



EVOLUTION OF THE COUNTERSPACE THREAT AND STRENGTHENING OF INTERNATIONAL SPACE PARTNERSHIPS

**Fifth PSSI Space Security Conference
June 9–11, 2019 Prague, Czech Republic
Conference Summary**

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The mission of the Prague Security Studies Institute is to help safeguard and strengthen the individual freedoms and

democratic institutions of the countries in Central and Eastern Europe and beyond. The Institute also seeks to illuminate select unconventional threats emanating from authoritarian governments that challenge the transatlantic alliance and other partners globally, especially in the economic & financial and space domains. PSSI is dedicated to the education and training of new generations of security-minded students and young professionals, including through its programmatic activities and growing academic network in the Czech Republic and abroad.

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PSSI Washington is dedicated to illuminating select, lesser known security challenges facing the United States and its key allies in Europe and

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In 2013, efforts resulted in the successful launch of an Epsilon Rocket prototype, a next-generation solid rocket which inherited the technologies of all the aforementioned rockets. In the practical satellite booster rocket field, We cooperates with the JAXA and has responsibilities in the solid propellant field including rocket boosters, upper-stage motors in development of the N, H-I, H-II, and H-IIA H-IIB rockets. We have also achieved excellent results in development of rockets for material experiments and recovery systems, as well as the development of equipment for use in a space environment or experimentation. In the defense field, we have developed and manufactured a variety of rocket systems and rocket motors for guided missiles, playing an important role in Japanese defense. With our wealth of technological expertise accumulated to date, the company will further enhance research and development activities to prepare for the coming space utilization age represented by a space station, as well as boldly take on the new fields of FRP components for jet engines, robot systems and so forth, ultimately contributing to the realization of mankind's dreams and advancement of society.

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The NEC Group globally provides "Solutions for Society" that promote the safety, security, efficiency and equality of society. Under the company's corporate message of "Orchestrating a brighter world," NEC aims to help solve a wide range of challenging issues and to create new social value for the changing world of tomorrow.

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BAWD Foundation

The BAWD Foundation is a private, United States based, charitable corporation established to support the charitable interests of the Elliman family. The interests of the foundation are concentrated in science and education. As the mission of PSSI, with elements of both security technology and education, are closely linked to the foundation's purpose, BAWD has been a longstanding proponent and supporter of its programs.

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The Aerospace Corporation serves as an independent and objective problem-solving advisor and partner to government and industry across every aspect of defense, civil, and commercial space, without conflict of interest. Since 1960 we have been honing our experience across the entire space enterprise to offer unmatched technical expertise, leadership, and innovation that ensures the success of today's most complex space missions and brings tomorrow's possibilities to life. As an unbiased, non-profit organization, our commitment is the pursuit and delivery of technical truth, and our motivation is finding new ways to use space for the public good.

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SpaceWatch.Global (previously SpaceWatch Middle East) is a digital magazine and portal for those interested in space and the far-reaching impact that space developments have. While showcasing the technology that enables the industry to edge closer to the next frontier, SpaceWatch.Global also provides analysis, forecasts and insight into the geopolitical implications of space developments. The Middle East, for example, is one of the most consequential regions in the world and as it pursues its unprecedented space ambitions, it is expected to be the fastest-growing market for years to come. From space policy, exploration and missions to space weapons and technology, we provide a complete perspective on the various regional space sectors and expanding into a global market. The team behind SpaceWatch.Global comprises a dynamic mix of space geeks, tech junkies, space policy experts, regional specialists and passionate writers. We fully believe that space should be used for humanity; that it enables knowledge and enriches societies. SpaceWatch.Global is published by ThorGroup GmbH, headquartered in Bern, Switzerland. In the true Swiss spirit, neutrality, ethics and integrity are at our core. SpaceWatch.Global abides by the Society of Professional Journalists' code of ethics; we seek truth and report it.

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Speakers at the Fifth PSSI Space Security Conference

I. Background

For over a decade, PSSI has been at the forefront of the European space security debate, producing research, analyses, roundtables/conferences, and recommendations for senior levels of the international space and security communities. In 2010, the Institute, in partnership with its affiliate organization, PSSI Washington, initiated what is now regarded as the leading conference series in this field. Five international conferences have been convened to date, involving leading space security experts and senior officials from Europe, the United States, and Japan. Prior to this year's conference (2019), two had been held in Prague (in 2011 and 2016), one in Tokyo (in 2013), and one in Washington, DC (in 2017). The key partnering organizations have included the European Space Policy Institute (ESPI), the European Space Agency (ESA), the Japanese Prime Minister's Office of National Space

Policy, the Secure World Foundation (CWF), and the Center for Strategic and International Studies (CSIS).

This fifth conference was held in Prague on June 9–11, 2019. Entitled "*Evolution of the Counterspace Threat and Strengthening of International Space Partnerships*," the event was co-organized by the European Space Agency and the Secure World Foundation and focused on the rapidly advancing counterspace threats and the role of space partnerships in addressing this higher risk environment. The nature of international space partnerships was put centerstage, as China and Russia pursue a non-democratic model of governance aimed at, in effect, buying the vertical integration of recipient countries' space sector under their influence or outright control, a phenomenon that PSSI terms "space sector capture."¹

¹ PSSI defines space sector capture as "a state actor's provision of space-related equipment, technology, services and financing ultimately designed to limit the freedom of action and independence of the recipient state's space sector, generally implemented on an incremental basis".



Fifth PSSI Space Security Conference

Evolution of the Counterspace Threat and Strengthening of International Space Partnerships

PSSI was especially delighted to welcome as keynote speakers Andrea Thompson, the U.S. Under Secretary of State for Arms Control and International Security, Lt. Gen. David D. Thompson, Vice Commander of the U.S. Air Force Space Command, Toshihiko Kasahara, Deputy Director of Japan's Cabinet Satellite Intelligence Center, Carine Claeys, Special Envoy for Space at the European External Action Service, and Dr. Kai-Uwe Schrogl, Chief Strategy Officer at the European Space Agency, seconded to the German Federal Ministry for Economic Affairs and Energy. The transcript of the Ms. Thompson's remarks is available in Appendix 3. The Conference brochure, including the list of speakers, is available in Appendix 1.

Reinforcing its role as the leading organization in the space security debate, PSSI's Chairman and Co-Founder, Roger W. Robinson Jr. and the Vice-Rector of the Charles University, Jan Konvalinka, jointly unveiled a new four-year Ph.D. scholarship in the field of Space Security, co-sponsored by PSSI at Charles University. The Ph.D. scholarship is named after the Honorable William P. Clark, National Security Advisor to President Ronald Reagan, who was largely responsible for institutionalizing the Strategic Defense Initiative on the President's behalf. PSSI was delighted to hold this ceremony in the presence of leading Conference participants. The video of the proceedings can be viewed at our Institute's website.



Toshihiko Kasahara, Deputy Director of the Cabinet Satellite Intelligence Center (CSISE) and Peter Martinez, Executive Director of the Secure World Foundation



doc. RNDr. Jan Konvalinka, CSc. and Roger W. Robinson. Jr. announcing the Charles University Ph.D. Scholarship in Space Security at the Conference Gala Dinner

II. Discussion Overview and Key Findings

The conference focused on the following topics:

- * Evolution of Counterspace Threat
- * Space Domain Awareness and Hybrid Operations
- * Space Resilience and Risk Mitigation
- * International Space Partnerships: Competition or Collaboration
- * Deterrence and Space Crisis Management
- * Private Sector Role in Space Security

Panel 1: Evolution of the Counterspace Threat

The space domain is rapidly evolving. An increasing number of countries and commercial actors are getting involved in space, resulting in more innovation and benefits on Earth, but also more congestion and competition in space. From a security perspective, an increasing number of countries are looking to use space to enhance their military capabilities and advance their strategic agendas. The growing use of, and reliance on, space for national security has also led more countries to consider the development of their own counterspace capabilities that can be used to deceive, disrupt, deny, degrade, or destroy space systems. This has the potential to heighten tensions on the ground that extend into space, or vice versa. Panelists discussed the current status of counterspace capabilities globally, highlighting recent trends and predicting what the domain could look like in the relatively near-term. The panelists also sought to address the most promising mitigation measures.

The panelists noted that to assess the current status of counterspace capabilities globally, much like threats to the land, air, and maritime domains, we need to understand the realities of current geopolitics driven by the U.S., China and Russia rivalries. Dr. Ashley Tellis from the Carnegie Endowment for International Peace noted that China and Russia share the same objective – to be able to defeat the U.S. conventional military superiority and, in the longer term, replace it as the principal actor in the global system. He also pointed out that China has an additional objective – to decouple the U.S. from its Asian and other allies. Accordingly, he believes that counterspace activities are “a growth industry” for the foreseeable future.

Space represents an important symbol of national pride that helps China and Russia preserve the credibility of their regimes. Much like the successful launch of Sputnik helped quiet domestic criticism of Khrushchev and helped boost Soviet prestige in the non-aligned countries, every space success helps reduce criticism of the communist party in China while

bolstering the country's status as a “great power”. It also assists Beijing's ability to engage foreign partners in its strategic global outreach (e.g. Belt and Road Initiative's Space Information Corridor, etc.). The constant requirement to maintain regime stability domestically could one day potentially precipitate the use of counterspace capabilities. At the same time, China, understands that its space capabilities are essential to enabling its bid for intelligence dominance/information superiority, a key element of its military doctrine.



