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SPACE SITUATIONAL AWARENESS: KEY TO A NEW SPACE SECURITY ARCHITECTURE

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ABSTRACT: This paper advocates an international space situational awareness (SSA) network as an initial key measure for confidence building and transparency. An internationally networked, cooperative SSA system can become the starting point for regulation on space traffic rules and management and, potentially, arrangements on the prevention of the weaponization of outer space (PAROS). The ultimate goal is to establish a regulatory framework for space security, which is more detailed and precise than the existing principles of the Outer Space Treaty. This paper discusses the current state of policy and law in the field of debris and PAROS in the United States and the European Union, the technical and policy background of SSA and conflicting SSA requirements of military and civilian applications.

1. THE CURRENT STATE OF POLICY AND LAW

The security and safety situation in outer space is changing. New incidents and players, like the Chinese anti-satellite test (January 2007), the U.S. missile strike against the disabled 'USA 193' satellite (February 2008), the collision of Iridium 33 and Cosmos 2251 (February 2009), the first launch of an Iranian satellite (February 2009) and a failed North Korean space launch (April 2009), show that maintaining space security has become more complex. Space security can be defined as a '*secure and sustainable access to, and use of, space and freedom from space-based threats*'.[1]

Already in January 2007 the successful Chinese anti-satellite test that shattered a defunct Chinese weather satellite into a huge space debris cloud[2] became a turning point for creating awareness about current and future needs to enhance space security. The Chinese ASAT test made clear that it cannot any longer be taken for granted that the access to and the use of outer space is free of man-made intentional or unintentional interference. Additionally, it

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has shown that space weapons and space debris are intrinsically linked. Yet, both areas lack sufficient regulatory clarity. Another event, the unintended Iridium-Cosmos collision, demonstrated that uncoordinated satellite traffic in certain orbital areas has its limits. Collisions lead not only to the loss of the space objects, but also to an uncontrolled increase of space debris.

The concepts of freedom of exploration and use of outer space and 'peaceful purposes', as enshrined in Articles I and IV OST,[3] do not provide sufficient guidance. Attempts to conclude binding international agreements on space debris and space weapons have failed.

However, in the field of space debris mitigation, the Inter-Agency Space Debris Coordination Committee (IADC) has established (non-binding) technical standards,[4] which have been endorsed by Resolution of the United Nations' General Assembly,[5] have led to incorporation in domestic laws of some States,[6] and tendencies are observed that they start to crystallize into international custom.[7]

Attempts to negotiate guidelines or even an agreement preventing a weaponization of outer space are in a permanent stall for more than a decade: The United Nations' Conference on Disarmament (CD) has the item of 'Prevention of an Arms Race in Outer Space' (PAROS) on its agenda for many years, but is deadlocked mainly over a dispute about agenda priorities.[8] In August 2008, the Russian Federation and China submitted to the CD a draft "Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat of Use of Force against Outer Space Objects" (PPWT).[9] The core provision of this draft reads:

The Parties undertake not to place in orbit around the Earth any objects carrying any kinds of weapons, not to install such weapons on celestial bodies and not to place such weapons in outer space in any other matter; not to resort to the threat or use of force against outer space objects; and not to assist or induce other States, groups of States or international organizations to participate in activities prohibited by this Treaty.

In August 2008 the United States presented their analysis of this draft, which concludes *i.a.* that the U.S. has not grounds to support establishing a committee to negotiate such a treaty and that for almost three decades the U.S. has consistently posited that it is not possible to develop an effectively verifiable agreement for the banning of either space-based "weapons" or terrestrial-based anti-satellite systems.[10]

With the Obama administration, U.S. space policy is about to change. Currently, the Pentagon is undertaking its Space Posture Review about operations strategies in space and the National Security Council is leading the White House review for an overarching civilian and military space policy.[11] It still needs to be seen to what extend these reviews will follow the concepts of President Obama during his campaign:[12]

Emphasizing an International, Cooperative Approach to Space Security

Developing an international approach to minimizing space debris, enhancing capabilities for space situational awareness ...

Negotiating Agreements on "Rules of the Road" ... for space to ensure all nations have a common understanding of acceptable behavior.

Opposing Weaponization of Space ... the stationing of weapons in space and the development of anti-satellite weapons. ... the United States must show leadership by engaging other nations in discussions of how best to stop the slow slide towards a new battlefield.

