

The Need to Counter Space Terrorism – A European Perspective

Nina-Louisa REMUSS, Project Manager at ESPI

The risk of terrorism spilling over from Earth to space is real and latent. However, the threat of “Space Terrorism” is currently to a large degree neglected by decision-makers. While security studies scholars have come to accept that actors and forms of threats changed after the end of the Cold War, space security studies lag behind this development and analyses the threat from State actors only. There is a need for a revised definition of “security” in space security studies. “Space Terrorism” is a timely topic especially in the light of the recent ESA Council Meeting at Ministerial level, which decided on the introduction of a preparatory programme on Space Situational Awareness (SSA) as well as the U.S.’ discussions on the reform of the U.S. export control system. Given the increased use of space for security purposes through programmes like Galileo and GMES, the upcoming Czech EU Presidency together with the other EU Member States and supported by the European Parliament has to address “Space Terrorism”, through the introduction of effective counter measures to protect satellites.

It is frequently recalled that “Operation Desert Storm” revealed to the world the great U.S. space dependency and the resulting U.S. vulnerability. An adversary with the right expertise could exploit this vulnerability by developing countermeasures against U.S. space-based assets. This exploitation is especially attractive as it could result in a dramatically degrading of efficiency in combat. In this regard China is often discussed as a new Soviet Union,¹ threatening to launch an anti-satellite ballistic missile. While most publications accept that space is the next “high ground”,² they usually refer to States as the main actors and neglect the possibilities of terrorists getting involved in space.³ Claiming that academics, researchers and policy makers neglect the possibility of “Space Terrorism” to a large extent, this essay will show that terrorists

are both motivated and capable of conducting a terrorist attack in space. Countering the argument of fighting weaponisation through weaponisation, it is argued that any space policy needs to be adapted to the new post-Cold War security order.⁴ Given that the EU increasingly intends to use space programmes like GMES and Galileo for security-related purposes, it risks facing similar vulnerabilities as the U.S. Being in the course of developing necessary structures to combine space and security policy, the EU can built in related and necessary provisions right from the start in order to account for the possible threat of space terrorism immediately. In particular, there is a need for the introduction of a counter-terrorism policy for space as well as relevant provisions introducing a common export control regime within the EU and a Space Situational Awareness (SSA) System.

Re-defining “Security”

The fall of the Iron Curtain as well as events as 9/11 in 2001, the Madrid and London bombings of 2004 and 2005 and the tsunami disaster of 2004 led to a re-thinking of the traditional perception of “threats” and “security”. According

¹ cf. as in Baum, Lt Col Michael E. “Defiling the Altar the Weaponization of Space”. Air Power Journal Spring 1994. <www.airpower.maxwell.af.mil/airchronicles/api/api94/spr94/baum.html>.

² cf. Fjetland, Michael. “Next: Space Terrorism?” 2003. 1 Sept. 2008. <www.borrull.org/e/noticia.php?id=21388>., who also only refers to States when discussing different options of weaponisation in space.

³ As in Chun, Clayton K. S. “Striking Out to Space. Technical Challenges to the Deployment of ASAT Weapons.” New Challenges in Missile Proliferation, Missile Defense, and Space Security. Ed. James Clay Moltz. Monterey Institute of International Studies: July 2003. 24, who only refers to countries when discussing options for satellite interference.

⁴ Thomson, Allen. “Satellite Vulnerability: a post-Cold War issue?” Space Policy 11 Febr. 1995: 19-30.

to the Cold War security perception, threats are actors focused and the classical threat is an armed attack by another State.⁵ As economic integration and military rationality proceeded, this purely territorial perception was overcome, and security became part of an enlarged concept in which defence played only a minor role. Consequently, “functional security” as a concept came to oppose traditional territorial security. Accordingly, there was no longer one external threat but instability and disintegration due to ethnic and religious conflicts inside non-democratic countries with ruined economies, so-called “failed States”. New threats are no longer only coming from other States but from non-State actors as well. Additionally, one can observe an ever accelerating pace of technological advancement, which places capabilities formerly considered to be “advanced” in the hands of non-State actors, thus making Space Terrorism, i.e. terrorists using space assets for their own purposes or destroying them, possible. As a response to the “new” threats and the re-defined perception of security, the way security is provided has to be adapted as well. As a result the structures of international military and security relations have been transformed, changing from bipolarity to multi-polar politics, making international cooperation in this policy domain more common.⁶

Space policy studies lags behind security studies in not accounting for new threats like space terrorism and thus needs to adapt to the new post-Cold War security order.