Speakers on the first panel: Ashley J. Tellis, Senior Fellow at the Carnegie Endowment for International Peace, Shuzo Takada, Director-General of the National Space Policy Secretariat at Japan's Cabinet Office, Martina Šmuclerová, Senior Fellow at PSSI, Jamie M. Morin, Vice President, Defense Systems Operations at the Center for Space Policy and Strategy, The Aerospace Corporation and Victoria Samson, Washington Office Director at the Secure World Foundation

As the number of actors in the space domain increases, along with their counterspace capabilities, the speakers agreed that state actors are likely to focus mainly on non-debris causing space denial activities in order to maintain the vital operational environment. Despite the highly visible ASAT tests (such as the destructive ones of China in 2007 or India in 2019), the current trend seems to suggest that space is considered a strategic enabler.

While countries with advanced counterspace capabilities wish to use space on an unfettered basis, denial of space to others to gain tactical or strategic advances is tempting and requires a careful choice among counterspace capabilities. Accordingly, a non-debris creating space attack could be used as the first measure even prior to engaging in terrestrial conflict (to prepare the environment), rather than as an effect of gradual escalation in other warfighting domains. It is difficult to assess, however, the unforeseen retaliatory spiral of any conflict that would extend to space which undeniably has a potential for extremely high negative knock-on effects.

Reversible and tailorable events, such as denying communications or precision targeting, are possibly the most problematic as they may trigger irreversible retaliatory responses. These various options need to be considered in trying to assess the escalatory potential. As Douglas Loverro, former U.S. Deputy Assistant Secretary of Defense for Space Policy, pointed out, it is difficult to predict second- and third-order effects (i.e. effects on the user), which may not necessarily be

reversible as opposed to the initial reversible attack on a space asset. Dr. Martina Šmuclerová observed that we have to understand the limitations of the existing international governance regime related to defining the legalities of counterspace operations (e.g. what constitutes an armed attack in space, etc.).

When highlighting these realities, the speakers suggested that despite our heavy dependence on space, there is a troubling lack of general awareness about the security challenges facing this domain. Commercial companies have become an integral part of this debate as an increased number of them operate in this domain previously exclusive to state actors. There is also the ever-present issue of space debris and the potential for collisions due to the overall lack of accurate situational awareness. Speakers suggested that the increasing public awareness about the issues of space debris could also help bring attention to counterspace threats. Japan's Prime Minister Shinzo Abe, for example, took the opportunity of the G20 Summit held in Japan in June of this year to promote, among other items, space debris mitigation measures in an effort to expand the discussion concerning space-related challenges beyond traditional space fora.

At the conclusion of the panel, the speakers sought to identify the most promising mitigation measures, stressing the importance of strengthening of international partnerships in this context. Strengthening partnerships, they pointed out, requires better awareness of the scope of the challenge, including operationally (e.g. relevant for the enhancement of capabilities, etc.), and broader security and foreign policy implications.

The panelists suggested that in order to be able to configure mitigation measures, we need to define comprehensively the role of space in protecting vital national and allied security interests in this rapidly evolving environment. These interests are today defined by the ability to achieve terrestrial objectives. Accordingly, the protection of space objectives has a reduced value if terrestrial goals fail to be achieved. Reducing the vulnerabilities of allied space systems is also a foundational requirement, including through the proper design of space architectures, efficient acquisition processes, and proper training of space

warfighters. Beyond that, however, there needs to be a clear set of policy objectives in which space serves as the key enabler for the above-referenced terrestrial objectives.

Allied and partner collaboration in employing diplomatic and other measures remains a cornerstone for preparedness against counterspace threats. Dr. Ashley

mentioned, for example, the ability to segregate valuable assets from the attacked environment, protecting high-value, low-density systems, investing in mitigation to diminish the effectiveness of non-kinetic attacks, forethought of requisite instruments for retaliation to inflict discriminatory response, or communicating potential penalty options to the would-be adversaries.

Summary of Key Findings

- ★ Counterspace activities remain “a growth industry”
- ★ Non-debris producing, low-threshold, and tailorable grey zone operations present an attractive counterspace option as they enable victory in a limited war scenario, while the preserving space domain operationally
- ★ The effects of offensive counterspace operations are largely unknown
- ★ Counterspace capabilities might be used to prepare the environment even prior to a conflict, not only as a means for gradual escalation after a conflict has commenced
- ★ Even limited counterspace operations can have serious and irreversible repercussions and possibilities of escalation are present in any, even limited, counterspace operations
- ★ When seeking to address counterspace threats, the main focus of the allies should be on how to preserve their terrestrial military objectives, not just the protection of space assets
- ★ Public awareness and discussion concerning counterspace threats is urgently required
- ★ Counterspace activities remain interconnected with terrestrial competition among global space powers
- ★ Growing Sino-Russian collaboration is likely to be reflected in the evolution of counterspace threats.

Panel 2: Space Domain Awareness and Hybrid Operations

The introduction of Offensive Cyber and Counterspace operations into the arena of international conflict has led to situations where activities short of military action are more easily employed by malign actors to accomplish strategic goals without the fear of clear attribution. To an ever-expanding degree, these tools are being used in combination with more traditional forms of non-military activities to coerce behavior that would have previously required more overt aggression. The difference here is in the ability to use non-kinetic cyber and other ‘grey zone’ actions. The panelists discussed the role of space domain awareness activities in this dynamic, and what new or enhanced capabilities are required to deter or respond to this type of space-related hybrid warfare.

When describing activities and potential threats in space, the panelists noted that there is a lack of universally accepted terminology, and SSA (Space Situational

Awareness), SST (Space Surveillance and Tracking), and SDA (Space Domain Awareness) are sometimes used interchangeably. While SSA is more focused on the



positioning and movement of space assets, regardless of their function or their capabilities, according to Mr. Travis Langster from Analytical Graphics, SDA focuses more broadly on a variety of activities. This can include space weather, RF interference, as well as cyber activities occurring in the domain.

This could potentially be more useful in the military context. Dr. Pascal Faucher from the French Space Agency noted that Europe has focused on SST. The EU institutions, however, are using the term SSA in the new budgetary planning. SSA is then understood to include SST, space weather, and near-Earth objects, similar to ESA's SSA program today. In the meantime, ESA is shifting from SSA to a Space Safety Program. Dr. Faucher also highlighted that SDA is not used in Europe, even if it may be a broader term potentially more helpful in describing space hybrid operations. Dr. Peter Hays noted that "SDA is about how we know where we are in terms of the status of space security".



Panelists on the second panel (from the left): Peter L. Hays, Associate Director at the Eisenhower Center for Space and Defense Studies, Pascal Faucher, EUSST Chairman and Security and Defense Officer, French Space Agency (CNES), Dana J. Johnson, Director, International Outreach and Policy, Office of the Under Secretary of Defense (Research and Engineering), U.S. Department of Defense, Travis Langster, Vice President, Space Situational Awareness Business at the Analytical Graphics, Inc. and Douglas L. Loverro, former U.S. Deputy Assistant Secretary of Defense for Space Policy

Dr. Dana Johnson pointed out that hybrid operations have recently been at the forefront of both NATO and EU defense/security deliberations, including the areas of strategic communications, energy supply and infrastructure, economic and financial infrastructure

protection, public health, nuclear-related risks, etc. Space infrastructure and space-enabled services and applications have largely been included as instruments to counter these broader threats. Dr. Johnson quoted the EU definition of "hybrid threats" and PSSI's definition of Space Hybrid Operations, noting the introduction of an additional area of concern by PSSI (i.e. threats emanating from the economic and financial (E&F) domain).

EU Definition of Hybrid Threats:

"[Hybrid threats] combine conventional and unconventional, military and non-military activities that can be used in a coordinated manner by state or non-state actors to achieve specific political objectives. Hybrid campaigns are multidimensional, combining coercive and subversive measures, using both conventional and unconventional tools and tactics. They are designed to be difficult to detect or attribute. These threats target critical vulnerabilities and seek to create confusion to hinder swift and effective decision-making"²

PSSI's definition of Space Hybrid Operations:

"Intentional, temporary, sometimes reversible, and often harmful space actions/activities specifically designed to exploit the links to other domains and conducted just below the threshold of requiring meaningful military or political retaliatory responses."³

Dr. Johnson also highlighted another dimension of hybrid operations, that is the underlying technological capabilities that provide the "foundation or the development of military and other capabilities to counter hybrid threats". She referenced findings of the latest "Worldwide Assessment of the U.S. Intelligence Community" that America's lead in science and technology is shrinking, as well as the capability gap

² European Union, *A Europe That Protects: Countering Hybrid Threats*, Factsheet, June 2018.

³ Robinson, J., Šmuclerová, M., Degl'Innocenti, L., Perrichon, L., Pražák, J. (2018) *Europe's Preparedness to Respond to Space Hybrid Operations*. Prague Security Studies Institute. [online] Available at: http://www.pssi.cz/download/docs/590_europe-s-preparedness-to-respond-to-space-hybrid-operations.pdf [Accessed on 30 Jul 2019].

between commercial and military technologies.⁴ This has implications for the U.S. and allied military technologies.

This is especially the case as innovation causes the gap between military technology and commercial technology to shrink, and it remains difficult to instill a permanent culture of innovation in the Ministries of Defence of the allied countries. The rise of commercial actors also adds to the increased congestion of space as commercial actors often prefer to deploy constellations of small satellites. Technological improvement in sensors will also mean that as SSA improves, concerns about the number of space objects will increase not only because of higher numbers of satellites in space, but the ability to see a much higher number of objects (mainly space debris).

While we are now able to track objects of around 1 m² large in GEO and around 10 cm² in LEO, eventually our capabilities will enable us to track objects the size of a few centimeters. Therefore, from 25,000 tracked objects, we may end up having to track 250,000. That said, the improved capability would also provide greater precision with regard to tracking non-standard behavior (such as the Luch's satellite approaches to other space assets since 2015 referenced below).



