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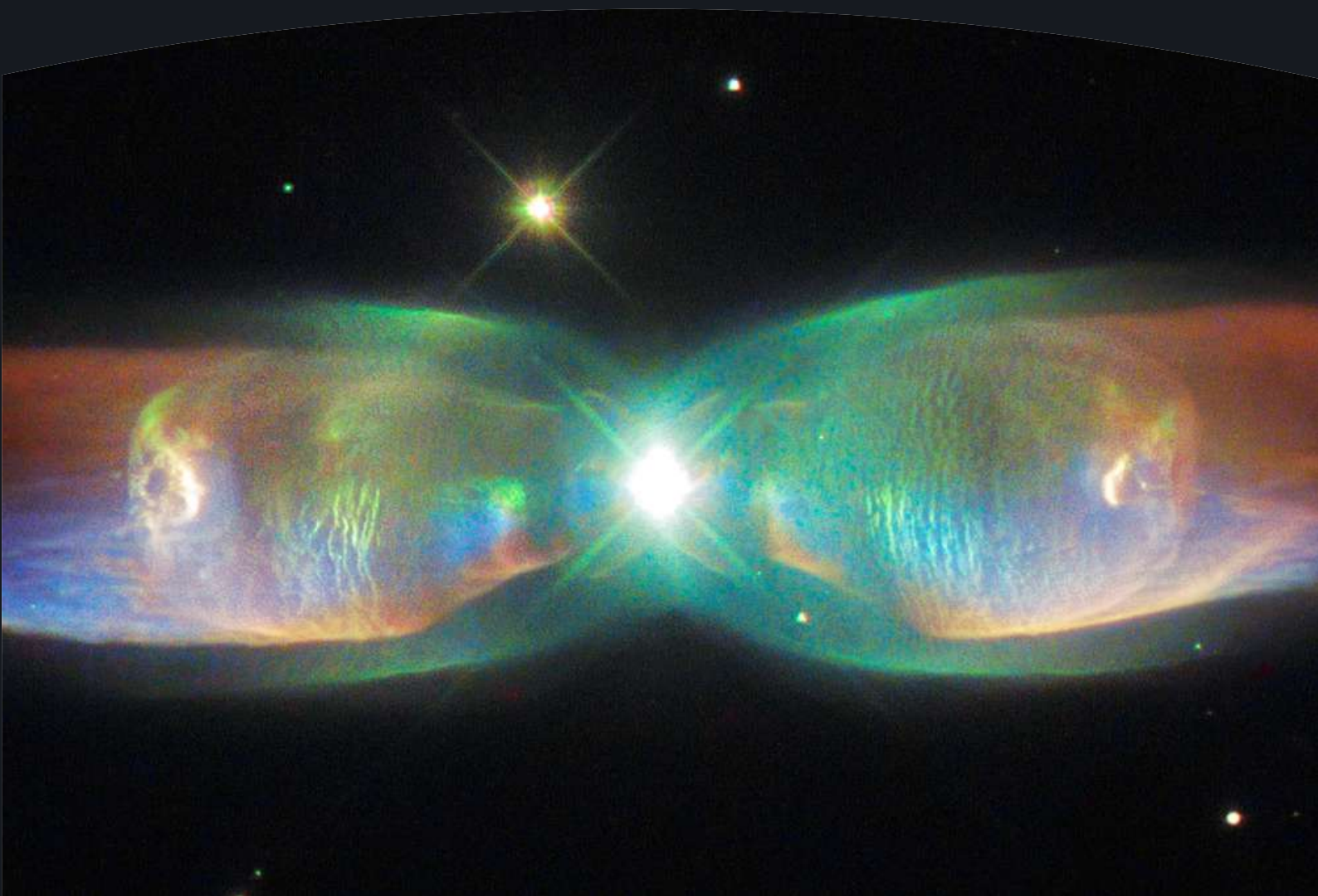
2025 Outer Space Security Conference Report

CHELSEA MAI · THANDO MATHE



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About UNIDIR

UNIDIR is a voluntarily funded, autonomous institute within the United Nations. One of the few policy institutes worldwide focusing on disarmament, UNIDIR generates knowledge and promotes dialogue and action on disarmament and security. Based in Geneva, UNIDIR assists the international community to develop the practical, innovative ideas needed to find solutions to critical security problems.

Notes

This report constitutes both a summary and analysis of the discussions and exchanges that took place at UNIDIR's Outer Space Security Conference held at the Palais des Nations in Geneva on 9–10 September 2025. Where this document reports or refers to statements made by panellists, every effort has been made to provide a fair representation of their views. The actual content and flow of the report, however, may differ slightly from the panellists' delivery and their presentations.

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About UNIDIR'S strategic partners for OS25

Centre for International Governance Innovation (CIGI) is an independent, non-partisan think tank whose peer-reviewed research, foresight and trusted analysis influence policymakers to innovate. With the engagement of a global network of experts and contributors, CIGI tackles the governance challenges and opportunities of data and transformative technologies, including artificial intelligence, and their impact on the economy, security, democracy and, ultimately, societies.

Secure World Foundation is a private operating foundation dedicated to the secure and sustainable use of space for the benefit of Earth and all its peoples. It works with governments, industry, international organizations and civil society to develop and promote ideas and action for international collaboration. The Foundation's aim is to achieve secure, sustainable and peaceful use of outer space.