While security studies have undergone a broadening by considering non-military security threats as well (e.g. environmental scarcity, degradation, terrorism and nuclear catastrophe), space security studies is lagging behind in this regard. By focussing on what happened instead of finding out what did not happen, one loses the opportunity to shed light on possible future attacks. Counter-terrorism experts often referred to foresight and the unfamiliar as crucial points, i.e. anticipation

rather than reaction, when trying to win the cat-and-mouse game that can be associated with the fight against terrorism.⁷

Space Terrorism: Motives

Having surveyed the changed context for space security after the end of the Cold War, this section will deal with the motives and characteristics of terrorism in order to draw some conclusions on if and why terrorists would attack engage in space terrorism.

While there is still no universal definition for the term “terrorism”, this essay relies on the following working definition:

the deliberate creation and exploitation of fear through violence or the threat of violence in the pursuit of political change (...) specifically designed to have far reaching psychological effects beyond the immediate victim(s) or object of the terrorist attack.⁸

While suicide is often referred to as “the main weapon”, it is according to counter terrorism experts rarely the first choice but is rather used when other ones fail. The method is a means of achieving an effect and not an essential requirement of the destructive act. Thus, terrorist groups might use any method as long as it is easy to acquire and useful to achieving mass casualties and/or a lasting psychological effect.⁹

Targets are usually chosen with regard to the accomplishment of a symbolic purpose and there is thus an open-ended category of targets. While specialists agree that terrorists’ operations and tactics reveal a remarkably low degree of innovation in contrast to a very high

⁵ Varwick, Johannes and Woyke, Wichard. Die Zukunft der NATO. Transatlantische Sicherheit im Wandel. 2nd Edition. Augsburg: Leske + Budrich, 2000. 127; Sundelius, Bengt. “Disruption - Functional security for the EU.” Disasters, Diseases, Disruptions: a new D-drive for the EU. Chaillot Paper No. 83. Ed. Antonio Missiroli. Paris: Institute for Security Studies, 2005. 68.

⁶ Varwick, Johannes and Woyke, Wichard. NATO 200. Transatlantische Sicherheit im Wandel. Augsburg: Leske + Budrich, 1999. 31; Sundelius, Bengt. op. cit. 68.; Thomson, Allen. op. cit. 19-30; David Held and Anthony McGrew, op. cit., p.222.

⁷ Hoffman, Bruce. “Rethinking Terrorism and Counterterrorism Since 9/11”. Studies in Conflict & Terrorism Vol. 25: 2002. p.311; Hoffman, Bruce. Inside Terrorism. New York: Columbia University Press, 2006. 24; Schilling in Gormley, Dennis M. “UAVs and Cruise Missiles as Possible Terrorist Weapons”. New Challenges in Missile Proliferation, Missile Defense, and Space Security. Ed. James Clay Moltz. Monterey Institute of International Studies: July 2003. 7.

⁸ Hoffman, Bruce. Inside Terrorism. New York: Columbia University Press, 2006. 40. Alex P. Schmid discusses more than one hundred different definitions of terrorism, trying to offer a reasonably comprehensive explication of the word, cf. Schmid, Alex P. Political Terrorism: A Research Guide. New Brunswick, N.J.: Transaction Books, 1994. For another discussion on the definitional question of terrorism cf. Laquer, Walter. The Age of Terrorism. London: New Brunswick, N.J.: Transaction Books, 2001.

⁹ Crenshaw, Martha. Terrorism in Context. Pennsylvania: Pennsylvania State University Press, 1995; Bloom, Mia. Dying to Kill: The Allure of Suicide Terror. New York: Columbia. Chapter 1; Gormley, Dennis M. op. cit. 7.

degree of imitation, foresight is crucial in contingency planning.¹⁰

It is feasible that terrorists will look for new targets and strategic methods to achieve their objective of mass casualties and long-lasting psychological effects.

Policy makers need to put themselves in their shoes to foresee new terrorist methods.¹¹ A terrorist-launched cruise missile would be quite a promising prospective for terrorists.¹² Given the great space dependency link of e.g. the U.S., satellites or space-based assets provide quite a potential target.

Articulating Space Terrorism: The Spectrum of Possibilities and Capabilities

U.S. Undersecretary of State Robert Joseph warned an audience at the George C. Marshall Institute about terrorist attacks on U.S. space assets on 12 December 2006.¹³ This is in line with Nicolas Peter's account in the 2006 / 2007 Yearbook on Space Policy, arguing that one can observe an increasing capability and role played by transnational actors in interfering with space assets.¹⁴ Apart from taking advantage of the existing dual-use capabilities including satellite navigation, high resolution imagery and digital mapping technologies for mission planning,¹⁵ there are three categories of "Space Terrorism".¹⁶ (1) measures against satellites¹⁷, (2) attacks on launch facilities and attacks on ground stations and (3) attacks on the

user/service equipment.

