iterates:

> *Recognizing* that it is in the interest of all mankind that Antarctica shall continue *forever* to be used exclusively for peaceful purposes and shall not become the scene or object of international discord;
> […]
> *Convinced* also that a treaty ensuring the use of Antarctica for peaceful purposes only and the continuance of international harmony in Antarctica will further the purposes and principles embodied in the Charter of the United Nations.

The reference to the UN Charter is only made in light of *furthering* the purposes and principles. As a consequence, in furthering a *jus contra bellum* and the maintenance of international peace and security, States have gone a step beyond the Charter and declared Antarctica off-limits to any military activity other than that for peaceful purposes. Moreover, Antarctica must not be made 'the scene or object of international discord'. These words may be interpreted as not to make Antarctica the scene or object of hostilities. While these preambular paragraphs do not have binding effect, their aspirations are captured by Article I of the Antarctic Treaty. State practice confirms that this regime cannot be derogated from, not even in wartime. States have implicitly acknowledged such an approach in 1967, employing similar terminology in the OST, emphasizing its comprehension with the words '*exclusively* for peaceful purposes'. Hence, it can be concluded that Article IV OST precludes any (offensive and defensive) military activity *on* and *against* celestial bodies.

VIII.3 Ballistic Missile Defence

A ballistic missile defence system is seeking defence of the State possibly through military deployment in outer space aiming at tracking and intercepting incoming missiles. The issue involved in this context does not so much concern the orbiting of those components – this is a legal activity when they comply with the OST and Article IV OST in particular –, but some of these components would undoubtedly claim some sort of protection, identification or exclusion zone around them. Any space asset that comes within such a zone risks being targeted. Then the question is, would the assumingly permanent nature of the associated 'keep out zones' of these assets run counter to international law? On the high seas, States have arguably acquiesced in the establishment of such zones, at least for the duration of a conflict. A strong argument can be presented that any interference arising from such a zone, be it in peace- or wartime, would be contrary to the freedom of navigation in space. Interestingly, there seems to be increasing acceptance of the fact that such missile defence may be accepted in a multilateral setting only, if at all. Yet, this clearly contradicts the principle that outer space cannot be subject to sovereign claims and, consequently, cannot be occupied. State practice in space on this point is, however, at present non-existent. Nevertheless, it may be claimed that that the practice of permanent 'keep out zones' fall outside the legal paradigm and limits current initiatives for unilateral deployment of a BMD when assets used for a BMD make use of 'keep out' zones in peacetime.

IX. The Law of Armed Conflict in Outer Space

The use of force is not only judged by the regime governing the legality of the resort to armed force, the *jus ad bellum*, but also by the law applicable in armed conflict, the *jus in bello*. Leaving aside the question of qualification of a certain conflict, a few but significant principles have been accepted as being applicable to any type of armed conflict: military necessity, humanity, proportionality and discrimination. Yet, it cannot be held beforehand that the *corpus* of the LOAC applies *in toto* to armed conflict in outer space because of the unique environment it presents and the specifics of space operations. Fortunately, hostilities in space have not arisen at this point in time. It can, however, not be excluded that one day outer space will be the fourth dimension of warfare and, consequently, may attain its own *corpus* of *jus in bello spatiale*, a law of armed conflict in space.

Yet, any development of a specific framework of the LOAC in outer space is likely two be premised on two levels of analogy. First, the law of armed conflict is characterized by numerous customary and conventional law norms for land, sea and, to a lesser extent, air warfare that would similarly limit the conduct of hostilities in the space environment as well (macro-level of analogy). Second, one should take into account that the OST assists significantly in shaping a minimum order and may therefore not be suspended or terminated. Thus, a number of norms could be specifically tailored to conform to the existing norms of the *corpus juris spatialis* regulating military activities in outer space (micro-level of analogy). Taken as a whole, the overriding objective in the development of a *jus in bello spatiale* should be not to:

> contravene in principle or in any important respect the rules already governing other forms of warfare […], but should extend the accepted principles […] so that the laws of war might be a unity in applying to all kinds of agencies of war.