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Abbreviations and acronyms

AI	Artificial intelligence
ASAT	Anti-satellite capability
ATLAC	Action Team on Lunar Activities
COPUOS	Committee on the Peaceful Uses of Outer Space
GGE	Group of Governmental Experts
GEO	Geostationary Earth orbit
GNSS	Global Navigation Satellite System
GLONASS	Global'naya Navigatsionnaya Sputnikovaya Sistema (Global Orbiting Navigation Satellite System)
GPS	Global Positioning System
ICBM	Intercontinental ballistic missile
ICAO	International Civil Aviation Organization
LBI	Legally binding instrument
IMO	International Maritime Organization
ISS	International Space Station
ITU	International Telecommunication Union
IHL	International humanitarian law
KYC	Know your customer
LEO	Low Earth orbit
LLM	Large language model
LTS	Long-term sustainability (of outer space activities)
OEWG	Open-ended Working Group
PAROS	Prevention of an arms race in outer space
PPWT	Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects
RPO	Rendezvous and proximity operations
SDA	Space domain awareness
SSA	Space situational awareness
TCBM	Transparency and confidence-building measures
UN	United Nations
UNIDIR	United Nations Institute for Disarmament Research
UNOOSA	United Nations Office for Outer Space Affairs

Geneva, Switzerland, 2025. 2025 OUTER SPACE SECURITY CONFERENCE. Credit: © Diana M Photography

Introduction

UNIDIR hosted its annual Outer Space Security Conference on 9–10 September 2025 at the Palais des Nations in Geneva. This two-day flagship event convened over 1,000 participants, both in person and online, providing a platform for dialogue on key issues in space security. The 2025 Outer Space Security Conference (OS25) opened with a high-level panel featuring the heads of the United Nations Institute for Disarmament Research (UNIDIR), the International Telecommunication Union (ITU), and the United Nations Office for Outer Space Affairs (UNOOSA). The discussion focused on the importance of multilateral leadership in shaping space governance, a theme further reinforced by remarks from the UN High Representative for Disarmament Affairs, which opened the second day's discussions.

This year's panel discussions brought together representatives from the diplomatic community, as well as experts from industry, academia, and civil society, to explore a range of pressing issues in outer space security. On Day 1, panels addressed emerging technologies and their impact on space security, mapped threats to space systems and their consequences for both space and Earth and examined evolving approaches to implementing space security and the prevention of an arm race in outer space (PAROS) in all its aspects.

Day 2 discussions examined and explored the security of cislunar space and beyond; strategic unpredictability in the space domain, including intersections, escalation, and restraint; and the evolving roles, responsibilities, and challenges posed by commercial actors in maintaining space security. The Conference also featured an interactive technology demonstration, giving participants an up-close look at space debris removal hardware. In addition, a discussion with a leading science-fiction author highlighted the role of storytelling in understanding emerging space security challenges.

Moreover, as part of the second edition of the Youth Video Competition, the conference highlighted the perspectives on space security from young professionals and students. Four competition winners had their videos premiered during the event and provided an overview of the inspiration behind their submissions. This document presents a summary of the key discussions and outcomes of the OS25 conference.

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Keynote conversation — bridging vision and responsibility: challenges and opportunities for a secure space future

OS25 opened with a high-level panel featuring Robin Geiss, Director of UNIDIR; Doreen Bogdan-Martin, Secretary-General of ITU; and Aarti Holla-Maini, Director of UNOOSA, who discussed the important role multilateral institutions play to ensure that outer space remains secure, sustainable, and inclusive. The discussion focused on the interplay between international governance, capacity-building, and collaborative frameworks for space security.

In their opening remarks, the panel members underscored the importance of the Outer Space Treaty as the cornerstone of global space governance. The Director of UNIDIR noted that the Outer Space Treaty remains a flexible and enduring framework, capable of adapting to evolving technological and operational realities in outer space. The Director of UNIDIR further identified four key trends that will shape the future of space security: (i) growing concerns over the acceptance of outer space as a warfighting domain, which could lead to proliferation of the testing of counterspace capabilities; (ii) rapid technological development through the integration with space systems of new technologies such as artificial intelligence (AI); (iii) the increasing number of space systems and actors in outer space; and (iv) the dual-use nature of many space systems which blur the line between civilian and military uses, as well as the dual-purpose nature of some space objects, which can blur the line between peaceful and aggressive purposes. UNIDIR's director underscored the importance of shared responsibility across

institutions and mandates to address these challenges and to ensure that outer space remains safe and secure.

Building on this, the heads of the ITU and UNOOSA discussed how multilateral institutions are already contributing to space security, and how they can continue to play an important role in maintaining the security, safety, and sustainability of outer space. Both emphasised that international bodies are uniquely positioned to promote compliance with existing legal and normative frameworks, facilitate coordination among diverse actors, and strengthen national capacities.

ITU Secretary-General, Doreen Bogdan-Martin expressed the importance of ensuring that outer space remains free from harmful radio interference, highlighting the security implications of intentional jamming and spoofing of space systems, which can negatively affect all space systems and the services they provide. While jamming and spoofing were identified as major intentional acts targeting GNSS systems, the head of ITU recognized that unintentional interference has been on the rise for several reasons such as the increasing number of satellites, shared use of frequency bands, uncoordinated or non-transparent orbital manoeuvres, and insufficient coordination of frequency assignments.

The head of the ITU identified three areas where multilateral institutions can work together to address these challenges: (i) continuous regulatory evolution, such as the ITU's Radio Regulations, which are updated every four years; (ii) international cooperation involving a wide range of stakeholders, which can contribute to solving shared challenges and establishing technical standards; and (iii) capacity-building efforts to strengthen national expertise and compliance with existing regulations.