The most direct way to eliminate a satellite is to destroy it. However if the objective is just to stop an operator from benefiting from its access to satellites, there are several options: disruption, denial, degradation, and deception of the space system in question. Satellite vulnerability varies according to the satellite's purpose. Different instruments have different vulnerabilities.¹⁸ Military systems are better protected than commercial satellites, but the latter are increasingly used for military purposes as well.¹⁹

In the past a series of jamming and piracy events occurred in the commercial satellite sector. First, the mobile satellite communication signal provided by Thuraya Satellite Telecommunications from three widely-separated locations inside Libya was jammed. Secondly, Sri Lanka's Tamil tigers (LTTE) hijacked the Intelsat Ltd. Intelsat-12 satellite in geosynchronous orbit to beam their propaganda across the Indian subcontinent. While Intelsat continuously tried to interrupt LTTE's pirating, LTTE was able to continue its satellite piracy for 2 years. Thirdly, two similar events happened in China, where China's Falun Gong spiritual movement in June 2002 overrode the broadcast signals of nine China Central Television stations and 10 provincial stations and replaced the programming with their content and in 2004 disrupted AsiaSat signals for four hours.²⁰ Those are only some recent examples.

The first step towards attacking a satellite is by tracking it. Already in the 1950s the "Moonwatch Program" as well as the Kettering Group proved that this required only a minimal technology approach: amateur satellite observers used stopwatches, sky maps, personal computers and sometimes binoculars to determine satellites' orbital elements. Hence, tracking can be done using common and inexpensive electronics with minimal training. This is in line with U.S. Undersecretary of State Robert Joseph's concern about non-governmental satellite observers tracking satellites and posting their orbits on the internet,

¹⁰ Juergensmeyer, Mark. *Terror in the Mind of God. The Global Rise of Religious Violence*. London: University of California Press, 2000. 14; Hoffman, Bruce. *Inside Terrorism*. New York: Columbia University Press, 2006. 230; Simpson, Bruce. "A DIY Cruise Missile - Answers to Frequently Asked Questions". Updated: July 2003. 01 Sept. 2008. <<http://www.interestingprojects.com/cruise missile/faq.shtml>>.

¹¹ Easterbrook, Gregg. "The All-too-Friendly-Skies as an afterthought." How did that happen? *Terrorism and the New War*. Eds. Gideon Rose and James F. Hoge Jr. Council on Foreign Relations, 2001. 24.

¹² Simpson, Bruce. op. cit.

¹³ Joseph, Robert. "The U.S. National Space Policy". Washington D.C.: The George C. Marshall Institute, 2006. 5. <<http://www.marshall.org/article.php?id=481>>.

¹⁴ Peter, Nicolas. "The security dimension." *Yearbook on Space Policy 2006 / 2007 – New Impetus for Europe*. Eds. Kai-Uwe Schrogl, Charlotte Mathieu and Nicolas Peter (eds.). Vienna: Springer, 2008. 70.

¹⁵ Gormley, Dennis M. op. cit. 3-9.

¹⁶ Given the lack of mass casualties resulting from an attack on astronauts this possibility will be neglected for now.

¹⁷ Today, satellites are the main focus of military space activities. During the 2004 Iraq war 68% of munitions were satellite guided. Parliamentary Office of Science and Technology. "Military Uses of Space." Postnote Dec. 2006, 273. 1.

¹⁸ Chun, Clayton K. S. op. cit. 24; Daly, John C. K. "LTTE: Technologically innovative rebels". *Security Watch* 5 June 2007. 1 Sept. 2008.

<www.isn.ethz.ch/news/sw/details_print.cfm?id=17696>.

¹⁹ In operation "Iraqi Freedom", commercial satellites provided 80% of U.S. data, compared to only 45% in "Desert Storm". Parliamentary Office of Science and Technology. op. cit. 4.

²⁰ Daly, John C. K. op. cit.; Peter, Nicolas. op. cit. 70; Space Security Summary 2008. Ontario: Project Ploughshares, 2008. 20.

which can possibly be used by terrorist organizations.²¹ Internet research actually proves that the amateur community²² maintains orbital elements for most classified U.S. vehicles in Low-Earth Orbit (LEO). Their identified missions can be derived from press stories and supplemented by an analysis of orbits and visual appearance. Geostationary Orbit (GEO) is intrinsically more difficult to monitor because of the much greater ranges involved but applicable technology is evolving rapidly, making an accurate SSA necessary.²³

Once the target is tracked, there are various possibilities of attacking it. The method and efficiency of interfering with a satellite depends to a large degree on the orbit, physical conditions and purpose of a satellite. In general, satellites in GEO are far more difficult to attack (and for the same reasons to defend) but also far more attractive, with most military assets²⁴ being positioned in GEO, thus crippling any kind of military operation.²⁵