Since Obama considered a global treaty banning weapons in space a daunting challenge, he suggested a *code of conduct for responsible space-faring nations.*[13]

Already in December 2008 the Council of the European Union approved a draft Code of Conduct for outer space activities[14] to *enhance the safety, security and predictability of outer space activities for all.*[15] It is built upon and emphasizes the *existing international framework*[16] *governing outer space activities,* but complements it by *codifying new best practices* to contribute *to transparency and confidence building measures.*[17] Under the Code of Conduct the subscribing states are to abide by the following principles:[18]

- *the freedom of access to, exploration and use of outer space and exploitation of space objects for peaceful purposes without interference, fully respecting the security, safety and integrity of space objects in orbit;*

- *the inherent right of individual or collective self-defence in accordance with the United Nations Charter;*

- *the responsibility of States to take all appropriate measures and cooperate in good faith to prevent harmful interference in outer space activities;*

- *…[to] take all the adequate measures to prevent outer space from becoming an area of conflict.*

Read in conjunction, these general principles display the comprehensive approach of the draft Code of Conduct. It embraces not only debris mitigation and, in more general terms, prevention of harmful interference[19] with space activities. It also covers effects of weapons in space to the extent they lead to debris and harmful interference, but without banning (space or ground-based) weapons per se. Rather to the contrary, this draft Code of Conduct re-states the inherent right of self-defence along the lines of Article 51 of the United Nations' Charter. It aims at the prevention of outer space becoming an area of conflict, but avoids touching upon arms control.[20] Based on the framework of the general principles of the draft Code of Conduct, it encompasses more detailed measures on space operations, space debris control and mitigation, notification of outer space activities, registration of space objects, information on outer space policies and executive measures, and a consultation mechanism.[21]

It needs to be seen, if the revised U.S. space policy will follow similar lines as the draft Code of Conduct of the Council of the European Union.[22] If so, a code of conduct, open for subscription to all space-faring nations, could be within reach. A legally non-binding code of conduct has not the force of international treaty law, but it would be an important step forward, following decades of standstill in that area. Albeit the avoidance and mitigation of space debris is common sense, the space faring nations did not achieve an internationally binding instrument on this subject matter. Multilateral arms or weapons ban agreements are even more ambitious. Realistically, diplomacy works only in small steps. Therefore attention needs to be paid to suitable confidence building measures and transparency, which can evolve incrementally into a cooperative, networked and finally institutionalized approach of improving space security.

2. SPACE SITUATIONAL AWARENESS IS KEY

This paper advocates an international space situational awareness network as an initial key measure for confidence building and transparency. Why space situational awareness? Because further steps, like space traffic rules and space traffic management only make sense, when space actors have space situational awareness.

What is space situational awareness? In plain language, situational awareness is the up-to-date knowledge about what is happening within a given space and time. The purpose of situational awareness is to project relevant events into the future in order to avoid threats or plan actions. Situational awareness concepts originated in complex and dynamic environments, where speedy human reaction is required, like aviation, complex machinery and the military. It is plausible to apply the

situational awareness concept also to outer space, because of the dynamics and complexity of the orbital movements of the increasing space object and debris population and its interactions. Space situational awareness is generally considered as the understanding and maintained awareness of [23]

- the Earth orbital population,[24]
- the space environment[25] and
- possible threats.[26]

Operating a space situational awareness system requires three principle elements:

- collection of information, typically detection and tracking by ground-based and space-based optical and radar sensors, and collection by other sources, like registration data and information exchanges with other agencies,
- maintaining a data base or catalogue of all space objects and space debris, including their orbital parameters and
- computer processing capacity to predict the status, events and threats in the future.

Currently, the most comprehensive work in that field is achieved by the U.S.. Under the current U.S. National Space Policy (2006) the Secretary of Defence is responsible for SSA not only for military purposes, but also for civil operations and commercial and foreign space entities.[27] Based on this, the U.S. Air Force Space Surveillance Network (SSN) operates a worldwide sensor network and provides the information to the Joint Space Operations Center (JSPOC) under the superior command of the U.S. Strategic Command (USSTRACOM). With these data inputs, the JSPOC catalogues Earth orbiting man-made objects and combines them with other information[28] to provide space situational awareness.