The Director of UNOOSA, Aarti Holla-Maini noted that while the work of UNOOSA and the Committee on the Peaceful Uses of Outer Space (COPUOS) focuses on the peaceful uses of outer space, the work done in Geneva and Vienna are two sides of the same coin, providing room for synergies that can address shared challenges. For example, the head of UNOOSA noted that the mandate of COPUOS was reinforce by Action 56 of the Pact for the Future which called for new frameworks for space traffic management, space debris, and space resource governance.[1] Preventing collisions, managing debris, and establishing fair rules for resource use are all also important for long-term space security. Like ITU's Secretary-General, UNOOSA's Director also stressed the important role that multilateral entities can play in encouraging and supporting the implementation of legal and normative frameworks, as well as enhancing national capacity-building efforts.

The importance of such multilateral cooperation was further reinforced by the High Representative for Disarmament Affairs, Izumi Nakamitsu, who highlighted how PAROS is inseparable from broader strategic security and requires inclusive engagement, strengthened frameworks, and coordinated international action. The insights of UNIDIR, ITU, UNOOSA, and the Office for Disarmament Affairs reflect a shared commitment to multilateralism as the foundation of effective space governance. By promoting cooperation, strengthening national capacity, and advancing coordinated regulatory efforts, these institutions are dedicated to strengthening space security.

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1 Action 56 of the Pact for the Future is a commitment by Member States to strengthen international cooperation for the peaceful exploration and use of outer space for the benefit of all humanity. See General Assembly, UN Doc. A/RES/79/1, Pact for the Future, 26 September 2024, https://docs.un.org/en/A/RES/79/1}

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Panel I.

Fact or fiction? emerging technologies and their impact on outer space security

The first panel explored how rapid technological innovation can reshape outer space. The discussion focused on autonomous systems, AI, quantum communication, data ethics and cybersecurity architectures. Panellists explored the technological realities, the pace of development, operational applications, and the legal, normative, and ethical frameworks needed to manage these developments.

The panel discussion opened with an emphasis on the evolving legal regimes applicable to emerging technologies. Some panellists commented that AI and quantum applications are already being integrated into space systems for purposes such as satellite imaging, debris management, mission planning, and spacecraft operations, yet existing governance frameworks offer limited guidance on their regulation. One panellist noted that the absence of a universally accepted definition of AI further complicates this situation, though legal frameworks such as the Council of Europe's Framework Convention on Artificial Intelligence, the European AI Act,[2] and Brazil's forthcoming instrument on the use of artificial intelligence,[3] all seek to provide a definition of AI systems. In this sense, some panellists expressed that clearer legislation and consistent terminology are essential to ensure transparency, accountability, and predictability in the application of these technologies in outer space.

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2 Commission Regulation 2024/1689 of the European Parliament and of the Council of 13 June 2024, Laying down Harmonised Rules on Artificial Intelligence and Amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act).

3 Bill on the Use of Artificial Intelligence, 2338, § 4 (2023), https://legis.senado.leg.br/diarios/ver/112653?sequencia=295

A major theme in the discussion concerned the dual-purpose nature of emerging technologies and their potential to improve operational efficiency but also increase security challenges. One panellist noted that while AI and quantum applications can enhance space operations, they can also be repurposed and exploited for disruptive or hostile applications. The panellist cautioned that advanced AI systems could indirectly increase space-related threats if used to automate cyberattacks, hijack interfaces, or exploit open-source data. They noted that space-to-space and Earth-to-Earth threat vectors can be particularly vulnerable to such cyber disruptions. Another panellist also pointed out that threats in cyberspace also extend to broader issues of strategic stability. The panellist highlighted that major spacefaring States are also nuclear powers and that AI integration into command, control, and communication systems could heighten the risk of miscalculation or inadvertent escalation if exploited for disruptive purposes. Uncertainty about emerging technological capabilities may fuel mistrust and initiate an arms race in space. To address these concerns, panellists emphasised the importance of robust cybersecurity preparedness through employee training, information-sharing, and inter-State coordination and called for continued dialogue among States to strengthen confidence-building measures and maintain strategic stability.

Ethical concerns were also a central part of the discussion, particularly regarding the collection, use, and sharing of space data. One panellist explained that space data includes imagery of crops, oceans, borders, infrastructure, and disasters that support climate models, national security tools, and humanitarian responses. However, the panellist stated that space data can be weaponized or exacerbate inequalities if only a few actors have access. Moreover, the use of biased or opaque datasets by autonomous systems could undermine trust. Panellists urged the adoption of key ethical safeguards, including the application of the precautionary principle, the auditability of AI systems, and maintaining human oversight for mission-critical operations, such as collision avoidance, to mitigate ethical challenges. These principles were argued to be essential to bridging existing legal and governance gaps in frameworks like the Outer Space Treaty, which do not explicitly address the complexity of autonomous decision-making in space.

Several panellists further highlighted the important role of transparency and shared understanding to minimize the challenges of emerging technologies. Information-sharing, prior notifications, and direct communication among operators were cited as useful tools to clarify intentions and reduce misperceptions, though limitations exist due to national security concerns, commercial sensitivities, and technological gaps between developing and developed space actors. Capacity-building and training for emerging spacefaring States were seen as essential for promoting responsible participation in space activities.

Overall, the panel underscored that addressing the security implications of emerging technologies requires a holistic approach, integrating technical, political, legal, and ethical perspectives. Continued dialogue, cooperation, and the development of norms and regulatory clarity were identified as key to ensuring that technological innovation in space contributes to stability and peace rather than insecurity.

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Panel II.