The first category and at the same time the simplest possibility to interfere with a satellite is electronic interference, i.e. jamming or spoofing the satellite's signal, its up- or down links. Jamming, referring to disrupting communication with a satellite by overpowering the signals sent to or from the satellite "by using a signal at the same frequency and higher power", is as simple as a "meaningless noise", drowning out the real signal at the receiver, thereby leading to malfunctioning on a temporary or permanent basis.²⁶

Spoofing in contrast is a way of mimicking the

characteristics of a true signal so that users receive fake signals instead of a real one. Spoofers and jammers have to be in the area of the space asset to be attacked and are thus comparatively easy to track. In this regard one could also think about cyber-terrorism as a form of space terrorism as terrorists could launch an information attack on either the satellite's command, control or communication network by introducing a computer virus, thereby degrading or possibly destructing the satellite.²⁷

A second category are laser attacks on satellite sensors. This could be either a direct energy weapon, interfering or damaging the satellite sensor, dazzling by swamping a satellite's optical sensor with light that is brighter than what it is trying to image or partial blinding, i.e. sufficiently high intensities laser light which permanently damages the sensors of imaging satellites. In addition to that laser can melt material or fragile electronic connections just as it can produce thermo-mechanical stresses and structural damage.²⁸

Thirdly, one can think of direct ascent weapons, direct energy weapons, orbital weapons and direct energy beams, aiming at destroying the satellite as a whole. Such ASATs however require several elements to accomplish their mission successfully:

- 1) need for a reliable booster system with a sufficient payload capacity;
- 2) the type of target and booster affect the choice of delivery system;
- 3) requires extensive maintenance and crew training;
- 4) an exhaustive system of surface, aerial and space-based surveillance and tracking system
- 5) needs a means to intercept its target to place it within an effective range of its weapon;
- 6) need for sufficient 'kill' capability to disable or destroy the target,
- 7) ability to determine if target has been rendered useless or requires another attack.

A permanent damage to satellites might lead to secondary damages as other space objects or even astronauts could be hit and damaged by debris, thus leading to a cascading effect as new collisions create more debris.²⁹

²¹ Joseph, Robert. "The U.S. National Space Policy". Washington D.C.: The George C. Marshall Institute, 2006. 5. <<http://www.marshall.org/article.php?id=481>>.

²² cf. Gunter's Space Page: <<http://www.skyrocket.de/space/space.html>>. ; Real Time Satellite Tracking: <<http://www.n2yo.com/database/>>.

²³ Caton, Jeffrey. "Joint Warfare and Military Dependence on Space – Retaining the current international character of space will remain critical to achieving national security goals." July 1994. 1 Sept. 2008. <www.fas.org/spp/eprint/LSN3APP2.htm>. ; Thomson, Allen. "Satellite Vulnerability: a post-Cold War issue?" Space Policy 11 Feb. 1995: 19-30.; Thomson, Allen. op. cit. 19-30.

²⁴ Mainly communication satellites reside in GEO, reconnaissance satellites are located in LEO.

²⁵ Dinerman, Taylor. "Hybrid wars and satellite vulnerabilities". The Space Review 13 March 2006. 1 Sept. 2009. <www.thespacereview.com/article/574/1>.

²⁶ Wright, David, Laura Grego and Lisbeth Gronlund. "The Physics of Space Security: A Reference Manual." Cambridge, American Academy of Sciences: 2005. 118; Chun, Clayton K. S. op. cit. 24, 26. According to the most recent account on trends in space in Space Security Summary 2008. op. cit. 22, jamming capabilities are proliferating.

²⁷ Ibid.; Chun, Clayton K. S. op. cit. 25.

²⁸ Wright, David, Laura Grego and Lisbeth Gronlund. op. cit. 123-5; 128 & 134.

²⁹ Caton, Jeffrey. op. cit.; Chun, Clayton K. S. op. cit. 25.

The fourth and probably most destructive possible measure against satellites is a nuclear explosion at an altitude of 250 kilometres in LEO, creating an intense electromagnetic pulse (EMP) and destroying all unshielded satellites in line of sight of the explosion. In addition to that, the radiation environment would make communication between high altitude satellites and their ground station difficult if not impossible for months or years. Given the effectiveness of an EMP attack this would probably be the method terrorists would favour, provided that they had a nuclear weapon and a medium-range missile to launch it.³⁰

"[T]he biggest space targets for terrorists [who want to disrupt satellite operations] are here on Earth"³¹ in the form of ground stations, industrial sites and critical individuals. Equipment and tactics required for attacks on launch facilities and ground stations from outside or even from inside are readily available. Instead of destroying the communication link between satellite and ground station as discussed earlier, one could simply damage or destroy the ground station. The majority of commercial space systems have only one operations centre and one ground station, leaving them extremely vulnerable to attacks. However, damage to a ground station can be repaired, a damaged satellite not.³²

A series of attacks could result in an incapability of armed forces or mass panic: starting with the blinding of a signal intelligence satellite, which in turn will be unable to indicate the destruction of a military communication satellite, leading to an incapability to monitor any battlefield, being followed by a destruction of the available launch facilities, making the replacement of the destroyed satellite impossible.³³ Hence, terrorists can achieve their main objectives of mass casualties and long-lasting psychological effects by engaging in space terrorism.