Despite space surveillance sensor capabilities like the French GRAVES and the German TIRA, Europe has not developed means of space situational awareness. The European Parliament has taken the initial step into that direction by supporting *the creation of a European space surveillance system leading to space situational awareness … to monitor the space infrastructure, space debris and, possibly, other threats* …and by supporting the possibility to fund a European space situational awareness system from EU funds.[29] The European Space Agency has started a program to study the technical implementation.

Operating all elements of a comprehensive space situational awareness system for detecting, tracking, monitoring and predicting the future status of a steadily increasing number of objects becomes a Sisyphean task. In December 2007 JSPOC was tracking about 11.800 identified and about 5,500 unidentified objects.[30] The pooling of information originating from a broad range of available sensors and the correlation of various computer models contributes to the accuracy and reliability of a space situational awareness system. Internationally, there must be the goal of creating a more accurate and comprehensive real-time picture of what is going on in space. International cooperation is a confidence building measure *par excellence* for enhancing transparency and, as subsequent steps, for formulating future rules of the road for space traffic. Key will be an international cooperation of space faring nations in the networking and sharing of sensor and object catalogue information, ultimately aiming at an internationally integrated space situational awareness system to share the common knowledge of space risks and threats.

3. THE CIVILIAN – MILITARY NEXUS: AN OBSTACLE ?

One of the main obstacles for creating an internationally networked SSA system is national security and the military use of space situational awareness. The U.S. military first saw the need for establishing a space situational awareness system. Situational awareness is a tool used by the military and it was a plausible step to extend it from the battlefield and airspace into outer space. The U.S. military has defined space situational

awareness with a military connotation,[31] established the first SSA system and U.S. military doctrine states the dependence of effective counter-space activities on space situational awareness.[32]

However, already the existing U.S. presidential space policy of 2006 states that the Secretary of Defense shall conduct space situational awareness also for U.S. commercial space capabilities, civil space capabilities and, as appropriate, commercial and foreign space entities.[33] The U.S. space policy, when revised by the end of the year, may go a step further, should it follow the Obama space program announcement, which mentions space situation awareness under the heading of an *international approach*.[34] This would also be in line with the draft Code of Conduct of the Council of the European Union, which calls upon subscribing States to *also consider providing timely information on space environmental conditions and forecasts to other Subscribing States or private entities through their national space situational awareness capabilities.*[35]

Crucial for any such international cooperation will be the drawing of the dividing line between information sensitive to national security and information relevant for non-military space situational awareness. For an effective cooperation and networking of the space situational capabilities, orbital data and space weather information need to be exchanged and their precision should not be degraded for security purposes.

But where is this dividing line? Clearly intelligence and reconnaissance data derived from military and intelligence sources are not of interest for civilian space situational awareness and no need is seen to disclose such information to a cooperative space situation awareness network. More difficult may be the handling of the identity and orbital data of functional military and intelligence satellites, in military terminology *friend or foe* space assets. But even this difficulty can be solved. At the present situation, it can be supported that the non-disclosure of the identity and orbital data of military and intelligence space objects, *friend or foe*, has only a minor or no effect on the effectiveness of a civilian space situational awareness network for two reasons:

- the small number of these objects in relation to the number of the catalogued objects and
- the self-interest of the (State) operators to avoid collisions of their crucial space assets.[36]

Following the Iridium-Cosmos crash, there is a new encouraging practice in the U.S. of providing relevant precision orbital data to commercial and foreign entities (CFE). Commercial and foreign entities may enter into an agreement[37] with Headquarters Air Force Space Command (HQ AFSC) and, upon request, obtain under its terms and conditions space situational awareness support including launch support and conjunction assessments.[38]

This shows, that a de-confliction is possible between civilian and commercial purposes on one hand, and security and military on the other. In the past, similar developments could be seen with other space applications, like remote sensing and satellite navigation. Both are of dual use nature. With maturing operations, dividing lines were drawn (and adjusted over time) to reserve precision applications to the military without hampering civilian uses. In addition, the institutional set-up of the Global Positioning System (GPS) is an example of a system financed and operated by the U.S. Department of Defence, which gradually was authorized to become a worldwide civilian application. Finally it must be emphasized that the military, worldwide, depends more and more on civilian and commercial space systems. As a consequence, a purely military space situational awareness system, limited to the protection of purely military space assets, does not any longer reflect real-world military operations.