Mapping space security: threats to space systems and consequences for space and Earth

The second panel examined the nature and consequences of space threats for both space and Earth. The discussion covered a wide range of threats, including the placement of weapons in outer space, the development and use of kinetic and non-kinetic counterspace capabilities, non-consensual rendezvous and proximity operations (RPOs), and the ambiguity of dual-use systems that blur civilian and military functions. Panellists also highlighted threats arising from doctrines and policies, as well as the lack of clarity and transparency in such.

A key theme during the discussion was the importance of defining a space threat. One panellist proposed that a comprehensive definition should include three elements: intent, behaviour, and adverse impact. The panellist explained that intent refers to deliberate, purposeful human actions, distinguishing threats from accidents or negligence; behaviour includes both active operations, such as jamming or spoofing, and inaction, such as withholding crucial data that could prevent collisions; and adverse impact encompasses both material and non-material harm, highlighting that threats extend beyond physical damage to systemic disruption. Closely linked to defining threats, one panellist explored space deterrence as an integral part of understanding space threats. The panellist stated that threats and deterrent measures are two sides of the same coin and explained that, for instance, anti-satellite (ASAT) testing by an adversarial State can simultaneously signal a potential threat while functioning as a deterrent aimed at maintaining strategic stability.

Several panellists further stated that defining and identifying space threats is becoming increasingly complex due to the growing range of activities and actors in orbit. They noted that challenges arise not only from the deployment of kinetic ASAT capabilities and non-kinetic interference, but also from the accumulation of space debris, expanding commercial activity, rising space traffic, and the proliferation of dual-use systems that blur the line between peaceful and military capabilities, as well as increasing concerns about dual-purpose objects, which could potentially be repurposed to harm other space systems.

Concerns regarding the rise in non-consensual RPOs was raised as a particularly illustrative example of this dual-purpose ambiguity. Several panellists mentioned that it is often technically difficult to distinguish between legitimate servicing or inspection missions and potentially hostile actions. One panellist stated that while consensual operations conducted with prior agreement between parties are generally clear, the perception of intent by third parties can still lead to misunderstanding. Some noted that even RPOs for active debris removal or the servicing of a State's own satellites can raise concerns, especially in geostationary orbit where 'shadowing' activities have been observed. Given these challenges, the panellists stressed the need for stronger operational protocols, prior notification measures, and enhanced information-sharing to build transparency and reduce the risk of misinterpretation.

Another issue discussed among the panellists was the challenge of defining a space weapon. One panellist stated that definitions are important for legally binding agreements and for transparency, citing the draft treaty on the prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects, which offers a definition of a space weapon,[4] and the 2024 Group of Governmental Experts report on PAROS,[5] which points to the importance of achieving a common understanding of key terminologies. Some panellists suggested that a space weapon could be understood as any object placed or operating in outer space that is deliberately designed, produced, or used to cause harm or destruction. Although there is no universal consensus on this definition, some panellists emphasized that the absence of agreement on a definition should not hinder bilateral or multilateral efforts to strengthen space security and promote the peaceful use of outer space. Moreover, some panellists cautioned that overly rigid definitions risk being either too vague or too restrictive, while others stressed that progress can still be achieved through dialogue and cooperative measures.

In addition to identifying and defining space threats, one panellist emphasised the importance of mapping space threats using a three-step approach. First, building transparency at the policy and doctrinal level, through reviewing doctrines, strategies, rhetoric and language, as well as sharing information on positions to help understand the posture of other actors. Second, sharing strategic intelligence within cooperative groups to provide a common understanding of threats. Third, developing situational awareness of actual events and behaviours, which means gaining a good understanding of capabilities and how they are meant to be used or not used against other actors. In this case, the panellist stressed that both space situational awareness and space domain awareness are equally important. Together, these measures link conceptual understanding of threats and deterrence with practical insights into real-world conduct. The panel discussion underscored that ensuring space security requires not only defining and identifying threats but also mapping and understanding them within an increasingly complex space environment.

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4 Art. I(b) draft treaty on the prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects (16 June 2014) [hereinafter 'PPWT'], defines "weapon in outer space" as "any outer space object or its component produced or converted to eliminate, damage or disrupt normal functioning of objects in outer space, on the Earth's surface or in the air, as well as to eliminate population, components of biosphere important to human existence, or to inflict damage to them by using any principles of physics"; https://docs-library.unoda.org/Conference_on_Disarmament_(2014)/1319%2BRussian%2BFederation%2BDraft%2BUpdated%2BPPWT%2B.pdf

5 GE-PAROS/2024/CRP.4, Final Report of the Group of Governmental Experts on further practical measures for the prevention of an arms race in outer space, https://docs-library.unoda.org/Group_of_governmental_experts_on_further_practical_measures_for_the_prevention_of_an_arms_race_in_outer_space_-_(2023)/GE-PAROS-2024-CRP.4.pdf

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Panel III.

From principles to practice: evolving approaches to space security and PAROS in all its aspects

Panel III examined evolving approaches to space security and the roles of legally binding instruments and non-legally binding measures in advancing PAROS. The discussion highlighted the importance of understanding the historical, institutional, and diplomatic context of PAROS, while addressing contemporary challenges in an increasingly contested and congested space environment. While each panellist offered a distinct perspective, there was recognition that these approaches can complement one another. However, some panellists noted that, although non-legally binding measures and legally binding instruments may work effectively in tandem, the former cannot substitute for the latter, which remain essential for ensuring long-term legal certainty and accountability.