In addition to a State producing and furnishing a terrorist group with an anti-satellite weapon

(ASAT),³⁴ the development of a delivery system by a terrorist group on its own through conversion of either an anti-ship cruise missile or a small airplane³⁵ or by building a cruise-missile themselves³⁶ is also feasible. While the lack of advanced mechanical and engineering experience, difficulties in acquiring or producing an appropriate WMD payload as well as problems in developing the delivery system and getting it in the right launch position are often cited as the main obstacles for space terrorists to develop their own ASATs, technological hurdles can be overcome with the help of workers for hire³⁷ and launching problems could be solved by acquiring a small satellite launcher, which after certain modifications would be suitable for launching anti-satellite weapons.³⁸

The Need for a Counter-Terrorism Policy for Space

Given that the threat of "Space Terrorism" is real and latent, policy makers need to develop a counter-terrorism policy for space. From a theoretical standpoint, a counter-terrorism policy, aiming at protecting and maintaining liberal democracy and the rule of law, can be divided into three main strategies:

- (1) the Political Pathway,
- (2) the Military Solution also known as the War-Model and
- (3) the Criminal-Justice Model, which has in the past been favoured by the EU.³⁹

The Political Pathway Model which argues that terrorism can best be countered by addressing its motives politically and diplomatically, is rarely used due to the problem of distinguishing root causes and sustaining factors.

Applying the Military Solution or War-Model to space, i.e. involving the military in fighting

³⁰ Wright, David, Laura Grego and Lisbeth Gronlund. op. cit. 138-9; Chun, Clayton K. S. op. cit. 26.

³¹ Dinerman, Taylor. op. cit.; for a similar line of argumentation cf. Space Security Summary 2008. op. cit. 22.

³² Wright, David, Laura Grego and Lisbeth Gronlund. op. cit. 133-4; Caton, Jeffrey. op. cit.; Space Security Summary 2008. op. cit. 20.

³³ For a similar account cf. Baum, Michael E. Lt. Col. "Defiling the Altar – The Weaponization of Space." *Airpower Journal* (Spring, 2004). 02 Sept. 2008 <www.airpower.maxwell.af.mil/airchronicles/api/api94/spr94/baum.html>.

³⁴ An example would be Iran furnishing Hezb'allah with the necessary equipment.

³⁵ There is also the possibility of purchasing a complete flight management system, which is at present not subject to export controls. Gormley, op. cit. 7

³⁶ Bruce Simpson who proved with his Do-It-Yourself cruise-missile Project documented on the internet that virtually any person or group with the necessary knowledge and skills can build a simple, autonomous and self-guided missile. cf. <<http://www.interestingprojects.com/cruisemissile>>.

³⁷ as shown by the NPO Energomash, which lost much of its experienced staff in September 1993, cf. Caton, Jeffrey. op. cit.

³⁸ Gormley. op. cit. 6-7; Dinerman, Taylor. op. cit.

³⁹ Wilkinson, Paul. *Terrorism and the Liberal State*. London: The MacMillan Press Ltd., 1977. 121; cf. Pedahzur, Ami and Magnus Ranstorp. "A Tertiary Model for Countering Terrorism in Liberal Democracies: The Case of Israel." *Terrorism and Political Violence* 13.2 (2001): 1-26.

terrorism including the use of weapons as one element to protect space assets, it would in consequence lead to a weaponisation of space approach.⁴⁰ This could consist of the introduction of a defensive system, destroying ASATs, i.e. a simple rocket-propelled explosive or kinetic device or the positioning of defensive satellites near high-value systems using active measures for eliminating attacking ASAT weapons.⁴¹ The protection of satellites by other satellites for space surveillance, while increasing the security for the actor employing them, raises concerns for the security of other actors in space. Moreover, space-based protection capabilities could be defeated by a determined attacker.⁴² This is why a future counter-terrorism policy for space has to refrain from including dual-use technologies (i.e. small manoeuvrable satellites for inspection, which can be used as space weapons).

Space-terrorists lacking any space assets cannot be deterred through space-based weapons.