The current *corpus* of the LOAC is therefore a logical starting point, in as far as the prescriptions or norms behind it could be transposable to the military use of space. This may certainly be the case for the rules relating to the conduct of hostilities, laid down in the 1977 First Protocol additional (AP I) to the 1949 Geneva Conventions. Interestingly, mention should be made of Article 49(3) AP I, which stipulates that 1977 Additional Protocol I applies to all existing types of warfare "which may affect the civilian population, civilian individuals or civilian objects on land". Article 49(3) makes apparent that land, naval and air warfare should have due regard to the rules laid down in Part IV of AP I concerning the protection of the civilian population against the effects of hostilities. It might be argued that the given dimensions are not meant to be exhaustive and thus that this provision applies to hostilities in any dimension of warfare, space included, that affect the civilian population, individual civilians or civilian objects on land.

It remains to be seen whether the existing rules related to the conduct of hostilities are appropriate to apply to space warfare, if only by analogy. This is, of course, without prejudice to the emergence of other principles and rules through any future State practice in space. To exemplify, this paper will reflect on two important applications of the principles of the LOAC: the protection of the space environment and the law of targeting in space.

X. Protecting the Space Environment during Armed Conflict

The concern of the law of armed conflict for the protection of the environment can be appreciated in two ways: firstly, the LOAC deals with the effect of warfare on the environment; secondly, the LOAC deals with the use of the environment as a means of warfare. Article 35(3) and Article 55 form the direct protection regime of the environment afforded by Additional Protocol I of 1977 and cover the first aspect of the LOAC's interference with the environment.

It is safe to assume that both provisions belong to the body of customary law. The place of Article 55(1) in the section on the protection of the civilian population on land may suggest its application is confined to land warfare. However, Article 35(3) is not so limited and, hence, as one commentator correctly notes, the protection of this provision extends to all types of warfare. That this includes space warfare as well, can be made apparent through the interpretation of 'natural environment', a term which is mentioned in both articles but has been left undefined. As both articles seem to take an ecological approach, the 'natural environment' is commonly referred to as a "system of inextricable interrelations between living organisms and their inanimate environment." The ICRC Commentary explains that "[t]he concept of the natural environment should be understood in the widest sense to cover the biological environment in which a population is living". Another authority asserts that the environment "represents the living space, the quality of life and the very health of human beings, including generations unborn". Bourbonnière comes to the conclusion that if the term is to be understood in the widest sense, "the concept of 'environment' can be interpreted to include the orbits within which there is human presence". To make similar provisions applicable to all orbits around celestial bodies, it should be argued that in the event that future generations may inhabit, or at least be present on or in orbit around celestial bodies, those bodies and orbits should also be covered by the regime protecting the space environment. Though such an interpretation may arguably be justified, it problematically demonstrates the exclusion of the remainder of outer space, in which (unmanned) assets may still be active such as space mines. Ultimately, one should not be surprised if a proposal finds its way to the negotiation table to declare the protection of the environment applicable to the whole of outer space as an area that affects the development of mankind.

The 1977 Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques (generally known as the ENMOD Convention) is concerned with the deliberate manipulation of the natural process. Importantly, the convention is limited only to "military or any other hostile use of environmental modification techniques" (Article I). The treaty is made explicitly applicable to outer space.[62] Nevertheless, the treaty's "utility in the context of space weapons is doubtful", as current space weapon technology is not focusing on deliberately manipulating the natural process. Assuming such technology will be available at a given moment and will be used, the treaty's value cannot be underestimated.

Be that as it may, force application in space will leave its traces during and (long) after armed conflict in the form of space debris. The production of debris in space is not only an environmental issue but, moreover, space debris can have the same effect as a weapon. It would take an enormous, but necessary effort of belligerents to limit the production of space debris to minimize environmental damage and to prevent damage to non-belligerent space assets. A future LOAC in space should reflect this appropriately.

XI. Targeting Issues

For the most widely accepted definition of a military objective today, one has to consider Article 52(2) AP I. This article intends to give effect to the principle of distinction between civilian objects and military objectives contained in Article 48 AP I. Article 52(2) sets out a two-pronged test in order to qualify an object as a military objective. First, a military objective must by its nature, location, purpose or use make an effective contribution to military action. Concerning the 'nature' of a military object, this is established when the object is integrated in the military structure. Objects by 'location' often refer to either a construction located at a strategic point or a designated area as a whole. Interestingly, the latter option could include an orbit. Regarding 'purpose and use', these criteria commonly indicate a dual-use object. Secondly, the objective's total or partial destruction, capture or neutralization, in the circumstances ruling at the time, must offer a definite military advantage.