The panel also illustrated the deep divide in approaches to PAROS. On the one hand, several panellists emphasised the importance of non-legally binding measures in advancing space security and the goals of PAROS, observing that existing legally binding instruments can sometimes be too abstract to regulate a sufficient range of activities, and concepts such as ‘due regard’ and ‘good faith’ require further elaboration to provide more accurate and practical guidance. Several panellists described non-legally binding measures as adaptable measures that can help to establish shared understandings of acceptable conduct and gradually evolve into binding norms over time, although it was stated by other panellists that non-legally binding measures cannot serve as a substitute for legally binding mechanisms. One panellist highlighted that non-legally binding measures are beneficial because they promote progress, build confidence, and encourage broader participation and cooperation without an immediate need to commit to legally binding obligations. Another panellist added that political

commitments, such as the "No First Placement of Weapons in Outer Space"[6] and the resolution calling for a moratorium on direct-ascent anti-satellite weapon tests,[7] illustrate the practical value of non-legally binding measures. Some panellists noted that voluntary commitments contribute to predictability and stability in outer space and demonstrate how political measures can generate momentum toward more formalized rules.

On the other hand, several panellists underscored the necessity of legally binding instruments for ensuring legal certainty and accountability in the long term. One panellist stated that while non-legally binding measures can enhance transparency and trust, they cannot replace legally binding instruments or be viewed as a prerequisite in addressing hard security issues such as preventing an arms race in outer space or the deployment of weapons in orbit. Another panellist explained that voluntary norms, political commitments, and confidence-building measures may be valuable interim steps but remain limited by their non-legally binding nature. The example of the No First Placement of Weapons in Outer Space commitment was again cited to illustrate these limitations; specifically, it was suggested that because of its voluntary status and the limited number of spacefaring States that signed up to this commitment, it was unable to function as a comprehensive prohibition. From this perspective, it was stressed that legally binding instruments remain indispensable for establishing binding obligations capable of constraining destabilizing behaviour and providing a durable framework for space security.

Several panellists emphasised the important role of the Open-ended Working Group (OEWG) on PAROS in all its aspects in promoting dialogue between the different camps supporting legally binding instruments and non-legally binding measures, established by decision 79/512[8], in promoting dialogue between the different camps supporting LBIs and non-legally binding measures. While initial discussions faced challenges, the OEWG process has laid valuable groundwork for exploring how the two approaches can complement each other. Some panellists cautioned that the merged OEWG should not be regarded as a 'silver bullet', but agreed that progress depends on building on previous efforts such as past OEWGs, Groups of Governmental Experts (including the 2013 report on transparency and confidence-building measures in space[9]), national proposals, and United Nations resolutions, while striving for a common understanding of space threats and embracing the complementarity between legally binding instruments and non-binding measures.

One panellist suggested that this complementarity is already evident in existing frameworks, such as the prohibition on the placement of weapons of mass destruction in outer space, which was originally a non-legally binding United Nations resolution later codified in article IV of the Outer Space Treaty. The 2024 Group of Governmental Experts report on PAROS was also cited as a useful resource containing recommendations that could be developed into either non-binding measures or legally binding instruments, including those related to definitions and verification.

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6 General Assembly, UN Doc A/RES/78/21, No First Placement of Weapons in Outer Space, 4 December 2023, https://docs.un.org/en/A/RES/78/21

7 General Assembly, UN Doc A/RES/77/41, Destructive Direct-Ascent Anti-Satellite Missile Testing, 7 December 2022, https://docs.un.org/en/A/RES/77/41

8 A/C.1/79/L.61/Rev.1, Open-ended working group on the prevention of an arms race in outer space in all its aspects, https://documents.un.org/doc/undoc/ltd/n24/320/22/pdf/n2432022.pdf

9 General Assembly, UN Doc. A/68/189*, Report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities, 29 July 2013, https://docs.un.org/en/A/68/189

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Panel IV.

The security of cislunar space and beyond

Research and development in cislunar space technologies are increasing rapidly, driven by accelerated plans on the part of States and commercial actors to return to the Moon. As such, space security concerns now extend to issues of cislunar traffic, lunar bases and space resource extraction. To explore this issue further, the fourth panel discussed how the existing legal and policy framework, particularly relating to the militarisation and weaponisation of celestial bodies, can address the challenges of the cislunar domain and beyond.

The panel discussed the extent and effectiveness of the international measures governing the Moon and other celestial bodies, including the prohibitions outlined in the Outer Space Treaty, particularly relating to the testing of any type of weapon and establishment of military bases set forth in article IV and the principles of due regard set out in article IX. While acknowledging the enduring relevance of principles set out in the Outer Space Treaty, several panellists pointed out that the Treaty was too vague, too broad and that the current legal framework serves as a foundation on which a more comprehensive and security-specific framework can be built. One panellist suggested that such a security-specific legal regime for lunar and cislunar space should recognise new State and commercial activities on the Moon, supporting lunar exploration objectives while suppressing militarisation.

One panellist alluded to the need to address discrepancies that may impact legal certainty arising from different language versions of the Outer Space Treaty. Article IX of the French and Spanish versions of the Outer Space Treaty were used to illustrate this issue, as they both employ a term that translates more closely to 'obstacles' rather than interference', which appears in the English version.[10]

10 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including

Another panellist argued that the diverse views of States can be unified by borrowing lessons from the Antarctic Treaty, which uses explicit language to prohibit any measures of military nature, such as the establishment of military bases and fortifications, the carrying out of military manoeuvres, as well as the testing of any type of weapon.[11] Some panellists suggested that States should reaffirm the core principles of existing lunar exploration. These include policy transparency, interoperable systems, safe debris disposal, and emergency assistance as seen in the Artemis Accords[12] and in the International Lunar Research Station Guide for Partnership.[13]

Some panellists raised the complex security implications and challenges associated with projects seeking to install nuclear reactors on the Moon. The deployment of such critical power infrastructure was noted as an action that may risk being interpreted by other actors as undue territorial influence, since especially as the establishment of nuclear power infrastructure will require a range of security as well as safety measures.