Travis Langster from AGI addressing the audience during the second panel of the Fifth PSSI Space Security Conference

Mr. Travis Langster also stressed the importance of going beyond the traditional paradigm of tracking satellites to having operational knowledge of space

environment in order to gain improved awareness of the constantly changing space situations, analytical assessments of what is observed, and confident attribution of events. Over 3,000 space asset maneuvers take place each month, predominantly in GEO. While there were over 4,000 conjunctions of 50km or less in GEO in 2018, around 22 of these were of high concern with a distance around 1km or less.

Russian satellite Luch Olymp was observed to perform a close-proximity operation multiple times, sparking questions about surveillance-type activities. It has been moved 13 times close enough to "sit" in the uplink beam of another satellite. Even though Luch never conducted an alarmingly close maneuver, it got close enough to be able to interfere in the RF spectrum. Luch mostly approached commercial satellites, except one (WGS-9) that belongs to the US Air Force (at that time not appearing in the public catalogue), raising additional questions with regard to how to respond to such situations⁵. Similar maneuvers were performed by a Chinese satellite SJ-17, but, to date, it has reportedly engaged in proximity operations only with other Chinese satellites (including, according to AGI, a couple of hundred of meters from a presumed non-functional communication satellite).

Dr. Faucher highlighted the potential threats stemming from the dual-use nature of space systems. Satellites can be designed for a commercial purpose but may hide additional military payload which then makes it more difficult to distinguish between a commercial and military system.

For example, the Chinese GEO satellite TJS-3, launched in late December 2018, was accompanied by an unannounced object presumed to be an Apogee Kick Motor (AKM), that turned out to perform a very similar pattern of maneuvers to that of the announced satellite. These two objects eventually made several synchronized maneuvers and then TJS-3 left the location eastward, leaving AKM behind.

4 Daniel R. Coats, Director of National Intelligence, *Statement for the Record: Worldwide Threat Assessment of the US Intelligence Community*, Senate Select Committee on Intelligence, 29 January 2019.

5 The Luch maneuvered away from WGS-9 two days after the U.S. published its location.



The panel discussed what new or enhanced capabilities are required to deter, or respond to, this type of space-related hybrid warfare. The EU continues to develop its SSA capabilities that are to have "an appropriate level of autonomy" from the U.S.. As space is clearly more contested than a decade ago, there needs to be a stronger push for implementation of existing norms, as well as the configuration of a stronger governance framework. In this context, the 21 UNCOPUOS

Guidelines on the Long-Term Sustainability of Outer Space, adopted (after some 10 years of work by experts from 92 countries) in June 2019, were seen as an important success in space diplomacy.⁶ The speakers also noted that there needs to be greater focus on investments in areas that would mitigate space hybrid threats, as well as raise awareness of potentially serious cross-domain impacts.

Summary of Key Findings

- * Improved Space Situational Awareness will increase the number of observable space threats with unknown policy implications
- * Space Domain Awareness should include the variability of space hybrid threats
- * Beyond satellite tracking, operational knowledge of the space environment requires improved situational awareness, analytical assessments of what is observed, and confident attribution of events
- * The ability to confidently attribute hybrid threats remains critical.
- * Commercial payloads may hide additional military payloads and such dual-use assets can become legitimate military targets in times of conflict

Panel 3: Space Resilience and Risk Mitigation

Resilient architecture should be able to support all necessary mission functions, including during hostile actions or across a range of adverse scenarios, conditions, and threats. It should be able to leverage cross-domain or alternative capabilities (government, commercial or partner).

The panelists discussed the extent to which our space architectures remain resilient today. To promote a safe and secure space environment, it is vital to understand the physical layer (i.e. space weather, debris, etc.) as well as hostile capability and intent. Achieving resiliency of the system to ensure mission continuity may even involve sacrificing survivability of certain nodes/satellites. The transient nature of malicious, non-kinetic activity leads not only to the disruption of space systems that may have a devastating impact

on the users, but also undermining confidence in space capability that is the foundation for space partnerships.

Carine Claeys, the EEAS Special Envoy for Space, noted that her organization has two main functions: diplomatic and operational. With regard to operational activities, the EEAS is focused on the security-sensitive components of the EU GNSS (i.e. Galileo and EGNOS). They are defined by Article 1 of the Council Decision

⁶ United Nations Office for Outer Space (2018) *Guidelines for the Long-term Sustainability of Outer Space Activities*, A/AC.105/2018/CRP.20 [online]. Available at: http://www.unoosa.org/res/oosadoc/data/documents/2018/aac_1052018crp/aac_1052018crp_20_0_html/AC105_2018_CRP20E.pdf [Accessed on 30 July 2019].

496/2014 in the field of The Common Foreign and Security Policy (CFSP) "on aspects of the deployment, operation and use of the European Global Navigation Satellite System affecting the security of the European Union and repealing Joint Action 2004/552/CFSP"⁷. The CD 496/2014 does not currently include the other EU flagship, Copernicus Earth observation program, or other programs (such as SST or GovSatCom).

Ms. Claeys noted, however, that there is currently a proposal by the High Representative to extend the responsibility to security-sensitive components of the entire current and future EU space program. A decision concerning this matter is to be made in early 2020 (together with the broader EU Space Regulation), with implementation beginning in 2021.

Ms. Claeys emphasized that it is crucial to harmonize security governance of the whole EU space program. She also observed that due to the complexity of the security governance of the EU, where the capacity is mostly based on pooling and sharing, it is challenging to coordinate the efforts and complement them with a suitable EU role and additional EU infrastructure.

With regard to diplomatic efforts, the EEAS supports the recent adoption of the 21 UNCOPUOS Long-Term Sustainability guidelines, as well as the joint new initiative by Canada, France, Japan, and the U.S. to implement the guidelines. The EEAS also strongly supports political commitments not to undertake activities that are detrimental to space security and sustainability, such as the intentional destruction of space objects (emphasizing the need for notification and verification mechanisms).



Panel 3 speakers: (from left) Carine Claeys, Special Envoy for Space, Space Task Force, European External Action Service (EEAS), Kevin Mcloughlin, Head of Space Security, UK Space Agency, Jean-Jacques Tortora, Director, European Space Policy Institute (ESPI), Hiroshi Koyama, Fellow, Electronic Systems Group, Mitsubishi Electric Corporation, and Tanja E. Zegers, Policy Officer, DG for Internal Market, Industry, Entrepreneurship and SME – DG GROW

Kevin Mcloughlin, Head of Space Security at the UK Space Agency, explained that the UK's national space security policy focuses both on civil and commercial use of space and that the publication of the Defence Space Strategy under the Ministry of Defence was expected soon. The UK Space Operations Centre (SpOP), with predominantly military-focused capabilities, cooperates and intends to foster collaboration with its allies. Recently, the UK announced the establishment of the National Space Council the activity of which will be reinforcing of the work that has been undertaken in various parts of the government both on the national and international levels.

Beyond the operational elements of resilience (that is deception, disaggregation, distribution, diversification, proliferation and protection)⁸, joint efforts among Europe, the U.S., and Japan (including their industries) in promoting information sharing and transparency would go a long way in mitigating risks to space operations.

Mr. Koyama from the Mitsubishi Electric Corporation supported the concept of a multidomain system with an international framework that would facilitate

7 "This Decision sets out the responsibilities to be exercised by the Council and the HR to avert a threat to the security of the Union or one or more Member States or to mitigate serious harm to the essential interests of the Union or of one or more Member States arising from the deployment, operation or use of the European Global Navigation Satellite System, in particular as a result of an international situation requiring action by the Union, or in the event of a threat to the operation of the system itself or its services." (Quote from the Council Decision 496/2014)

8 For more information see the 2015 Pentagon report entitled "Space Domain Mission Assurance: A Resilience Taxonomy", available at: <https://fas.org/man/eprint/resilience.pdf>



standardization and information sharing among the U.S., Europe, and Japan. Furthermore, he underscored that much is still to be done to raise awareness among the relevant policy-makers and the general public concerning the crucial role the space systems have in the socio-economic development of countries. Time synchronization provided by global navigation satellite system (GNSS) is widely used in social infrastructures, such as international transactions, internet data transfer, mobile phone timing or synchronization among computer systems and its disruption would lead to serious damage. That said, the security aspects of space operations have remained in the background of space-related multilateral discussions.

Tanja Zegers from the European Commission's DG GROW explained that the new EU Space Programme regulation pulls together all EU level space activities. That includes EU GNSS (i.e. Galileo and EGNOS), Copernicus Earth observation programme, SSA and Governmental Satellite Communications (GovSatcom). GovSatcom is a new element of EU space policy that aims to provide secure satellite communication on a governmental level and builds upon the pooling and sharing concept referenced by Ms. Clayes that combines both existing governmental and commercial satellite systems. She noted that Prague will have an important security role as the host of the EU Space Agency that will manage all four components of the EU space programme.



Ms. Tanja Zegers from DG GROW discussing the importance of Prague for the EU space programme

When discussing gaps in our current space policies that could impact on space resiliency in the longer term, the panelists stressed that space is part of critical infrastructure and about 60 % of the economic life is dependent directly or indirectly on space systems. Satellite mega-constellations were mentioned as a worrisome challenge for space security as our current space traffic management system does not address them and other emerging trends (e.g. new technologies). Accordingly, space situational awareness remains a key component of space resilience, including in addressing space debris, the inherently dual-use nature of space assets, and the implementation of a future space traffic management system.