Then the question arises whether a civilian asset that performs military functions for one or both belligerent parties can be considered a military objective? The question relates to dual-use objects, *i.e.* objects being used both - either simultaneously or alternatively - for military as for civil purposes. The law of armed conflict does not, however, use such a terminology but only speaks of military objectives and civilian objects. These notions are used to the exclusion of the other, although a civilian object may be turned into a military objective. Interestingly, certain means of communication were proposed to fall under Article 52(3), where it is stated that in case of doubt a civil object is presumed to be so used. Satellites, though not explicitly mentioned, play a crucial role in today's communications infrastructure. However, those means failed to be included precisely because of their more likely military use in wartime. This also corresponds to the 'purpose' criterion. The intended future use of an object in space may even, as suggested by Schmitt, be inferred from the execution of a contract dealing with the future acquisition of data from satellite use by the military. Hence, the general rule of Article 52(2) AP I applies. In case an object has a military purpose or use it constitutes a legitimate target, notwithstanding its registration as a civilian space asset.

In addition, there are a number of proportionality issues making targeting a legal labyrinth. The law requires (Articles 51(5)(b) and 57(a)(ii) AP I) weighing the *concrete* and *direct anticipated* military advantage against the *anticipated* loss of civilian lives; the latter must not be excessive in relation to the former. This applies to civilian assets used for military purposes as well as to military assets providing civilian services. Judging the excessiveness may be further complicated by multi-ownership of assets and neutrality issues. Moreover, the obligation to minimize collateral damage includes an assessment of possible damage done to other assets through space debris resulting from an attack. The foreseeable long-term or reverberating effects – except environmental concerns – are, even if identifiable, not considered part of the current legal restraints on targeting, but seem to worry States nonetheless. This can be explained by today's technologically advanced societies, which rely more and more on sophisticated and (civil-military) integrated systems, networks and infrastructures. Yet, these systems often use satellites which, in turn, are likely to be the objectives of belligerents. Attacking these satellites may disrupt and damage large segments of modern day societies (including medical and other emergency response capacities) depending on satellite data and communications.

A further matter that may complicate observance of the LOAC in space warfare relates to the taking of precautionary measures. In land and air warfare, belligerent parties have the obligation to take the required precautionary measures *in* attack (Article 57 AP I) and *against the effects* of attacks (Article 58 AP I). Article 57 obliges *inter alia* to do everything feasible to verify that the objects to be attacked are not civilian objects. Article 58 includes the obligation to separate civilian objects under the control of a party from military objectives. While the former task may be facilitated by the Registration Convention, the latter is complicated by the fact that a rather large portion of space assets are of a dual-use nature, or may be used so. This category of assets makes it virtually impossible to separate the military functions from the civilian ones. Moreover, the possibility cannot be discarded that, one day, space warfare may develop the way naval warfare has developed. That is, merchant shipping and civil spacecraft may support the military effort in space extensively. The San Remo Manual, therefore, opted not to include the obligation to take precautionary measures against the effects of attacks in naval warfare. This arguably demonstrates that more weight is put on the attacking party in taking precautionary measures and is likely to develop into a similar rule for space warfare as well, considering the great number of dual-use assets.

On top of that, if a space asset kills, injures or captures an adversarial asset through the invitation of the confidence leading the enemy to believe that the asset is entitled to, or is obliged to be accorded, protection under the rules of international law applicable in armed conflict, with intent to betray that confidence, it is culpable of perfidy. Let's take, for instance, the feigning of civilian status as explicitly mentioned in Article 37(c) AP I. The example used in this respect by Schmitt concerns that of military asset that is registered as civilian, which provides data to facilitate targeting the enemy. It is thus not its status as civilian *per se* that is perfidious, but an additional act is necessary to constitute perfidy. Schmitt uses the criterion of 'facilitation to attack' to substantiate this point. One should, however, be careful not to stretch the causality issue too much. There still has to be a definite result of either killing, injuring or capturing an adversary as a (direct) result of the perfidious act to fall within the prohibition of Article 37 AP I. An example can be the sending of an illegitimate distress signal by a civil registered but in fact military space asset, upon which an enemy manned military spacecraft comes to the rescue and is caught in an attack from the ‘civilian’ asset, as a consequence of which the crew of the spacecraft gets killed.