In line with deterrence theory,⁴³ it is claimed that the development of ASATs reduces the possibility of one's own space assets being attacked. Yet, this does not hold for the field of space. While according to the theory more weapons lead to more security and stability in the world order,⁴⁴ terrorists do not need to possess space assets to be a space threat and can thus interfere with the world order without fearing deterrence. Destroying an attacker's satellites in retaliation for the loss of space assets is infeasible if the attacker, i.e. the terrorist, does not operate satellite systems. Apart from that, deterrence leads to radical escalation and severe moral condemnation from the world community⁴⁵ and is contrary to the idea of the peaceful use of outer space.

The Criminal Justice Model involves the investigation of terrorist crimes in order to bring the individuals involved to justice using the police and judiciary of the country where the

incident took place. Translated to space, this means involving the criminal justice infrastructure of the country whose space system was attacked. Apart from the general application problems, i.e. the need for an independent judiciary and police, the choice of the country to deal with the case is complicated especially in case of cooperative space systems or more than one system being under attack. In addition to that the Criminal Justice Model is too elastic⁴⁶ allowing for democracies to deviate from the rule of law and democratic standards by introducing special anti-terror legislation.

Having surveyed the three possible Counter-Terrorism approaches, it becomes clear that no single approach will make an effective counter-terrorism policy, especially not in space. Thus policy makers have to come up with a combination of the three approaches, as each type of measures only addresses part of the problem.⁴⁷ Such a Counter-Terrorism Policy for Space has to include provisions on disarmament in line with the peaceful use of outer space negotiation outcome just as it has to involve a common European export control regime, aiming at achieving transparency in the transfers of conventional arms and dual-use goods and technologies,⁴⁸ seeking international notifications for all equipment, systems and specially designed components that would enable airplanes to be converted⁴⁹ into ASATs. Moreover, policy makers need to focus on international cooperation in counter-terrorism in space instead of taking individual steps. An EU Counter-Terrorism Policy for Space could provide a building block for an internationally coordinated effort.

Protective Measures

Once they have agreed on a counter-terrorism policy for space, policy makers have to think about detailed protective non-military measures and survivability planning for defending system functions. This requires considerations of the system architecture as a whole.⁵⁰ In this regard, the first step is an analysis of the space dependency link, including an evaluation of the space system's vulnerability. The space dependency link is based on three criteria:

⁴⁰ According to the Space Security 2008 Index, the U.S. continues to pursue a space-based satellite protection and is thus favouring the military approach. Cf. Space Security Summary 2008. op. cit. 21.

⁴¹ Chun, Clayton K. S. op. cit. 26; Thomson, Allen. op. cit. 19-30.

⁴² Space Security Summary 2008. op. cit. 21.

⁴³ The deterrence theory is often discussed in the context of nuclear weapons. cf. Sagan, Scott D. and Kenneth N. Waltz. *The Spread of Nuclear Weapons – A Debate Renewed*. New York / London: W. W. Norton & Company, Inc., 2003.

⁴⁴ Sagan, Scott D. and Kenneth N. Waltz. op. cit. 49.

⁴⁵ Thomson, Allen. op. cit. 19-30; Caton, Jeffrey. op. cit.

⁴⁶ cf. Crelinsten, Ronald D. & Alex P. Schmid. *Western Responses to Terrorism*, London: Frank Cass, 1993.

⁴⁷ Pillar, Paul. *Terrorism and U.S. Foreign Policy*. Washington D. C.: THE BROOKINGS INSTITUTION, 2003. 29.

⁴⁸ The U.S. issued in 2003 a proposal to the Wassenaar Arrangement.

⁴⁹ Gormley, Dennis M. op. cit. 8.

⁵⁰ Thomson, Allen. op. cit. 19-30.

- (1) the types of space systems in use;
- (2) the extent of space system application; and
- (3) enemy means to affect system performance.

Afterwards, one needs to evaluate the possible ability to influence these criteria by both national as well as terrorist forces. This way after having assessed all elements of a system for vulnerability, one can provide survivability measures. Given that the space dependency link varies among States, the threat scenario resulting from an attack on space assets varies accordingly. Thus, survivability and protective measures as well as emergency plans including a particular institutional set-up have to be adapted to the vulnerabilities as depending on the space dependency link but also have to include international cooperation. In order to reduce the space dependency link, military personnel needs to be trained to identify emergencies and practice “alternate means of conducting operations which normally include space dependency links”.⁵¹

Protective Measures depend on the space dependency link and the resulting system vulnerabilities and aim at preserving the functions of the system.