Summary of Key Findings

- ★ Space resilience needs to be supplemented by an international framework among Europe, the U.S., Japan and other partners that would promote transparency and information sharing between the private and government sectors
- ★ New EU Space Programme regulation pulls together all EU space activities with planned seat in Prague
- ★ GovSatcom is a new element in EU space policy that aims to provide secure satellite communication on a governmental level
- ★ Space situational awareness remains a key component of space resilience
- ★ At least 60 % of economic life on Earth is dependent on space technology, yet there is only a modest high-level policy push for strengthened space governance and establishing a leadership role for Europe, the U.S. and its allies in these discussions
- ★ Current space traffic management is insufficient to manage emerging space technologies and infrastructure (e.g. mega-constellations, etc.)

Panel 4: International Space Partnerships: Competition or Collaboration?

Absent strengthened international space cooperation, civilian and commercial space assets, services and applications will likely be at considerably greater risk due to the increasingly competitive and contested space environment. At the same time, the U.S. national space strategy puts America first, Europe calls for greater strategic autonomy, including in space, and Japan recognizes a national need to develop its own strategic space capabilities. This begs the question of how these high-level strategic national security initiatives affect allied space security cooperation operationally. This is especially relevant as our competitors, notably China and Russia, are undertaking to challenge the current international governance regime, including through forging their brand of international space partnerships, accompanied by an effort to gain technological superiority. This panel discussed options for strengthening trilateral efforts to establish a more robust global space partnerships and space norms based on transparency, the rule of law and recognition that a heated competition is well underway.

The panelists recognized that the competition for space partnerships is tied not only to the historical rivalry between the U.S. and the Soviet Union, but also the global ambitions of China. While a degree of competition may occur even within genuine collaborative efforts nowadays, countries such as China and Russia pursue stifling asymmetric partnerships which create undue dependencies for countries with nascent space programs.

Dr. Jana Robinson introduced the Prague Security Studies Institute's recent research in this area, announcing the publication of the Executive Summary⁹ of a report entitled "State Actor Strategies in Attracting Space Sector Partnerships: Chinese and Russian Economic and Financial (E&F) Footprints." This report tracks and visually maps, as well as analyses, space related transactions of Chinese and Russian state-controlled enterprises globally over a number of years. It concludes that these two countries have been pro-actively seeking international space partnerships that are, however, often unbalanced and unsustainable, potentially exposing countries to a phenomenon that PSSI terms "space sector capture". It is defined as vertically integrated control of the recipient country's space sector by these external actors (e.g. provision of the manufacturing of one or more satellites, launch and insurance services, the construction of ground segments, operations of their assets, 100% subsidized financing, other services such

as those stemming from their GNSS, etc.) resulting in an undue level of dependency.

Dr. Robinson called for the inclusion of this economic and financial (E&F) dimension in future deliberations over space domain awareness and the development of a common operating picture. She argued that this component of hybrid operations should be better understood, monitored and countered by enhanced allied and partner space engagements globally, including through bolstering the Western space partnership content and benefits. This would also, in her view, help our allies appreciate the asymmetric threat to global space norms and standards stemming from these lop-sided agreements.



John Stopher, former Principal Assistant to the Secretary of the Air Force for Space, delivering his opening remarks (left) with Dr. Jana Robinson, Space Security Program Director at the Prague Security Studies Institute (PSSI)

9 Robinson, J. Robinson, R., Davenport, A., Kupkova, T., Martinek, P., Emmerling, E., and Marzorati, A. (2019). State Actor Strategies in Attracting Space Sector Partnerships: Chinese and Russian Economic and Financial Footprints. Prague Security Studies Institute. [online] Available at: http://www.pssi.cz/download/docs/686_executive-summary.pdf [Accessed on 6 Jul, 2019].



Dr. Regina Peldszus from the DLR Space Administration sought to provide a European perspective on space partnerships, recognizing that the lines of conflict are blurred, rather than well-defined, and that it is possible to collaborate with competitors to foster certain goals and shared interests (e.g. safe operational space environment). It requires, however, a carefully crafted strategy that Europe will hopefully undertake due to its long history of intra-European collaboration that goes back to the 1960s.



Dr. Regina Peldszus, Senior Policy Officer at the DLR Space Administration's Department of Space Situational Awareness, delivering her opening remarks

The panelists also discussed options for strengthening trilateral efforts to establish stronger and more sustainable global space partnerships and norms based on transparency and the rule of law. Dr. John Stopher from the U.S. Air Force noted that more effort needs to be directed toward revising national policies and regulations that currently restrict intelligence-sharing among allies for reasons which may be outdated. In this connection, reconsidering the compartmentalization of issues on which our allies can collaborate would be beneficial given the ever-evolving nature of the challenges facing the space domain. Reducing such barriers to productive partnerships is just as important for strengthening the partnerships themselves as devising new strategies for preparing to tackle future threats.

Dr. Ajey Lele from the Institute for Defence Studies and Analyses described India's approach to cooperation, describing that his country has pursued a collaborative role with their space program. They have successfully cooperated with the EU countries and attempted to mitigate regional tensions in South-East Asia, while emphasizing that isolating China and Russia from global cooperative efforts may be counterproductive. In terms of international cooperative efforts, opportunities to raise issues within the G7 and other such fora could assist in the acceptance of behavioral norms.



Dr. Ajey Lele, Senior Fellow at the Institute for Defence Studies and Analyses, India (right) with Dr. John Stopher, former Principal Assistant to the Secretary of the U.S. Air Force for Space and Dr. Jana Robinson, PSSI Space Security Program Director (from left)

Eric Desautels of the U.S. State Department emphasized that the global competition is broader than space warfare and that hybrid operations have become much more challenging primarily due to the fact that countries like China seek to create their own vision of the space environment. He noted that it is not in our interest to have an authoritarian country that suppresses human rights at home, such as China, lead the creation of global norms of behavior for space. He emphasized that the U.S. and its allies need to be at the forefront of promoting the rule of law and the rules of the road based on best practices, as many non-binding best practices can lead to voluntary, non-legally binding transparency and confidence-building measures. He noted that some level of predictability and certainty is in everyone's interest.



Eric Desautels, Director, Office of Emerging Security Challenges, Bureau of Arms Control, Verification and Compliance, U.S. Department of State

Mr. Desautels challenged the conference participants by raising the question of what other fora and approaches should be undertaken by our allies and how can we shape the existing environment beyond the UNCOUOS, G-7, the Conference on Disarmament (where the Working Group on Space Security and TCBMs has not made any progress). He agreed with the Conference Concept Paper's assessment that we have tolerated jamming and other hybrid activities for too

long and asked those assembled whether we should reset this norm, and how. He mentioned cybersecurity and export controls as two important areas that require attention. At the end of his remarks, he noted that we need to figure out how to communicate clearly our intentions and expectations to our competitors.

With regard to allied partnerships, the panelists agreed that they may not always be fully balanced, but each partner brings a different set of assets and capacities that may end up being equally crucial in facing the threat environment and building a stable coalition.

When it comes to broader international partnerships, European countries, the U.S., Japan and other allies need to insist on disclosure, fair trade practices, transparency, proper risk management, good governance, and the rule of law to promote a more robust and sustainable model of space partnerships that preserves the space sector independence of the recipient countries.

Summary of Key Findings

- ★ China and Russia are seeking to create their own vision of the space environment and use hybrid operations as a means to achieve their strategic goals and objectives
- ★ China and Russia are pursuing international partnerships which create undue dependencies for countries with nascent space programs, including "space sector capture"
- ★ Space hybrid operations are in need of more careful study and include the increasingly important economic and financial (E&F) dimensions.
- ★ National policies and regulations should be revisited to support expanded intelligence sharing among allies.
- ★ New fora and approaches should be explored beyond UNCOUOS, the Conference on Disarmament, and G-7 to help shape global space governance
- ★ Allied space partnerships may not always be fully balanced, but each partner has a set of assets and capacities that may end up being equally important in facing a specific threat environment



Panel 5: Deterrence and Space Crisis Management

As referenced in panel 2 on "Space Domain Awareness and Hybrid Operations", the employment of hybrid operations for the achievement of strategic goals without the fear of clear attribution is becoming an increasingly popular counterspace go-to option. Is it past time to expand space-related deterrence measures, including pre-crisis communication of specific consequences that will befall a space-faring nation that engages in cyberattacks, jamming/spoofing, dangerous proximity operations and other forms of activities in this 'grey zone'? Is there an allied crisis management architecture in place that can be instantly activated in the event of a serious denial of services or damage to space assets? What should be the thresholds for triggering a crisis management response? The goal of this panel was to address these and related issues.

The panelists discussed how deterrence applies to the space domain. It was pointed out that in the case of a kinetic conflict in space, the collateral disruption of space services would impact all space actors (due to the creation of space debris, unintended consequences, etc.). That said, kinetic attack against space assets cannot be ruled out (e.g. for self-defense or offensive operations). The threat spectrum, however, is much broader and involves a wide scope of hybrid operations with varying degree of attribution.

Accordingly, it is important to be able to communicate clearly and credibly demonstrate the capability to identify, and respond to, behavior deemed unacceptable in the space context. As deterrence is actor-driven, international partnerships are essential for defining clear a set of rules and shared norms that would guide and, if needed, discipline/penalize irresponsible actors.

Heidi Robinson, Director for Engagement at the Office of Deputy Assistant Secretary of Defense for Space Policy, U.S. Department of Defense, emphasized the importance of communication and the use of language, noting that even though we might speak the same language we often mean different things using the same expressions or vice versa. Example cited are the terms SSA, SDA and SST that all have slightly different meanings to different groups of experts. To underscore that the U.S. is encouraging enhanced communication, Ms. Robinson mentioned the existence of 100 SSA sharing agreements (both with countries and commercial entities). She noted that it is done through the sharing of the increased capabilities of the SSA data with partners who want to be responsible, safe and professional in how they perform their space operations. In this context, Brig Gen Michel Friedling, Commander of the Joint Space Command at the French Ministry of Defence, reminded the audience that

the French military operates with the terms SSA and RSP (Recognized Space Picture).