XII. Is There an Obligation to Use Space Weapons?

Despite the prohibitions or restrictions of the means and targets in warfare, it should be explored whether certain space weapons would ensure greater compliance with the LOAC than the deployment of other weapon systems and, therefore, whether their use may be not only permissive but even obligatory. As satellites used for military purposes are instrumental to the functioning of a great number of combatants, their neutralization would severely weaken enemy potential. It thus contributes to one of the main purposes of warfare, namely to disable “the greatest possible number of men.” Technological advancement in space weaponry may display increasing compliance with the LOAC through, for instance, precision attacks. Despite the capabilities of certain space weaponry, under the LOAC, there is simply no obligation to use weapons that can carry out precision attacks in every instance. Space weapons cannot and should not be seen as panacea to minimize collateral damage and less so to guarantee zero-casualty warfare. The attacking party has to take the necessary precautionary measures and in doing so it has to match the best means and methods with the military objective. Only if the outcome of the ‘matching’ would require the deployment of space weapons would there be a specific obligation to use them. Thus, if space were to be weaponised, there would not be a general obligation to use space weapons.

XIII. Conclusion

Technological developments and States’ interest in the weaponisation of space call for a legal appraisal of permissible legal activities in space, in particular the use of force. The Outer Space Treaty regulates only partly the non-weaponisation of space through its prohibition of WMD and the non-militarisation norm only applies to celestial bodies. The OST leaves it to other norms to fill the gaps but determines through its differentiated regimes the framework in which other legal sources regulate the use of force. Moreover, space weaponry itself poses a challenge to existing norms. The prohibition on the use of force requires an acknowledgment of this challenge. Such an approach is necessary if the absolute character of the prohibition is to be retained. Another implication of force application in space will be a lawful extension of the powers of the Security Council under Chapter VII of the UN Charter.

Furthermore, the right of self-defence is of major importance to the proper functioning of the UN Charter. The contents of this right have always been contested but seem to face new difficulties when applied to outer space. Additionally, the right of self-defence is affected by the division of regimes in the OST. It clearly does not override just any other legal regime. Demilitarised zones, like those for celestial bodies, are established precisely to further international peace and security. It has thus been argued that this may limit the exercise of the right of self-defence.

Moreover, the precise rules of a law of armed conflict in space or *jus in bello spatiale* are unlikely to emerge in the near future; the law of armed conflict is inherently shaped after a conflict rather than before. Yet, the issues identified take a central place in shaping such a regime, notwithstanding the problems inherent to the use of analogies. The crucial test for such analogies will be their appropriateness in the context of space warfare, though parties to a conflict remain bound by the general principles of international law and the law of armed conflict which are undeniably applicable to the use of force in space as well.

This limited study has highlighted a number of issues likely to be encountered by law-makers and policymakers involved in military space activities. There is an obvious need for these activities to be drawn into the legal sphere. Overall, this work has attempted to demonstrate that, when force application will take place in space and space will be turned into a fourth dimension of warfare, lawyers and policymakers need to rethink existing rules and apply them in the space medium in accordance with the fundamental principles underlying them.

Summary – Résumé – Samenvatting - Zusammenfassung – Riassunto - Resumen

A Legal Exploration of Force Application in Outer Space - Summary

Military use of outer space has been part and parcel of national security strategies ever since the space age began, 50 years ago. Recent developments in technology and military doctrine have shown an increased interest by States in the deployment of force application devices in space. Undoubtedly, military activity in space will only increase in wars to come. Thus, an assessment thereof under international law seems pertinent.

Contrary to common belief, the arms control provisions of the 1967 Outer Space Treaty reserve only celestial bodies to be used for 'peaceful purposes', thereby demilitarising them completely. Conversely, the Treaty does not limit military activities in the space between celestial bodies, the outer void space, except for the prohibition of weapons of mass destruction and the application of general international law, including the UN Charter.

Yet, force application by space weaponry challenges the regime governing the use of force in international relations, the *jus ad bellum*, as spelled out in the Charter on a conceptual and substantive level. Firstly, the concept of 'force' needs to be revisited. Secondly, the differentiated regimes of outer void space and celestial bodies have significant impact on the lawful exercise of the right of self-defence, including the deployment of spatial missile defence shields.

Lastly, a possible *jus in bello spatiale*, a law of armed conflict in outer space, is examined. The analysis focuses on the application of the general principles and the environmental protection regime existing under the current regulation of means and methods of warfare. Additionally, targeting issues under the law of armed conflict are evaluated in view of the characteristics of space assets.