One panellist called for a more detailed definition of commonly used terms in space security, such as 'peaceful purposes', 'harmful activities', and 'use of force' when considering lunar operations, arguing that definitional ambiguities persist and can be of particular concern when applied to activities on the Moon. This was credited to the practical challenges on the Moon such as a limited number of geographic locations which have access to sunlight, can support travel and where objects can be safely located. Another panellist, observing the complexity of cislunar space security implications, raised the possibility of occupation of cislunar locations, such as the Earth–Moon Lagrange points, as strategic locations for surveillance or attack.

Discussing the challenges associated with competition for scarce lunar resources, one panellist noted how that might lead to the creation of 'safety zones' that could be used to exclude others while intended to protect infrastructure such as nuclear energy sources and landing sites. Similarly, another panellist referenced visitation rights, such as prior notification outlined in the Artemis Accords, to emphasize that actors should honour these rules and avoid monopolising spatial and physical resources on the Moon using safety zones. One panellist, citing a policy analysis by NASA,[14] argued that safety zones should not be misconstrued as 'keep out' zones but rather as liability zones where actors exercise limitation of liability in case of other actors entering those zones. The principles governing lunar activities—such

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the Moon and Other Celestial Bodies, 27 January 1967, 18 UST 2410; 610 UNTS 205; 6 ILM 386 (entered into force 10 October 1967). Article IX of the English version mandates appropriate international consultations for "an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties". By contrast, the French and Spanish texts use terms that translate more closely to 'disturbance' (gêne potentiellement nuisible) and 'obstacle' (obstáculo capaz de perjudicar), respectively. See Spanish and French texts at https://treaties.un.org/pages/showdetails.aspx?objid=0800000280128cbd ; see also Almudena Azcárate Ortega & Victoria Samson (eds.), A Lexicon for Outer Space Security, UNIDIR (2023), https://doi.org/10.37559/WMD/23/Space/05 ; see also https://spacesecuritylexicon.org for translations in the official United Nations languages.

11 Antarctic Treaty, art. 1, 01/12/1959 12 U.S.T. 794; 402 U.N.T.S. 71.

12 Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, NASA (13/10/2020), https://www.nasa.gov/wp-content/uploads/2022/11/Artemis-Accords-signed-13Oct2020.pdf?emrc=692f4302023d7.

13 International Lunar Research Station Guide for Partnership, China National Space Administration (16/06/2021), https://www.cnsa.gov.cn/english/n6465652/n6465653/c6812150/content.html.

14 NASA Office of Technology, Policy and Strategy, *Lunar Landing and Operations Policy Analysis, 30 September 2022,* https://www.nasa.gov/wp-content/uploads/2023/05/nasa-otps-lunar-landing-and-operations-policy-analysis-final-report-2.pdf.

as exclusive use for peaceful purposes, prohibition of use of force, non-militarisation and due regard as set out in the Outer Space Treaty and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies were also presented as a means to avoid a lunar resource race.

Several panellists called for more diverse multilateral platforms to discuss the future of cislunar governance with a wide range of stakeholder perspectives. Pointing to ongoing multilateral discussions on PAROS, one panellist emphasised the need to adopt a similar approach to build a cooperative future on the Moon. Another panellist further called for the development of non-legally binding instruments as a short-term measure to address current complexities in the lunar regime, with a clear shared vision of moving towards a legally binding instrument in the long term.

Panellists proposed several other ideas to facilitate the security of cislunar space. One panellist suggested that there was need to improve space situational awareness capabilities for cislunar operations. Another panellist argued that transparency and confidence-building measures can enhance transparency and mutual understanding among actors, adding that information-sharing—through registration, specification of intent, and improved timing—would be an important step forward. Panellists also discussed the concept of a centralised lunar coordination body, weighing the potential benefits and drawbacks of having the commercial sector take the lead on such an initiative.

Some panellists pointed out the need to effectively operationalise and jointly apply articles IX and XI of the Outer Space Treaty. It was acknowledged that the two articles together mandate principles of cooperation, consultation, disclosure and effective dissemination of information on the conduct of space activities, among other obligations. The panel underscored the scope of the challenge for ensuring cislunar security and the corresponding need for cooperation and commitment towards peaceful use of lunar and cislunar space. The panel also encouraged the bolstering of policies and law governing lunar activities by building on the existing codification of non-militarisation in the Outer Space Treaty.

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Panel V.

Strategic unpredictability in the space domain: navigating intersections, escalation, and restraint

The increasing entanglement of space systems with national security architectures raises concerns about strategic predictability in the space domain and the risk of misperception, operational entanglement, and crisis escalation, particularly in a context where space capabilities support strategic functions. This panel discussed the evolution of the wider geostrategic context and covered how stability is being affected by these various factors.

Panellists highlighted that there is underdeveloped understanding of space-related disputes due to limited experience in dealing with conflicts arising from interactions between Earth-based and space-based defence systems. It was noted that the growing migration of national security functions into the space domain is inadvertently driving the development of technologies, such as anti-satellite systems, and strategies aimed at hedging against or neutralising the systems that support such functions. Another panellist added that the pressure on States to ‘use it or lose it’ for counterspace systems is greater than with conventional Earth-based systems, since in space even less capable actors can hold at risk the space assets of a more capable actor. One panellist added that uncertainty and conflict can also be fuelled by national space doctrines oriented towards superiority in outer space.