Brig Gen Michel Friedling, Commander of the Joint Space Command at the French Ministry of Defence, (left) giving his opening remarks, together with (from left) Heidi Robinson, Director for Engagement at the Office of Deputy Assistant Secretary of Defense for Space Policy, U.S. Department of Defense, Steve Eisenhart, Senior Vice-President Strategic & International Affairs at The Space Foundation, Cassandra Steer, Interim Executive Director, Women in International Security, Canada, and Lt Col Manfred Schwiebert, Space Officer at the Strategy and Politics Department of the German Ministry of Defence

Brig Gen Friedling also underlined the need to have a strong strategic message and precise declaratory policy, to make it clear to your opponents – and your allies – what you intend to do, how you understand certain events and what will be your answer to specific actions in space. He also pointed out that the first French Defence Space Strategy (announced in July 2019) is a major development for France, as it recognizes space as the fifth warfighting domain and as being a crucial force enhancement for multi-domain operations. The new strategy also aims at improving further space surveillance capabilities with the goal of France being able to detect any space object of military interest by the end of 2020. The Strategy also introduces active defence, that is a means to protect and defend space systems.

Lt Col Manfred Schwiebert, Space Officer at the Strategy and Politics Department of the German Ministry of Defence, emphasized the importance of what he called the 'shaping' process of the space environment. Shaping, together with 'crisis management' and 'deterrence', are among the three main fundamental processes used in dealing with space incidents. It also includes soft power to accomplish military goals. It is defining standards by communicating, encouraging and discouraging and requires acting, not reacting. Lt Col Schwiebert pointed out that the allies have not been particularly successful at this process because of few space incidents demanding a response. At the same time, he admitted that any responses need to be carefully crafted as a nation does not want to expose itself unnecessarily before a certain threshold/or crisis materializes. At the same time, he thought that certain risks are worth taking to shape the environment, or others will do so, which may put us at a disadvantage. With regard to crisis management related to "space threats", Lt Col Schwiebert pointed out that "grey zone" activities are taking place below the threshold of what the international community considers a crisis.

Lt Col Manfred Schwiebert also noted that Germany is currently focusing mainly on building its SSA capabilities, specifically to strengthen knowledge of the space domain, as information is crucial to sound, measured action.

The panelists agreed that space deterrence is not limited to space and includes all the physical domains and the cyber domain. Space deterrence is not about how much force one needs, but about how much one needs to know. In short, information and the ability to assess and understand situations is crucial. The panelists pointed out that successful deterrence requires cross-domain options and is built on responsible behavior of the actors. Nevertheless, if the allies lose a conflict in space, they might also have lost it on the ground, at sea and in the air, and quite rapidly.

John Sheldon, Chairman of the ThorGroup GmbH, emphasized that space deterrence must not be approached separately but rather from a holistic perspective. Even though we might hear about "space war" or "cyber war", there is no such thing – there is only war. There is deterrence that includes the use of space capabilities.

The panelists agreed that responding to threats to space systems through another domain is probably the better approach, be that an alternative military response or non-military response. The panelists also concurred that responding through the economic and financial domain has the potential to be very effective, if carefully configured.



Dr. Cassandra Steer, Interim Executive Director, Women in International Security, Canada (left) and Lt Col Manfred Schwiebert (right)



Summary of Key Findings

- * Space deterrence must be approached from a holistic perspective, not separate from other domains
- * A key part of a deterrence strategy is to communicate one's position clearly and demonstrate the capabilities to respond
- * There are potentially serious risks to not responding to space abuses that are conducted in the 'grey zone' (i.e. below the threshold of triggering a clear military or political response)
- * Pro-active shaping of the space environment is crucial if we are to preserve a competitive advantage
- * The new French Defense Space Strategy recognizes space as the fifth warfighting domain and as being an essential enhancement for multi-domain operations; aims at improving further space surveillance capabilities; and introduces active defense as a means to protect and defend space systems

Panel 6: Private Sector Role in Space Security

Many in the space community are excited about the prospects for commercialization of space. Traditional players, as well as new private companies, seek to position themselves to provide commercial services beyond telecommunications, ranging from launch, Earth observation, SSA, on-orbit servicing, to mining on celestial bodies. This panel discussed the evolving role of the private sector in space security. It also probed Western space industry competitiveness globally, particularly vis-a-vis the predatory commercial/strategic practices of authoritarian space powers actively collecting their brand of international space partnerships. Finally, it assessed its status in supporting allied militaries (e.g. in resilience and deterrence).

The panel elaborated on several important aspects of the current trend of the commercialization of the space sector. The national security of a country and its commercial interests are increasingly viewed as convergent. It was pointed out that economic and financial activities which underpin space security have not been adequately addressed in our national and allied policies. Space-related business practices on the ground such as below-market pricing, forced transfer of intellectual property, undue dependencies, economic espionage and subsidized financing can constitute a serious threat.

What was once traditionally a national security realm is now becoming more prevalent in the private sector. For example, we already have private companies that are providing sub-meter resolution synthetic-aperture radar (SAR) imagery, as well as companies offering radio frequency geolocation. Companies such as HawkEye 360 or Kleos Space are getting into what might be considered "hardcore military intelligence" areas,

offering it as a commercial service. These SatCom and Earth observation (EO) services are being provided for a large number of government and commercial clients, which raises questions about risk and liability to which these companies could be exposed, and the awareness of these risks by the shareholders. There are also complexities stemming from the way the companies are structured. Kleos, for example, employs British engineers, is registered in Luxembourg, and listed on the Australian stock exchange.



Speakers on Panel 6 (from left) Kevin O'Connell, Director of the Office of Space Commerce, U.S. Department of Commerce, Bhavya Lal, Science and Technology Policy Institute, Institute for Defense Analyses (IDA), John B. Sheldon, Chairman, ThorGroup GmbH, Masahiro Atsumi, Vice President & Senior General Manager Space Systems Division, Mitsubishi Heavy Industries, and Agnieszka Lukaszczyk, Senior Director, European Affairs, Planet Labs, Inc.

Kevin O'Connell, Director of the Office of Space Commerce at the U.S. Department of Commerce, pointed out that in 2018 private investments in space hit an all-time high and there were no signs of it cooling down through the first quarter of 2019. Since 2009, commercial space investment has gone up 79%. The space economy has been labeled by some as having the potential to top \$1 trillion in the next 20 years (Morgan Stanley assesses that the market for space-related products and services will reach \$1.1 trillion by 2040, and the U.S Chamber of Commerce last projection was \$1.5 trillion in the same timeframe).¹⁰ With regard to the private sector role in space security, it seems to be on the rise. According to O'Connell, there are the following five building blocks which are critical for the "\$1 trillion space economy": innovation; improved SSA/STM; agile insurance and investment markets; talent; and a lighter regulatory environment.

O'Connell, also noted that governments should govern space innovation (if the business model is sustainable), not block it. He mentioned that as part of structurally keeping up with the rapidly developing industry, one of their initiatives is to talk to early startup entrepreneurs to enable the Commerce Department to configure appropriate regulations.

He also pointed out that only scant attention is being paid to how the commercial space market will

influence, or be influenced by, security developments in space and their effects on business on the ground. He mentioned that the Office of Space Commerce is trying to integrate thinking about the role of the private sector into national-level planning and doctrine (e.g. integrate commercial space activities into tabletop exercises and wargames, including the second and third order consequences). He further noted that there needs to be a better understanding concerning the consequences of the increasing reliance of the national security-relevant organizations on commercial companies. Companies are seeking new partnerships to access technologies and markets at an unprecedented rate. That puts a bigger burden on regulators concerning the intersection of commerce and national security.

Finally, O'Connell agreed that the economic and financial activities that underpin space security are underdeveloped and that nefarious activities in the E&F space domain are going largely unaddressed.



Kevin O'Connell, Director of the Office of Space Commerce, U.S. Department of Commerce

Dr. Bhavya Lal explained that, based on their recent research, the space market in China is evolving fast, and enjoys strong political support from the central government and financial support from provincial governments. On July 25, 2019, for example, the Chinese company iSpace successfully launched satellites (for Beijing Institute of Technology and CASIC Space, an affiliate of state-owned China Aerospace Science and Industry Corporation) for

¹⁰ Rayne, Rachel. "Space case. Why reaching for the stars could soon be a \$1 trillion industry." *CBS News*. July 16, 2019. <https://www.cbsnews.com/news/space-is-a-more-than-400-billion-market-and-getting-bigger/>.



the first time.¹¹ This was seen as an important achievement after unsuccessful launch attempts by other companies, LandSpace and OneSpace, in this strategically-important sector. It demonstrates China's determination to use new companies to facilitate its long-term strategic goals, including the advancement of its extensive military space program. These "commercial" launch companies, however, are dependent on technology developed by their state-controlled counterparts (e.g. China Aerospace Science and Technology Corporation).¹² During her opening remarks, Dr. Bhavya Lal pointed out the dearth of primary data research on China and the importance of studies such as those by IDA and PSSI .