It is concluded that existing rules are profoundly tested, but should, nevertheless, be applied in the space medium in accordance with the fundamental principles underlying them.

Etude juridique de l'application de la force dans l'espace extra-atmosphérique – Résumé

La militarisation de l'espace extra-atmosphérique fait partie intégrante des stratégies sécuritaires nationales depuis le début de l'exploration spatiale, il y a 50 ans. Les dernières évolutions intervenues dans le domaine de la technologie et de la doctrine militaire démontrent un intérêt accru des Etats pour l'utilisation d'armes spatiales. Il va sans dire que les activités militaires dans l'espace ne feront que s'accroître pendant les guerres futures. Il est par conséquent indispensable de procéder à une évaluation de l'usage de la force dans l'espace en vertu du droit international.

Contrairement à ce qui est généralement admis, les dispositions en matière de maîtrise des armements du Traité de 1967 sur l'espace extra-atmosphérique stipulent que les corps célestes seront

exclusivement utilisés à des « fins pacifiques « et qu'ils doivent par conséquent être complètement démilitarisés. Par contre, le Traité n'impose aucune limitation aux activités militaires dans l'espace existant entre les corps célestes, à savoir le vide interstellaire, hormis l'interdiction des armes de destruction massive et l'application du droit international, y compris la Charte des Nations Unies.

Toutefois, l'application de la force par le recours aux armes spatiales met en question les instruments juridiques régissant l'usage de la force dans les relations internationales, le *jus ad bellum*, prévu par la Charte des Nations Unies sur le plan conceptuel et du contenu. Premièrement, il convient de revoir le concept 'force'. Deuxièmement, les différents instruments juridiques concernant l'espace extra-atmosphérique et les corps célestes ont un impact significatif sur l'exercice légal du droit de la légitime défense, y compris le déploiement de boucliers de défense anti-missiles dans l'espace.

Enfin, un *jus in bello spatiale* possible, un droit des conflits armés dans l'espace extra-atmosphérique fait également l'objet d'une étude. L'analyse porte sur l'application des principes généraux et des techniques de protection de l'environnement stipulés dans les nouveaux moyens et méthodes de guerre. D'autre part, la question des objectifs dans le cadre du droit des conflits armés est évaluée à la lumière des caractéristiques des moyens spatiaux.

L'auteur conclut en disant que les règles actuelles de droit international sont fortement mises à l'épreuve mais qu'elles devraient néanmoins être appliquées dans l'espace en conformité avec les principes de base sous-jacents.

Een Juridische Verkenning van Geweldstoepassing in de Ruimte - Samenvatting

Het gebruik van de ruimte voor militaire doeleinden maakt deel uit van het veiligheidsbeleid van ruimtevarende Staten sinds het begin van het ruimtetijdperk, dat zo een 50 jaar geleden begon. De almaar toenemende belangstelling voor het gebruik van ruimtewapens kan mede verklaard worden door de recente ontwikkelingen in ruimtetechnologieën en militaire doctrines. Militaire activiteiten in de ruimte zullen zonder twijfel alleen maar toenemen in de komende oorlogen. Het is daarom noodzakelijk om het gebruik van geweld in de ruimte te toetsen aan het internationale recht.

In tegenstelling tot wat vaak gedacht wordt, behouden de wapenbeperkende bepalingen uit het Ruimteverdrag van 1967 alleen het gebruik van ruimtelichamen voor vredelievende doeleinden voor en deze dienen daarom gedemilitariseerd te zijn. Daarentegen stelt het Ruimteverdrag geen andere grenzen aan militaire activiteiten in de ruimte tussen de hemellichamen, de zogenaamde loze ruimte, dan het verbod op massavernietigingswapens en de toepassing van het internationale recht, waaronder het Handvest van de Verenigde Naties.

Niettemin beproeft het gebruik van geweld het huidige regime dat het gebruik van geweld beheerst, het *jus ad bellum*, zoals vastgelegd in het Handvest op zowel conceptueel als inhoudelijk niveau. Allereerst behoeft het concept 'geweld' een extensievere interpretatie. Ten tweede hebben de verschillende regimes betreffende de loze ruimte en de hemellichamen in belangrijke mate invloed op de rechtmatige uitoefening van het recht op zelfverdediging, inclusief het gebruik van ruimteschilden.