Taking a look at the functions performed by satellites as well as their operational environment, threatened States might be able to exploit any potential for rapid change and surprise to confuse terrorists. The objective of any survivability strategy should be to make satellites hard to find, hard to hit or hard to kill. As a long-term strategy, aiming at decreasing the space dependency link, designers could allocate satellite capability to a distributed network rather than to a few satellites, thus reducing reliance on any single satellite. One could also think about spare satellites to replace lost ones as well as the development of a capacity for quick-response launches.⁵² The need for rapid replacement however would ask for smaller satellites as well as survivable and flexible launch systems. Alternatively, satellites could be placed in deep-space storage orbits in order to manoeuvre them down as needed, however operational and budgetary impacts could be a major obstacle.⁵³

⁵¹ Caton, Jeffrey. op. cit.

⁵² A closely related initiative is the U.S.’ Operationally Responsive Space effort, aiming at smaller satellites and smaller boosters cf. National Security Space Office <<http://www.acq.osd.mil/nssso/ors/ors.htm>>.

⁵³ Thomson, Allen. op. cit. 19-30. cf. Space Security Summary

In order to make tracking and interception difficult, system designers and planners can adapt the size and position of satellite segments in non-traditional ways just as they could use material making hiding behind a wall of radar reflective material possible. The use of decoys or replicas would also be an option. While manoeuvring is often mentioned as the best strategy, it is of little use when there are only a few minutes from ground operators to observe an ASAT launch. Additionally, the large majority of active satellites have no manoeuvring capability.⁵⁴

Electronic and laser attacks could be countered by hardening of the exposed surfaces, building in redundancy and deploying a protective shield against the laser light, as long as it does not unreasonably compromise overall system design.⁵⁵ Additionally relevant authorities should take up several precautions for ground stations and launching facilities such as screening the employees’ backgrounds, making sure that critical personnel understand that they could be targeted and that they know how to recognize the signs and making plans to transfer the ground stations to another facility in case of emergency. Communication links and ground stations can also be protected by employing shielding and directional antennas or burst transmissions, the latter being unique to military systems and among the capabilities of more technically advanced States.⁵⁶ Given the increasing military dependence on commercial satellites, there is a need to create market incentives for the protection of commercial satellites.⁵⁷ Responses to attacks on military and commercial satellites will probably vary depending on the individual space dependency link, the geopolitical position of the State attacked and the overall counter-terrorism strategy. Europe needs to develop its own identity and strategy in this regard.

In Need for European Solutions

The analysis above has elaborated on the spectrum of possibilities for attacking a space system and provided countermeasures as well

2008. op. cit. 22. for a detailed description on the current state of progress in the field of responsive space systems.

⁵⁴ Chun, Clayton K. S. op. cit. 26. Caton, Jeffrey. op. cit.; Chun, Clayton K. S. op. cit. 25-6; International Academy of Astronauts. Cosmic Study on Space Traffic Management. Paris: IAA, 2006. 11.

⁵⁵ Thomson, Allen. op. cit. 19-30.; Wright, David, Laura Grego and Lisbeth Gronlund. op. cit. 134.; Caton, Jeffrey. op. cit.

⁵⁶ Dinerman, Taylor. op. cit.; Space Security Summary 2008. op. cit. 20.

⁵⁷ Parliamentary Office of Science and Technology. op. cit. 4, 21.

as policy recommendations in order to decrease the space dependency link and the resulting vulnerabilities. In this regard it is important to provide economic incentives to increase protective measures for commercial satellites, which are increasingly militarily used. These protective measures should be taken as a basis for a new EU Counter-Terrorism Policy for Space, which should be part of the existing structures of the European Space Policy (ESP).⁵⁸ Additionally, the EU Counter-Terrorism Policy needs to take the possibility of Space Terrorism into account.

Moreover, most of the necessary protective and preventive measures would require a SSA system, which is the necessary basis for a satellite warning service including the training of operating staff to take effective measures. It would also help to maintain information on manoeuvring and launching of space assets. Given that space surveillance can support both protection and negation activities, it is of great importance to incorporate transparency measures in the collection and use of space surveillance data in order to guarantee a positive contribution to the security of outer space.⁵⁹

The EU has to take the lead in introducing counter-terrorism measures for space as part of a European Space Security Strategy.

Both the ministers of the ESA Member States, who gathered in November 2008 to discuss the course of Europe's space programme in the context of the ESA Council at Ministerial Level as well as the upcoming and following EU Presidencies together with the European Parliament, which is actively involved in the debate on space security, have to take the threat of "Space Terrorism" into account and start introducing the necessary measures, including SSA and a European Export Control System for dual goods, to counter it. The Czech EU Presidency has to make use of the momentum created by the renewed debate on the peaceful use of outer space and the resulting increased awareness on space security matters under the last presidencies. While discussing the EU's proposal on a Code

of Conduct for the peaceful use of outer space, the Czech EU Presidency has the opportunity to point to the threat of "Space Terrorism". Thereby it clearly has to emphasise that countering "Space Terrorism" through space-based weapons is not an option as it is contrary to the idea of a peaceful use of outer space.