China is currently preparing to release, possibly by 2023, its "first space law" that is to specify parameters for private sector participation in the space sector. This June, China announced a set of rules for the development of launch vehicles in the commercial sector¹³, jointly developed by the State Administration of Science, Technology and Industry for National Defense (SASTIND) and the Equipment Development Department of the Central Military Commission.¹⁴



Kevin O'Connell, Director of the Office of Space Commerce, U.S. Department of Commerce (left) and Bhavya Lal from Science and Technology Policy Institute, Institute for Defense Analyses (IDA) (right)

Overall, it was noted that China is acting strategically with regard to its space sector development, notably in the E&F domain, and that Chinese companies are seeking to be internationally competitive. The allies should, therefore, improve their cooperation and coordination in building and developing space infrastructure and provide a strong innovation platform that offers international investment opportunities to the space industry. Moreover, companies based in authoritarian regimes, such as China and Russia, do not follow free market principles which has serious implications for the space market development and the future competitiveness of the Japanese, U.S. and European companies.

Masahiro Atsumi, Vice President & Senior General Manager of the Space Systems Division at Mitsubishi Heavy Industries, pointed out that his company seeks flexibility when building new systems, such as the H3 launch vehicle. At the same time, he noted, new systems and technological developments lead to an increased number of space systems that will require better coordination. He noted that commercial space actors need to consider space security-related issues and behave responsibly in space and that governments should share information about various threats with companies.

Agnieszka Lukaszczyk from Planet stated that her company aims to set an example in this regard and strives to be a model of responsible behavior for other commercial space actors, including those developing mega-constellations. She also added that the goal of their company is to index the Earth the way Google has indexed the internet. They want to use machine learning and AI to enable instant understanding of what is happening on the surface of our planet (e.g. counting the number of ships in a certain area; observing natural disasters, etc.). Many of these applications are dual-use and can be used for terrestrial security/defense

11 Hancock, Tom. "Chinese space company hails first successful satellite launch." *Financial Times*. July 25, 2019. <https://www.ft.com/content/d2ea53f2-aec1-11e9-8030-530adfa879c2>.

12 Ibid.

13 "国家国防科技工业局 中央军委装备发展部关于促进商业运载火箭规范有序发展的通知". State Administration of Science, Technology and Industry for National Defense, PRC. June 10, 2019. <http://www.sastind.gov.cn/n112/n117/c6806483/content.html>

14 Jones, Andrew. "Chinese commercial launch sector regulations released, new launch vehicle plans unveiled." *Space News*. July 2, 2019. <https://spacenews.com/chinese-commercial-launch-sector-regulations-released-new-launch-vehicle-plans-unveiled/>.

purposes. However, in light of transparency and their goal to „make the planet a better place“ all of their data is unclassified. They provide data to both the private sector and government. Their data also appears in media (e.g. images of existing illegal nuclear facilities; the recent nuclear test conducted by North Korea, etc.).

According to the panelists, consideration should be given to finding ways to streamline standards and regulations for all commercial space actors. Private space pioneers such as Elon Musk or Jeff Bezos, traditional large aerospace companies aligned with the government and NewSpace actors like Planet may tend to act differently with regard to space norms. NewSpace companies have different interests and operate differently. They are less organized, profit-oriented and do not want to take unnecessary risks. Hence, their decisions are made on different principles than those of larger companies.



From left: John B. Sheldon, Chairman, ThorGroup GmbH, Masahiro Atsumi, Vice President & Senior General Manager Space Systems Division, Mitsubishi Heavy Industries, and Agnieszka Lukaszczyk, Senior Director, European Affairs, Planet Labs, Inc.

The speakers acknowledged the increasing challenge to commercial space assets and operations stemming from cyberattacks. A better framework for intelligence-sharing among companies and the government would go a long way towards mitigating such threats. For their part, governments should identify the most robust level of unclassified information and provide it to companies when their assets are at risk.

Summary of Key Findings

- ★ Understanding economic and financial activities which implicate space security is underdeveloped and nefarious activities in the E&F space domain are largely going unaddressed (e.g. below-market pricing, subsidized financing, unfair trade practices, forced transfer of intellectual property, economic espionage, etc.)
- ★ In response to predatory Chinese and Russian E&F activities, the U.S. should improve its cooperation and coordination with partners in building and developing space infrastructure and providing innovation systems that offer investment opportunities to the space industry
- ★ Governments have to proactively reach out to the emerging startups to structurally keep up, as well develop an understanding of the most appropriate regulatory options
- ★ Satcom and Earth observation (EO) services are being provided by private companies to a large number of government and commercial clients raising questions about risk and liability
- ★ The size of the space industry is hard to quantify, but, based on expert opinion, has the potential to exceed \$1 trillion by 2040
- ★ Consideration should be given to finding ways to streamline standards and regulations for all commercial space actors. Private space pioneers such as Elon Musk or Jeff Bezos, traditional large aerospace companies aligned with the government and NewSpace actors like Planet have different approaches to space norms and standards



III. What's Next

There is an active effort underway by China and Russia to eliminate future opportunities for U.S. and Western firms to provide space-related equipment, technology and services to a large range of countries internationally as part of their efforts to forge their brand of "international space partnerships". This is also relevant to commercial space businesses as their future export markets are steadily contracting. From a policy perspective, it is not in America's, Japan's or other allies' interest to have a country such as China, which suppresses human rights and political freedoms at home, become a leading voice in creating global norms of behavior in space and promoting its vision of the space environment.

PSSI will continue its efforts to curtail the increase in the number of non-democratic international partnerships established by China and Russia. PSSI,

working with key decision-makers in government and industry, will aim to focus attention on these and related issues and help advance policy goals in this area through various presentations, articles, as well as a roundtable, planned for late March 2020. The planned roundtable will raise issues such as: Will the future space environment be open and accessible for global commerce? Will it offer an even playing field for free-market practices or be a wired game featuring long-term, sole-source contracts? Will it be governed by behavioral norms reflecting our fundamental values and principles or those of police states? PSSI also plans to publish an article concerning the strategic competition for space partners and markets in the second edition of the Springer Handbook of Space Security. Finally, the Institute plans to concentrate the topic of its sixth PSSI Space Security Conference to a greater extent on this and related topics.

List of Acronyms

ASAT – Anti-Satellite
CFSP – The Common Foreign and Security Policy
EEAS – European External Action Service
E&F – Economic and Financial
EGNOS – European Geostationary Navigation Overlay Service
EO – Earth Observation
EU – European Union
GEO – Geosynchronous Equatorial Orbit
GNSS – Global Navigation Satellite System
GovSatcom – Governmental Satellite Communications
HEO – Highly Elliptical Orbit
HR – High Representative of the Union for Foreign Affairs and Security Policy
LEO – Low Earth Orbit
MEO – Medium Earth Orbit
NEO – Near Earth Objects
OST – Outer Space Treaty
PRS – Public Regulated Service
RF – Radio Frequency
RFI – Radio-Frequency Interference
RPO – Rendezvous and Proximity Operations
SAR – Synthetic-aperture Radar
Satcom – Satellite Communications
SDA – Space Domain Awareness
SpOP – Space Operations Centre
SSA – Space Situational Awareness
SST – Space Surveillance and Tracking
UNCOPUOS – United Nations Committee On the Peaceful Uses of Outer Space



Appendices

Appendix 1: Conference Program

SUNDAY, 9 JUNE 2019

Venue: Golden Well Restaurant (Terasa U Zlaté Studně), U Zlaté Studně 166/4, Prague 1

- 18:00–20:00 **OPENING RECEPTION** (by special invitation only)
Opening Remarks:
Roger W. Robinson Jr., Chairman and Co-Founder, Prague Security Studies Institute
Peter Martinez, Executive Director, Secure World Foundation

MONDAY, 10 JUNE 2019

Venue: Ministry of Foreign Affairs of the Czech Republic, Czernin Palace, Loretánské nám. 5, Prague 1

- 8:30–9:00 **COFFEE AND REGISTRATION**

- 9:00–9:30 **OPENING SESSION**
Welcome Remarks:
Roger W. Robinson Jr., PSSI Chairman and Co-Founder, Prague Security Studies Institute
Peter Martinez, Executive Director, Secure World Foundation
Opening Remarks:
Aleš Chmelař, Deputy Minister of Foreign Affairs for European Issues, Czech Republic

- 9:30–10:45 **PANEL 1: EVOLUTION OF THE COUNTERSPACE THREAT**
The space domain is rapidly evolving. An increasing number of countries and commercial actors are getting involved in space, resulting in more innovation and benefits on Earth, but also more congestion and competition in space. From a security perspective, an increasing number of countries are looking to use space to enhance their military capabilities and advance their strategic agendas. The growing use of, and reliance on, space for national security has also led more countries to consider the development of their own counterspace capabilities that can be used to deceive, disrupt, deny, degrade, or destroy space systems. This has the potential to heighten tensions on the ground that extend into space, or vice versa. Panelists will discuss the current status of counterspace capabilities globally, highlighting recent trends and predicting what the domain could look like in the relatively near-term. Finally, the panel will seek to address the most promising mitigation measures.
Moderator: Victoria Samson, Washington Office Director, Secure World Foundation
Panelists:
Jamie M. Morin, Vice President, Defense Systems Operations, Center for Space Policy and Strategy, The Aerospace Corporation
Martina Šmuclerová, Senior Fellow, Prague Security Studies Institute
Shuzo Takada, Director-General, National Space Policy Secretariat, Cabinet Office, Japan
Ashley J. Tellis, Senior Fellow, Carnegie Endowment for International Peace