Several panellists alluded to the space–nuclear nexus, with one raising concerns over the lack of attention to the first strike incentives presented by these strategic systems. One panellist cautioned against allowing nuclear issues to encroach upon space security discussions, while another argued that renewed anxieties—driven by emerging and asymmetric vulnerabilities—necessitate the strengthening of nuclear-related provisions. Acknowledging the heterogeneity in reliance on space

systems across States, one panellist advocated for new policies that are inclusive of both non-nuclear and non-spacefaring States to prevent discriminatory prioritisation of security concerns. This view was further elaborated, revealing how the pursuit of a shared goal of reducing crisis and ensuring stability for all obligates States to care for needs beyond their own, even amid political tensions.

Some panellists raised concerns over the risks arising from the development of space-based defence systems, suggesting that these systems represent a departure from earlier agreed normative behaviours and risk breaking the taboo of no placement of weapons in space. However, other panellists suggested that space weapons are no longer taboo as they may already exist in the form of dual-purpose capabilities such as debris removal and in-orbit servicing. Moreover, it was noted that the development of space-based defence systems that are meant to target Earth-based threats also have attack capabilities that could target satellites in orbit, thus blurring the definition of a space weapon. One panellist suggested that space-based missile defence systems may inadvertently serve to incentivise the development of defensive capabilities by perceived adversaries.

One panellist broached the need to centralise the role of strategic culture beyond technical considerations in international security, arguing that different national, institutional, individual, demographic and psychological backgrounds influence decision making in crisis. It was highlighted that decision-making in space security is similarly influenced by cultural backgrounds, therefore greater emphasis on mutual understanding is required as a precondition when approaching negotiations. Some of the background factors mentioned as influencing strategic culture include disparities in the maturity of space security institutions such as space agencies, space forces and space commands.

The discussion drew attention to the wider implications of the rapid development of military-capable space technologies for peace and sustainability in space. One panellist argued that space superiority may be interpreted as compatible with space sustainability, even though the two can be at odds. In a similar manner, panellists warned that the pursuit of military power in space could be met with reciprocal initiatives from adversarial States.

Another panellist highlighted the need for strategic awareness-raising wherein States make a conscious effort to better understand the concerns and priorities of others. To improve the speed of multilateral discussions, one panellist encouraged intensifying dialogue among actors, including adversarial States, and initiating tabletop exercises designed to build a shared understanding of perceived threats.

This panel addressed the challenges of inherent geopolitical tensions influencing the misperception of capabilities and the interpretation of actions. It also considered the need to revisit the development of tools for the verification of capabilities. The panellists converged on the need to enhance international cooperation based on shared values, strategic cultures, norms and traditions for ensuring peaceful use, sustainability and access for all.

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Panel VI.

Commercial actors and space security: evolving challenges, roles and responsibilities.

Many commercially operated space systems are dual-use, combining civilian and military capabilities in an ambiguous manner that can heighten tensions, thus raising questions about targetability and the responsibilities of commercial actors. Certain commercial technologies also raise concerns, as their capabilities could potentially be repurposed to commit harm, for example, thus blurring the lines of what constitutes a space weapon. As outer space becomes increasingly populated with advanced technologies, commercial pursuits and diverse actors, new and complex security challenges are emerging. This panel explored such challenges, examining practical steps to strengthen cooperation in a manner that encourages innovation and also promotes space security and the goals of PAROS.

Several panellists indicated the value of increased commercial participation as a driver of innovation but also signalled the need for improved compliance with international law through adherence to transparency and confidence-building measures. One panellist observed that commercial actors often have limited understanding of the legal, regulatory, and policy frameworks governing space activities—including article VI of the Outer Space Treaty which affirms that States bear international responsibility for all national activities in outer space, including those conducted by non-governmental entities. Another panellist emphasized that principles of international humanitarian law—such as distinction, proportionality, and military necessity—apply to space in the context of an armed conflict and should serve as guiding norms for commercial actors involved in the development of space systems. It was pointed out that article VI of the Outer Space Treaty concerns responsibility rather than liability, and it forms the basis of a State's obligation to authorise and continually supervise commercial activities to ensure compliance with international law.

Further on regulation, one panellist suggested that principles of IHL, such as the above-mentioned, also apply to space more generally and therefore should serve as guiding principles for commercial

actors that are involved in the supply chain of component systems that are used in international conflict. One panellist expressed concern over the growing power of some commercial actors and the limited regulatory measures for space activities in some areas of activity. It was suggested this could complicate the fulfilment of national obligations to authorise and supervise space activities. Two panellists addressed challenges facing emerging space economies. One highlighted how commercial pressure to expand beyond civilian services stems from the need to remain profitable amid limited investment. The other emphasized the role of governments in supporting commercial actors by de-risking the sector through public investment and partnerships aimed at attracting domestic venture capital and reducing dependence on foreign funding that could undermine national sovereignty.