4. OUTLOOK AND CONCLUSIONS

States should not miss the opportunity to foster international cooperation for a networked space situational awareness system. This can serve as a confidence building measure for activities in outer space and enhance transparency required before agreeing on space traffic rules and space traffic management. If such rules or standards will lead to a code of conduct or a binding treaty needs to be seen. Any step into this direction is important, although soft law instruments are legally non-binding. Even a binding instrument would not necessarily solve all issues, as it is unlikely that all space actors, including Iran or North Korea would sign such a treaty. The progress in international relations and the formulation of new rules and standards is slow. Yet, every step is to be supported to keep space faring nations on a steady path to gradually establish coherent practices. Ultimately, this can lead to emerging customary law. International cooperation in an efficient space situational awareness network could become an important stepping stone. Real-life cooperation, flanked by the common understanding to do the right thing, is stronger than well intended language alone.

An additional effort would be arrangements on the prevention of an arms race in Outer Space (PAROS), arms control, arms limitations, or even a partial or complete ban of space weapons. As a matter of diplomacy, it appears wise not to mate from the beginning the topics of space debris and space situational awareness with the complex issue of weaponization of space. Once confidence building measures have evolved to a common conduct in space activities, this may be a more solid ground to enter into negotiations about a regime on space weapons.

These steps all serve the same purpose: the protection of outer space environment close to the Earth for the benefit of mankind. These incremental steps, in combination, all need to be taken to warrant space security, the secure and sustainable access to and use of space and freedom from space-based threats.

The freedom of any space faring nation to explore and use outer space is inherently limited by the same freedom of other States. To secure this freedom in an equitable manner and without discrimination requires more precise common understanding, coherent State practice and, ideally, more precise rules, to establish a reliable public order in outer space. Ultimately, the freedom to explore and use outer space will be guaranteed by the rule of law, not by its absence.

1 See Introduction of Executive Summary, SPACESECURITY.ORG, 'Space Security 2008"; see also Preamble A. of European Parliament Resolution (2008/2030(INI)), 10 July 2008

2 For the policy implications, see Kaiser, 'Chinese Anti-Satellite Weapons: New Power Geometry – New Legal Policy', 6 Astropolitics (2008), 313; see also IAC 07-E6.5.21

3 Outer Space Treaty = Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 27 January 1967, 18 U.S.T. 2410, T.I.A.S. 6347, 610 U.N.T.S. 205 (effective 10 October 1967).

4 IADC Space Debris Mitigation Guidelines, Rev. 1, Sep 2007, Doc. IADC-02-01

5 UNGA Res. 62/217

6 For example in the United States of America Code of Federal Regulations, 47 CFR 25.283, Title 47. and in Germany, 'Verfahren zur Anmeldung von Satellitensystemen bei der Internationalen Fernmeldeunion und Übertragung deutscher Orbit- und Frequenznutzungsrechte', Amtsblatt Reg. TP Nr. 6/2005, Apr. 6 (2005), p. 239.

7 Mejia-Kaiser, 'Informal Regulations and Practices in the Field of Space Debris Mitigation', 24 Air and Space Law (2009), 21

8 After it had appeared that the Conference on Disarmament had finally reached a consensus on a seven point program in May 2009 – including PAROS, in August 2009 consensus failed on the implementation schedule, because of an intervention by Pakistan.

9 CD/1839, 23 February 2008; see also the conference report of the CD 2008, CD/1853, 9 September 2008; and the conference report 'Security in Space: The Next Generation' on behalf of UNIDIR, CD/1844, 23 June 2008

10 Points 22., 24. of CD/1847, 26 August 2008

11 Butler, 'Protection a Top Priority for Space Reviews', AW&ST 03 August 2009

12 Obama 08, Advancing the Frontiers of Space Exploration, BarackObama.com, December 2008

13 Reuters, 'Challenges loom as Obama seeks space weapons ban', 25 January 2009

[14] Council of the European Union, 17175/08, 17 December 2008

[15] Art. 1.1 draft Code of Conduct, *supra* note 14

[16] Art 3.1 of the draft Code of Conduct, *supra* note 14, expressly lists the following instruments: the Outer Space Treaty (1967), Rescue Agreement of (1968), Liability Convention (1972), Registration Convention (1975), ITU Constitution and Convention (2002), Nuclear Test Ban Treaty (1963), Comprehensive Nuclear Test Ban Treaty (1996), International Code of Conduct against Ballistic Missile Proliferation (2002), Outer Space Principles of UNGA Res. 1962 (XVIII), Principles on Nuclear Power Sources of UNGA Res. 47/68, Declaration of International Cooperation of UNGA Res. 51/122, Recommendations on Registration of UNGA Res. 62/101, Space Mitigation Guidelines of UNGA Res. 62/217.