- 10:45–11:00 **COFFEE BREAK**
- 11:00–12:30 **PANEL 2: SPACE DOMAIN AWARENESS AND HYBRID OPERATIONS**
The introduction of Offensive Cyber and Counterspace operations into the arena of international conflict has led to situations where activities short of military action are more easily employed by malign actors to accomplish strategic goals without the fear of clear attribution. To an ever-expanding degree, these tools are being used in combination with more traditional forms of non-military activities to coerce behavior that would have previously required more overt aggression. The difference here is in the ability to use non-kinetic cyber and other 'grey zone' actions. Given these realities, what role does space domain awareness activities play in this dynamic, and what new or enhanced capabilities are required to deter or respond to this type of space-related hybrid warfare?
Moderator: Douglas L. Loverro, former U.S. Deputy Assistant Secretary of Defense for Space Policy
Panelists:
Peter L. Hays, Associate Director, Eisenhower Center for Space and Defense Studies
Travis Langster, Vice President, Space Situational Awareness Business, Analytical Graphics, Inc. (AGI)
Pascal Faucher, EUSST Chairman and Security and Defense Officer, French Space Agency (CNES)
Dana J. Johnson, Director, International Outreach and Policy, Office of the Under Secretary of Defense (Research and Engineering), U.S. Department of Defense
- 12:30–13:00 **SPECIAL ADDRESS:**
Kai-Uwe Schrogl, Chief Strategy Officer, seconded to the German Federal Ministry for Economic Affairs and Energy, European Space Agency (ESA)
Carine Claeys, Special Envoy for Space (acting), Space Task Force, European External Action Service (EEAS)
Introduced by:
Václav Kobera, Director, Intelligent Transport Systems, Space Activities and R&D Department, Ministry of Transport of the Czech Republic
- 13:00–13:45 **BUFFET LUNCHEON**
Keynote Remarks: Toshihiko Kasahara, Deputy Director, Cabinet Satellite Intelligence Center (CSICE), Japan
Introduced by:
Peter Martinez, Executive Director, Secure World Foundation (SWF)
- 14:00–15:30 **PANEL 3: SPACE RESILIENCE AND RISK MITIGATION**
Resilient architecture should be able to support all necessary mission functions, including during hostile actions or across a range of adverse scenarios, conditions, and threats. It should be able to leverage cross-domain or alternative capabilities (government, commercial or partner). To what extent are our space architectures resilient today and what is missing in our space policies to ensure space resiliency in the long-term?
Moderator: Jean-Jacques Tortora, Director, European Space Policy Institute (ESPI)
Panelists:
Carine Claeys, Special Envoy for Space (acting), Space Task Force, European External Action Service (EEAS)
Kevin Mcloughlin, Head of Space Security, UK Space Agency
Hiroshi Koyama, Fellow, Electronic Systems Group, Mitsubishi Electric Corporation
Tanja E. Zegers, Policy Officer, DG for Internal Market, Industry, Entrepreneurship and SME – DG GROW
- 15:30–15:45 **COFFEE BREAK**



- 15:45 – 17:30 **PANEL 4: INTERNATIONAL SPACE PARTNERSHIPS: COMPETITION OR COLLABORATION?**
Absent strengthened international space cooperation, civilian and commercial space assets, services and applications will likely be at considerably greater risk due to the increasingly competitive and contested space environment. At the same time, the U.S. national space strategy puts America first, Europe calls for greater strategic autonomy, including in space, and Japan recognizes a national need to develop its own strategic space capabilities. This begs the question of how these high-level strategic national security initiatives affect allied space security cooperation operationally. This is especially relevant as our competitors, notably China and Russia, are undertaking to challenge the current international governance regime, including through forging their brand of international space partnerships, accompanied by an effort to gain technological superiority. This panel will discuss options for strengthening trilateral efforts to establish more robust global space partnerships and space norms based on transparency, the rule of law and recognition that a heated competition is well underway.
Moderator: Jana Robinson, Space Security Program Director, Prague Security Studies Institute
Panelists:
Regina Peldszus, Senior Policy Officer, Department of Space Situational Awareness, DLR Space Administration
John P. Stopher, Principal Assistant to the Secretary of the U.S. Air Force for Space
Ajey Lele, Senior Fellow, Institute for Defence Studies and Analyses (IDSA), India
Eric Desautels, Director, Office of Emerging Security Challenges, Bureau of Arms Control, Verification and Compliance, U.S. Department of State
- 19:15 **GALA DINNER (BY SPECIAL INVITATION ONLY)**
Venue: Mlýnec Restaurant, Novotného lávka 9, Prague 1
- Keynote Speaker: Lt Gen David D. Thompson**, Vice Commander, U.S. Air Force Space Command
Introduced by: Roger W. Robinson Jr., Chairman and Co-Founder, Prague Security Studies Institute

TUESDAY, 11 JUNE 2019

Venue: Ministry of Foreign Affairs of the Czech Republic, Czernin Palace, Loretánské nám. 5, Prague 1

- 7:30–8:00 **COFFEE AND REGISTRATION**
- 8:00–8:45 **OPENING SESSION**
Opening Remarks:
Andrea L. Thompson, Under Secretary for Arms Control and International Security, U.S. Department of State
Introduced by: Jana Robinson, Space Security Program Director, Prague Security Studies Institute
- 8:45–10:15 **PANEL 5: DETERRENCE AND SPACE CRISIS MANAGEMENT**
As referenced in panel 2 on "Space Domain Awareness and Hybrid Operations", the employment of hybrid operations for the achievement of strategic goals without the fear of clear attribution is becoming an increasingly popular counterspace go-to option. Is it past time to expand space-related deterrence measures, including pre-crisis communication of specific consequences that will befall a space-faring nation that engages in cyberattacks, jamming/spoofing, dangerous proximity operations and other forms of activities in this 'grey zone'? Is there an allied crisis management architecture in place that can be instantly activated in the event of a serious denial of services or damage to space assets? What should be the thresholds for triggering a crisis management response? The goal of this panel is to address these and related issues.

Moderator: Steve Eisenhart, Senior Vice-President Strategic & International Affairs, The Space Foundation

Panelists:

Brig Gen Michel Friedling, Commander, Joint Space Command, Ministry of Defence, France

Heidi Robinson, Director for Engagement, Office of Deputy Assistant Secretary of Defense for Space Policy, U.S. Department of Defense

Cassandra Steer, Interim Executive Director, Women in International Security, Canada

Lt Col Manfred Schwiebert, German Ministry of Defence

10:15–10:45

COFFEE BREAK

10:45–12:30

PANEL 6: PRIVATE SECTOR ROLE IN SPACE SECURITY

Many in the space community are excited about the prospects for commercialization of space. Traditional players, as well as new private companies, seek to position themselves to provide commercial services beyond telecommunications, ranging from launch, Earth observation, SSA, on-orbit servicing, to mining on celestial bodies. This panel will discuss the evolving role of the private sector in space security. It will also probe Western space industry competitiveness globally, particularly vis-a-vis the predatory commercial/strategic practices of non-democratic space powers collecting their brand of international space partnerships. Finally, it will assess its status in supporting allied militaries (e.g. in resilience and deterrence).

Moderator: John B. Sheldon, Chairman, ThorGroup GmbH

Panelists:

Kevin O’Connell, Director of the Office of Space Commerce, U.S. Department of Commerce

Bhavya Lal, Science and Technology Policy Institute, Institute for Defense Analyses (IDA)

Masahiro Atsumi, Vice President & Senior General Manager Space Systems Division, Mitsubishi Heavy Industries

Agnieszka Lukaszczyk, Senior Director, European Affairs, Planet Labs, Inc.

12:30–13:30

CLOSING LUNCHEON



Appendix 2:

Remarks of Andrea Thompson, the U.S. Under Secretary of State for Arms Control and International Security (as prepared)

Jana, thank you for those kind welcoming remarks. I am the other Thompson that is here today to give remarks on behalf of the United States on space security issues. In the U.S. if you are going to have a meeting on space security issues, you are guaranteed to have at least one Thompson in the room, sometimes more. It can get a bit confusing.

I want to start by thanking PSSI for hosting this fifth conference and inviting me to give some remarks. It is an exciting time to be working on space issues. This is a period of technological change and innovation that has significant policy implications. It is an issue that is a priority for this Administration as evidenced by the reestablishment of a National Space Council chaired by Vice President Pence and four Presidential space directives. At the President's direction, the United States is working to establish a U.S. Space Force and a U.S. Space Command, which will help to focus our attention on the emergent threats in the space domain. I would add that space holds a personal connection for me as a former cadet of mine from West Point, Lieutenant Colonel Anne McClain, is currently orbiting the earth on the International Space Station.

Finally, from a historical perspective, 2019 is also the fiftieth anniversary of the Apollo 11 landing on the moon; and there is a renewed national commitment to get back to the moon.

In a world that is ever more reliant on space capabilities, it is important for this conference to address topics such as deterrence and space crisis management, and the role of the private sector in space security. That latter is really important and challenging. There is not much distinction in outer space between a number of important governmental and private sector activities. Our governments rely more and more upon private companies for satellite communications and imagery as well as space launch and other support functions. Private sector space systems and their supporting ground infrastructures already are targets. Against this

backdrop we should begin thinking now and together about the responsibility of governments to those private companies in a crisis or conflict.

For my remarks, I'd like to provide my perspective on two subjects related to this agenda. First, I want to discuss what the State Department is doing to enhance deterrence in the space domain and second, let me talk about the need for rules to enhance crisis stability.

First, let me start by reiterating what you have heard before, space has become a warfighting domain. Russia and China have made it so. It was China that conducted an anti-satellite test in 2007 that created thousands of pieces of debris; a system which the U.S. Intelligence Community has determined is operational in China. It is Russia that has publicly announced the deployment of a ground-based anti-satellite laser. And it is those two countries that are conducting sophisticated and concerning on orbit activities. All of this is occurring both literally and figuratively in a vacuum. In the land, sea and air domains, we have considerable experience in developing rules of responsible behavior, known as the laws of armed conflict. Those terrestrial

laws apply to outer space, but we don't have any specific rules for conflicts that extend to outer space and that is a problem that can lead to miscalculations in a crisis or significant consequences to those operating in the space domain.