In de laatste plaats wordt een raamwerk voor een humanitair ruimteoorlogsrecht besproken. Hierbij wordt gekeken naar de toepassing van algemene beginselen van het humanitair oorlogsrecht betreffende de middelen en methoden van oorlogvoeren zoals die gevonden kunnen worden in de bepalingen voor de bescherming van het milieu het aanvallen van doelen.

De conclusie die getrokken wordt, is dat de huidige internationaal-rechtelijke bepalingen sterk op de proef worden gesteld, maar dat deze niettemin toegepast kunnen en moeten worden met inachtneming van de aan hen onderliggende beginselen.

Eine rechtliche Erforschung der Gewaltanwendung im Weltraum – Zusammenfassung

Die militärische Nutzung des Weltraums ist ein wesentlicher Bestandteil von den nationalen Sicherheitsstrategien seit dem Anfang der Weltraumära, etwa 50 Jahren her. Die neuesten Entwicklungen in den Weltraumtechnologien und militärischen Doktrinen beweisen das ständig wachsende Interesse der Staaten an der Nutzung von Weltraumwaffen. Militärische Aktivitäten im Weltraum werden zweifelsohne in künftigen Kriegen nur noch zunehmen. Es ist denn auch erforderlich die Gewaltanwendung im Weltraum am internationalen Recht zu prüfen.

Im Gegensatz zu dem, was man allgemein glaubt, bestimmen die Anordnungen zur Rüstungskontrolle aus dem Weltraumvertrag von 1967, dass die Himmelskörper ausschließlich zu friedlichen Zwecken genutzt werden und dass sie deswegen völlig entmilitarisiert werden müssen. Der Weltraumvertrag dagegen, grenzt die militärischen Aktivitäten im Weltraum zwischen den Himmelskörpern, in der sogenannten interstellaren Leere, nicht ein, abgesehen vom Verbot von Massenvernichtungswaffen und von der Handhabung des internationalen Rechts, worunter die Charta der Vereinten Nationen.

Dennoch stellt die Gewaltanwendung mittels Weltraumwaffen das Regime, das die Gewaltanwendung in internationalen Beziehungen regelt, das *jus ad bellum*, wie in der Charta sowohl auf konzeptuellem als auf inhaltlichem Niveau festgelegt wird, zur Diskussion. Zuallererst braucht das Konzept „Gewalt“ eine Revision. An zweiter Stelle haben die unterschiedlichen Regimes bezüglich der interstellaren Leere und der Himmelskörper in wesentlichem Maße Einfluss auf die Ausübung des Selbstverteidigungsrechts, einschließlich der Anwendung von Weltraumschilden.

Zuletzt untersucht man den Rahmen für ein Kriegsvölkerrecht im Weltraum, das *jus in bello spatiale*. Die Analyse konzentriert sich auf die Anwendung der allgemeinen Grundsätze und Naturschutztechniken, die in der heutigen Regelung der Mittel und der Methoden der Kriegsführung bestimmt werden. Auf der anderen Seite evaluiert man die angestrebten Ziele im Rahmen des Kriegvölkerrechts im Licht der Charakteristiken der Weltraumwaffen.

Der Autor folgert, dass die heutigen internationalrechtlichen Anordnungen auf eine harte Probe gestellt werden, aber dass sie trotzdem unter Berücksichtigung der zugrunde liegende Regeln gehandhabt werden sollten.

Analisi sull’uso della forza nello spazio extra-atmosferico – Riassunto

La militarizzazione dello spazio extra-atmosferico fa parte integrante delle strategie di sicurezza nazionale fin dall'inizio dell'esplorazione spaziale, iniziata 50 anni or sono. Gli ultimi sviluppi della tecnologia e della dottrina militare rivelano un crescente interesse degli Stati per l'utilizzo di armi spaziali. Di conseguenza, è probabile che le attività militari nello spazio non faranno che aumentare nel corso delle guerre future, e ciò rende indispensabile stabilire una disciplina giuridica dell’uso della forza nello spazio.