Individual EU Member States' threat perception and perceived urgency may vary as a result of varying degrees of the space dependency link, national history, previous experiences with terrorism, national demographics, specific national characteristics (i.e. political strengths and weaknesses), the importance of bilateral relations as well as historical legacies (i.e. mistrust), budget constraints, intricacies of each country's national security system, technological development as well as strategic choices.⁶⁰ In particular, threat perceptions among the U.S. and Europe vary. Thus their policy choices will vary, thereby taking into account the specific role of the U.S. and Europe on the international scene. Threat perception influences the choice of counter-terrorism-instruments and affects the energy and resources dedicated to counter-terrorism.⁶¹ Research on the possible effects resulting from a terrorist attack on European space assets has thus to be conducted in order to contribute to an increased awareness of the threat of "Space Terrorism".

In order to achieve the best possible outcome, European governments need to focus on European cooperation instead of taking individual steps. An increased European cooperation and at a later stage increased international cooperation, will reduce any terrorist's motivation to engage in "Space Terrorism". With no single country, operating a

⁵⁸ cf. Rathgeber, Wolfgang. The European Architecture for Space and Security. ESPI Report 13. Vienna: European Space Policy Institute, 2008. 1 Oct. 2008. <http://www.espi.or.at/images/stories/dokumente/studies/espi_report_13.pdf>.

⁵⁹ Thomson, Allen. op. cit. 19-30; Space Security Summary 2008. op. cit. 23-4.

⁶⁰ Cardona, Meliton. "The European Response to Terrorism." Western Responses to Terrorism. Eds. Crelinsten Ronald D. and Alex P. Schmid. op. cit. 249; Crelinsten Ronald D. and Alex P. Schmid. op. cit. 308-9; Linde, Erik J. G. van de, et al. Quick Scan of Post 9/11 National Counter Terrorism Policymaking and Implementation in Selected European Countries. Leiden: RAND Europe, 2002. 4 & 13; Hippel, Karin von. Europe Confronts Terrorism. New York: Palgrave Macmillian, 2005. 9 & 11 & 266; Grabbe, Heather. "Breaking new ground in internal security." Europe After September 11th. Eds. Edward Bannerman et al. London: Centre for European Reform, 2001. 67; Adrich, Richard J. and Wyn Rees. "Contending Cultures of Counterterrorism: Transatlantic Divergence or Convergence?" International Affairs 81, 5 (2005): 907.

⁶¹ Sundelius, Bengt. "From National Total Defense to Embedded Societal Security." Protecting the Homeland: European Approaches to Total Defence and Societal Security and Their Implications for the United States. Eds. Daniel Hamilton, Bengt Sundelius and Jesper Grönvall. Washington D.C.: Center for Transatlantic Relations, 2005. 3; Hippel. op. cit. 12; Cardona. op. cit. 249; Adrich and Rees. op. cit. 907.

certain satellite, it becomes more difficult to target a particular State. For the same reasoning, through the allocation of a single task to more than one satellite, one can lower the motivation for terrorists while at the same time diminishing the effect of a possible terrorist attack in space.

Europe should avoid duplicating the problems and vulnerabilities of the U.S. and shall instead immediately build in the necessary protective and preventive measures in a newly evolving and developing structure. In this regard the EU through its Presidencies supported by the European Parliament and national governments should take the opportunity of taking the lead and bringing about a sample case in which other States might join later.

In line with the European Security Strategy (ESS), mentioning terrorism as a key threat and the EU's Counter-Terrorism Strategy, a common European approach to countering "Space Terrorism" would add value by strengthening national capabilities, developing a collective capability and promoting international partnerships.⁶²

A future European Space Security Strategy (E3S)⁶³ should thus include a section on "Space Terrorism". Europe is already "recognised as an important contributor to a better world" and should thus continue to rise to new challenges like Space Terrorism.⁶⁴

⁶² Council of the European Union. The European Union Counter-Terrorism Strategy. 14469/4/05 REV 4. 30 Nov. 2005.

⁶³ IFSH and ESPI. "In need for a European Space Security Strategy (E3S)." Joint memorandum by IFSH and ESPI. 2007. 24. Nov. 2008.
<<http://www.espi.or.at/images/stories/dokumente/studies/memorandum%20on%20e3s.pdf>>.

⁶⁴ Council of the European Union. "Report on the Implementation of the European Security Strategy – Providing Security in a Changing World." S407/08 Brussels: Council of the European Union, 11 Dec. 2008.



Palais Fanto
Schwarzenbergplatz 6
(Entrance: Zaunergasse 1-3)
A-1030 Vienna, Austria
Tel +43 1 718 1118 -0 / Fax -99

www.espi.or.at

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