[17] Art. 1.3 draft Code of Conduct, *supra* note 14

[18] Art. 2 draft Code of Conduct, *supra* note 14

[19] The term of 'harmful interference' is apparently taken from the ITU, but is used here in a broader sense than in provision 1003 of the Annex to the ITU Constitution.

[20] Even though the European Parliament has resolved to recommend *the adoption of legally binding international instruments focusing on banning the use of weapons against space assets and the stationing of weapons in space*, see section 45 of European Parliament Resolution (2008/2030(INI)), 10 July 2008

[21] Arts. 4 to 9 draft Code of Conduct, *supra* note 14

[22] The draft Code of Conduct, *supra* note 14, of the Council of the European Union seems to be rooted in a broader consensus of international space policy experts, see e.g. the 'Model Code of Conduct for Responsible Space-Faring Nations' released by the Stimson Center, 24 October 2007.

[23] User Expert Group of ESA SSA requirement study, cited after del Monte, A European Approach to Space Situational Awareness, Fourth European Space Weather Week, Brussels, 5-11 November 2007

[24] Comprising man-made objects (e.g. objects contained in US SSN Catalog, i.e. spacecraft, rocket bodies, mission-related objects, and fragments)

[25] Comprising natural objects (near Earth objects, meteorites), man-induced effects on the space environment and space weather (solar activity, radiation). Space weather is not only important for its direct threats against operational space objects, e.g. solar activity affecting radio communication of satellites, but also for its changes of the orbital parameters of all orbiting objects.

[26] Comprising risks to humans and property on the ground and in the air space due to re-entries, on-orbit explosions and release events (accidental or intentional), on-orbit collisions (accidental or intentional), disruption of mission and/or service capabilities.

[27] Sec. 5 (National Security Space Guidelines) of the U.S. National Space Policy , 31 August 2006: … *the Secretary of Defence shall: …Have responsibility for space situational awareness; in this capacity, the Secretary of Defense shall support the space situational awareness requirements of the Director of National Intelligence and conduct space situational awareness for: the United States Government; U.S. commercial space capabilities and services used for national and homeland security purposes; civil space capabilities and operations, particularly human space flight activities; and, as appropriate, commercial and foreign space entities.*

[28] Such other information is e.g. intelligence and reconnaissance data

[29] Secs. 20, 21, European Parliament Resolution (2008/2030(INI)), 10 July 2008

[30] Whitelaw, 'The Problem of Space Debris' US News and World Report, 4 December 2007

[31] *E.g.* U.S. Strategic Command (STRATCOM) in its 'Space Control CONOPS, 2004' defines SSA as *the requisite current and predictive knowledge of space events, threats, activities, conditions and space system (space, ground, link) status, capabilities, constraints and employment – to current and future, friendly and hostile – to enable commanders, decision makers, planners and operators to gain and maintain space superiority across the spectrum of conflict.* – cited after Hand / Benz / Holts / Longmire / Hendrickson / France, *Environmental Space Situation Awareness and Joint Space Effects*, paper presented at the AMOS conference 2006, Maui, Hawaii

[32] E.g. see U.S. Secretary of the Air Force, Chapter Four, Space Power, Counterspace in 'Air Force Doctrine Document 1', 17 November 2003: *Effective counterspace operations depend on space situational awareness to provide an understanding of global space operations and is derived from C2, ISR, and environmental information.*

[33] See *supra* note 27.

[34] See *supra* note 12.

[35] Art. 8.2 Art. draft Code of Conduct, *supra* note 14.

[36] Conversely, it may be argued that such the non-disclosure of the identity and orbital data could be used to cover up space objects intended for use as anti-satellite weapons. However, anti-satellite issues should be addressed within the framework of PAROS or any similar instruments about the limitation or ban of space weapons. At the current stage of establishing confidence building measures and transparency, a comprehensive resolution of anti-satellite issues appear pre-mature.

[37] The agreements do *i.a.* not allow re-distribution of data without prior DoD consent; use of data is at own risk of CFE and the U.S. government does neither warrant accuracy and precision of data nor accept any liability.

[38] For details see http://www.space-track.org/orbitaldatarequestprocess.html