So, what do we need to do about it? As Vice President Pence said, the United States seeks to "forge a new era of peace through strength in outer space." Under the President's National Space Strategy, the United States will seek to deter, counter, and defeat threats in the space domain that are hostile to the national interests of the United States and our allies. Accordingly, the Administration's new strategy calls for strengthening the safety, stability, and sustainability of our space activities. You've heard about the Space Force. That is

just one aspect of the U.S. comprehensive approach to enhancing deterrence.

A key part of any deterrence strategy is communicating your position in a clear manner. For the first time, this Administration has taken steps to ensure that global competitors know we take the security of our space-based assets seriously by including a declaratory policy in the National Security Strategy. That strategy affirms that "any harmful interference with or attack upon critical components of our space architecture that directly affects this vital interest will be met with a deliberate response at a time, place, manner, and domain of our choosing." We use the phrase "space architecture" to describe both the space-based systems and the associated ground infrastructure that is critical to the operation of satellites. Depending upon the mission and situation, this space architecture includes U.S. Government owned systems, U.S.-licensed commercial systems as well as the space systems of an allied or foreign partners. Finally, just because interference or an attack occurs in space, this statement from the National Security Strategy makes clear that a U.S. or combined response may come in any domain. We will decide when and where to respond.

This is an incredibly important statement of policy and our competitors should reflect on the fact that we are serious about the consequences of an attack on our space assets.

We also address the issues of attacks on our space-based Nuclear Command, Control and Communications (known as NC3) systems in the Nuclear Posture Review. That review calls for the United States to ensure that our space-based NC3 assets are resilient and agile, thereby deterring potential attacks against those systems.

It is also important to note that these efforts to deter conflict in space are not something the United States is undertaking alone. We recognize the importance of our allies in this effort and have begun working closely with them to address these threats. That is why we welcomed NATO's adoption of language at the Brussels Summit calling for the development of an overarching NATO Space Policy. That is why every year the G7 Statement includes language on space security. That

is why we include allies in the Schriever Wargame series so we can harmonize our plans and policies. And, that is why the State Department leads bilateral dialogues with our allies as well as partners like the European Union to discuss space security and how we can cooperate together to address these threats.

We recognize that it is through these collective efforts that we can deter these threats.

So that brings me to my second topic, how do we manage the competition to prevent a conflict in space. To do that, we believe we need to work collectively to develop rules of behavior that can prevent miscalculations in a crisis or limit the consequences of a conflict from extending into outer space. We cannot leave it to Russia and China to establish the norms or rules for operating in space. It is the responsible countries represented in this room that must lead on these developments.

Miscalculations is a particular issue we are focused on in the United States. Russia has publicly displayed its ground-based anti-satellite laser. We are literally talking about combat at the speed of light. What are the crisis implications of that type of system? When faced with attacks that can unfold at the speed of light damage to or destruction of critical national security satellites, there is going to be a tendency not to want to absorb the first blow.

Or what if a potential adversary starts moving a satellite close to a U.S. or allied satellite in a crisis? Depending on a range of factors, some that may be unknown to the potential adversary, that type of close-approach may be viewed as threatening. But, as long as this satellite's maneuvers are not deemed to be causing "harmful interference" with your satellite, there are currently no clear guidelines for preventing a collision or defending from a hostile action. What are the impacts of such actions on crisis stability?

That is why we need to work together as allies to develop these rules of behavior. We need to understand what actions can cause challenges or create threats. I look forward to hearing your thoughts on these subjects in the coming panels and I look forward to engaging with you in the coming months on these topics.



One area where progress has been made on this issue is in the United Nations Committee on Peaceful Uses of Outer Space. In particular, U.S. government and private sector experts have worked closely with our allies and other members of the Committee over the past decade to develop 21 consensus guidelines for the long-term sustainability. These voluntary, non-legally binding guidelines represent best practices for spaceflight safety. They are an important set of transparency and confidence building measures (TCBMs). Along with our G7 partners, we believe the practical implementation of these guidelines by all spacefaring nations should serve as the basis for further work by COPUOS in the coming years and also serve as a foundation for other bilateral and multilateral TCBMs.

Finally, I would be remiss as the Under Secretary for Arms Control and International Security to not make a few comments on why arms control isn't our preferred approach to dealing with the security situation in outer space. In many cases, arms control is an appropriate response to dealing with a particularly difficult security issue. But, we are not there yet in outer space. We cannot define a "space weapon" without potentially foreclosing promising opportunities for commercial activities like on-orbit servicing or active space debris removal capabilities. It is exceedingly difficult to verify the existence of weapons in space and credible verification is the cornerstone of compliance with any arms control treaty. Finally, we need willing and

trustworthy partners, and we just don't have those. To those who have offered flawed space arms control proposals – we have been clear in our objections and why these proposals would decrease stability – the opposite of any well-constructed arms control treaty. That is why the United

States is focused on advancing and developing norms of behavior in outer space and best practices for space operations, not legally-binding treaties driven by lowest-common denominator agreements that undermine existing norms and principles.

As Vice President Pence has noted, "President Trump and our entire administration believe it is our duty to ensure that our most cherished values and ideals are the foundation of our future in space — that it's a future of freedom, of free commerce, and free enterprise, and security."

So to conclude, let me state that the rules and values of space, like every great frontier, will be written by those who had the courage to get there first and the commitment to stay. As the United States renews its commitment to leadership in space, we welcome opportunities to work together with you, your governments and your companies to ensure an orderly space environment so that all humanity can have a secure and prosperous future on this infinite frontier.

Acknowledgements

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International Security, U.S. Department of State, Lt. Gen David D. Thompson, Vice Commander, United States Air Force Space Command, Toshihiko Kasahara, Deputy Director, Cabinet Satellite Intelligence Center (CSICE), Japan, Kai-Uwe Schrogl, Chief Strategy Officer, seconded to the German Federal Ministry for Economic Affairs and Energy, European Space Agency (ESA), and Carine Claeys, Special Envoy for Space (acting), Space Task Force, European External Action Service (EEAS).

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About the Authors

Dr. Jana Robinson is currently Space Security Program Director at the Prague Security Studies Institute (PSSI). She previously served as a Space Policy Officer at the European External Action Service (EEAS) in Brussels, as well as a Space Security Advisor to the Foreign Ministry of the Czech Republic. From 2009 to 2013, Ms. Robinson worked as Resident Fellow at the European Space Policy Institute (ESPI), seconded from the European Space Agency (ESA), leading the Institute's Space Security Research Programme. Prior to joining ESPI, Dr. Robinson served as Development Director at PSSI from 2005 to 2009, and administered its affiliate organization in Washington DC, PSSI Washington. Ms. Robinson is an elected member of the International Institute of Space Law (IISL) and the International Academy of Astronautics (IAA). She is also a member of the Advisory Board of the George C. Marshall Missile Defense Project of the Center for Strategic and International Studies (CSIS) in Washington, D.C. Ms. Robinson holds a PhD from the Charles University's Faculty of Social Sciences, Institute of Political Studies, in the field of space security. She also holds two Master's Degrees, from George Washington University's Elliott School of International Affairs and Palacky University in Olomouc, respectively. She received scholarships to attend the International Space University's (ISU) 2009 Space Studies Program (SSP09), the 2008 Summer Training Course at the National Taiwan Normal University in Taipei, and a one-year course of study at Shanghai University 1999–2000.

Tereza Barbora Kupková is a former Project Coordinator within PSSI's Space Security Program. Her work included a range of activities, including in-depth research and analyses and speaking engagements at international gatherings. Prior to this role, she provided independent analyses to a member of the Czech Senate Committee for Foreign Affairs, Defence, and Security and her research interests have revolved around the strategic importance of NATO and its intra-Alliance dynamic, forms of hybrid warfare and innovative defence mechanisms, as well as the discourse surrounding contemporary controversies within *jus*

ad bellum and *jus in bello*. Ms. Kupkova holds an MSc in Security Studies with Distinction from University College London and a First-Class MA (Social Sciences) in Politics / Central and Eastern European Studies from the University of Glasgow. She also spent a semester at Université de Genève in Switzerland and is a co-founder of the academic non-profit Yoda Mentorship Programme.

Patrik Martínek is a Program Assistant within the PSSI's Space Security Program involved in various space security projects including primary data gathering, in-depth research and analyses of Chinese and Russian economic and financial (E&F) activities in the space sector. He holds a bachelor's degree in International Studies and Diplomacy from the University of Economics in Prague, where he is currently pursuing a Master's degree in International Politics and Diplomacy. Mr. Martínek is an alumnus of the PSSI's Robinson-Martin Security Scholars Program and will be spending the 2020 spring semester abroad in the Paris Institute of Political Studies in France. His main areas of interest are diplomacy and space security. His bachelor's thesis focused on the current general trends in space security and for his master's thesis he plans to conduct research on SSA and dual use technologies.

Jakub Pražák is a Project Assistant in PSSI's Space Security Program since June 2018. Prior to joining PSSI, he was an intern at the Ministry of Defence and at the National Cyber and Information Security Agency. He is currently finishing his Master's degree in International Relations and is pursuing a PhD degree in International Relations at the Charles University. Mr. Pražák holds a Bachelor's degree in Political Science and International Relations and a Master's degree in Security Studies at the Faculty of Social Sciences. He also spent a semester abroad at the Tallinn University in Estonia and is anticipated to spend the upcoming semester at the Uppsala University in Sweden. His research primarily focuses on space weapons and dual-use technology. Mr. Pražák recently co-published an article about Active Debris Removal Systems in the Space Policy Journal.