Contrariamente a ciò che si crede, le disposizioni in materia di controllo degli armamenti, contenute nel Trattato del 1967 sullo spazio extra-atmosferico, affermano che i corpi celesti possano essere utilizzati esclusivamente a “fini pacifici”, e che i medesimi debbano essere quindi completamente smilitarizzati. Di contro, il Trattato non impone alcuna limitazione alle attività militari nello spazio intercorrente tra i corpi celesti (il vuoto interstellare), fatti salvi il divieto di uso di armi di distruzione di massa e l’applicazione delle norme di diritto internazionale esistenti, compresa la Carta delle Nazioni Unite.

Ad ogni buon conto, il ricorso alle armi spaziali mette forte in dubbio l’efficacia degli strumenti giuridici che disciplinano l’uso della forza nelle relazioni internazionali (lo *jus ad bellum*, come previsto dalla Carta delle Nazioni Unite), sia sul piano concettuale che contenutistico. Da un lato, difatti, occorrerebbe rivedere il concetto di “forza” nel diritto internazionale; dall’altro, si dovrebbe comunque considerare che i diversi strumenti giuridici che disciplinano lo spazio extra-atmosferico ed i corpi celesti hanno un impatto significativo sull’esercizio del diritto di legittima difesa, compreso lo spiegamento di schermi di difesa anti-missile nello spazio.

Da ultimo, nello studio viene esaminata la possibilità di uno *jus in bello spatiale*, ossia un diritto dei conflitti armati nello spazio extra-atmosferico. L'analisi s’incentra sull'applicazione dei principi generali e delle norme di tutela dell'ambiente oggi esistenti nell’ambito della disciplina dei mezzi e metodi di guerra. Inoltre, vengono considerate talune questioni riguardanti gli obiettivi militari legittimi, alla luce delle caratteristiche dei mezzi spaziali eventualmente impiegati.

Nelle conclusioni, l’autore afferma che, nonostante l’efficacia delle norme di diritto internazionale esistenti siano fortemente messe alla prova dalla specificità dell’ambiente spaziale, tuttavia le medesime regole dovrebbero comunque trovare applicazione nello spazio, in conformità ai i principi di base del diritto dei conflitti armati.

Estudio jurídico de la utilización de la fuerza en el espacio ultraterrestre – Resumen

La utilización militar del espacio ultraterrestre siempre ha sido parte integrante de las estrategias de seguridad nacional desde el principio de la era espacial, hace 50 años. Los recientes desarrollos de la tecnología y de la doctrina militar revelan el interés creciente por parte de los estados en el despliegue de armas espaciales. No cabe duda que las actividades militares en el espacio seguirán aumentando durante guerras futuras. Por lo tanto, se necesita una evaluación de la utilización de la fuerza desde el punto de vista del derecho internacional.

En contra de lo que se suele creer, en materia de control del armamento, el Tratado sobre el espacio ultraterrestre de 1967 (Tratado sobre los principios que deben regir las actividades de los Estados en la exploración y utilización del espacio ultraterrestre, incluso la Luna y otros cuerpos celestes) proclama el principio de utilización de la luna y demás cuerpos celestes con fines exclusivamente pacíficos, y por tanto impone su completa desmilitarización. En cambio, el Tratado no limita las actividades militares en el espacio entre los cuerpos celestes, el espacio vacío interestelar, sino prohíbe de colocar armas de destrucción masiva e impone la aplicación general del derecho internacional, incluso la Carta de las Naciones unidas.

Sin embargo, el recurso a los armamentos especiales pone en tela de juicio los instrumentos jurídicos que rigen el uso de la fuerza en las relaciones internacionales, el *jus ad bellum*, como especificado en la Carta de las Naciones Unidas a un nivel conceptual y substancial. En primer lugar el concepto de ‘fuerza’ necesita una revisión. En secundo lugar, los diferentes instrumentos jurídicos que regulan el espacio ultraterrestre y los cuerpos celestiales tienen un impacto significativo en el ejercicio legal del derecho al auto-defensa, incluso el despliegue de escudos espaciales de defensa contra misiles.

Por último, se examina la posibilidad de establecer un *jus in bello spatiale*, derecho de conflictos armados en el espacio ultraterrestre. El autor analiza la aplicación de los principios generales y las técnicas de protección del medio ambiente establecidos por las reglas que rigen los nuevos medios o métodos de guerra. Además la cuestión de los objetivos está analizada a la luz de las características de los medios espaciales.

El autor concluye que las reglas actuales del derecho internacional se ponen a dura prueba, sin embargo se debería aplicar dichas reglas en el espacio de conformidad con sus principios fundamentales subyacentes.

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