The panel drew attention to the definition and understanding of the dual-use nature of certain commercial technologies, and what that implies on the responsibilities of the developers of those technologies. One panellist emphasised that the dual-use nature of many space systems should not be used as an excuse for technology developers to neglect their responsibilities, urging commercial actors to exercise 'Know Your Customer' norms as done in other industrial sectors. Another panellist, echoing that developers are always required to comply with State regulations, cited the draft treaty on the prevention of the placement of weapons in outer space (see Panel II) as a multilateral tool that could serve as a basis to classify what constitutes a weapon in the context of dual-use technologies.[15]

One panellist argued that commercial actors are under pressure to offer exclusive services to States, even when those services were originally intended for civilian markets, while at the same time the rules governing responsibility and liability for either party remain unclear. A proposed solution was the development of joint capability roadmaps by industry and States, where transparency underpins best practices such as open procurement and voluntary information-sharing, especially across jurisdictions. Regulatory sandboxes were also proposed as interventions that allow experimentation by industry in a State-monitored environment to analyse risks and co-create solutions. Another panellist highlighted the importance of involving end-users in multi-stakeholder decision-making for dual-use policy development, given the overlap between defence and civilian applications.

In light of some established spacefaring States and regional groupings developing commercial integration strategies that include indemnification for commercial actors involved in national security missions, it was noted that emerging markets do not yet have any indemnification standards. However, panellists underscored the need for a cooperative approach that ensures participation of industry from the early stages of discussion in developing these commercial strategies. One panellist explained the impact of blurred regulations by exemplifying how component manufacturers in some emerging markets face export control barriers as they need to prove that their technology will not be used for non-civilian purposes.

Panellists urged State and commercial actors to cooperate in an effective manner that outlines the responsibilities of each party under the obligations of international law. The panel also emphasised that both commercial and State actors are equally subject to international law, and that guiding principes from international law and the Outer Space Treaty should be observed.

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15 PPWT, supra note 4, at 2.

UNOOSA side event — space sustainability, solutions and success stories

On the first day of the conference, UNOOSA, in partnership with UNIDIR, organised a side event to provide the Geneva-based audience with an overview of the work being done by UNOOSA and COPUOS in Vienna. The session was moderated by Robin Geiss, Director of UNIDIR, with a presentation by Aarti Holla-Maini, Director of UNOOSA.

The discussion highlighted the role of space as an enabler of diverse socioeconomic solutions. These include the use of communication satellites to improve access to education in remote areas, and provision of telehealth and communication platforms during natural disasters. The use of space-borne imagery of the natural environment was also showcased for enabling precision farming, the tracking of deforestation and rapid damage assessment for disaster relief. The ability to monitor and track more than half of the Essential Climate Variables[16] using satellite imagery was cited as an important space application for solving today's shared climate challenges.

Participants drew focus to the space governance debate on non-legally binding instruments versus legally binding instruments in the context of implementing the Guidelines for the Long-term Sustainability of Outer Space Activities[17] and the Space Debris Mitigation Guidelines.[18] The discussion pointed to the underestimated strength of non-legally binding measures, emphasizing that they reflect collective will. Furthermore, the head of UNOOSA, Aarti Holla-Maini explained that many Member States require further understanding of how to implement guidelines, pointing towards the need for United Nations entities and agencies to support Member States by translating from abstract discussions to what implementation actually means in practice.

The head of UNOOSA further explained how UNOOSA leans on the shared incentive of space actors to maintain peace in an environment with high political tension. It was revealed that, underpinning this incentive is the idea that, regardless of purpose or use of space, all actors seek to maintain the strategic relevance and economic benefit of their space assets and services. The need for constant affirmations of the value of space through operational mandates that foster custodianship of its peaceful use was reiterated. UNOOSA's Director, Aarti Holla-Maini also encouraged the Global South and emerging space economies to maintain conversations with global space powers emphasising the peaceful uses of space as a province of all humankind.

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16 An Essential Climate Variable (ECV) is a physical, chemical or biological variable or a group of linked variables that critically contributes to the characterisation of Earth's climate. GCOS currently specifies 55 ECVs; see Global Climate Observing System (GCOS), Essential Climate Variables, World Meteorological Organization (2025), https://gcos.wmo.int/site/global-climate-observing-system-gcos/essential-climate-variables.

17 See https://doi.org/10.18356/9789210021852

18 See https://doi.org/10.18356/2d85575e-en

One participant from the floor queried how varying treaty interpretations complicate implementation and whether it presents some risks in the face of counterspace capabilities that are emerging contrary to treaty principles that are sometimes perceived as outdated by certain parties. UNOOSA's Director, Aarti Holla-Maini pointed to the principle of due regard as one that can be upheld by enhanced communications, honest conversations and exchanges between parties to clarify issues of alignment and non-alignment. Another contribution from the floor summarised three steps for a common approach to due regard which emerged from a symposium held by the International Institute of Space Law and the European Centre for Space Law.[19] These steps were (i) substantive information-sharing; (ii) awareness-raising on issues that are important to parties involved; and (iii) consultation to discuss solutions. The steps were proposed as a solution that operationalises space law by using diplomatic dialogue to solve challenges where actors may not be aware of issues that are important to other actors, while upholding good faith.

Both heads of UNOOSA and UNIDIR noted the disparity between diplomatic negotiations in Geneva and Vienna in terms of input from industry. Aarti Holla-Maini, the head of UNOOSA observed how input from industry stakeholders enhances the depth and coverage of policy as industry is highly invested in technical outcomes, such as safety and sustainability, outside of political interests. Using the outcome of the long-term sustainability guidelines as an example, States were encouraged to consult with technical experts in industry and to include them in their delegations. UNOOSA's partnerships with industry, including for the provision of low-cost satellite imagery, launch technologies and project funding, were highlighted as testament to fruitful collaboration without compromising independence and integrity. Aarti Holla-Maini further recommended increased cooperation and exchanges between Vienna and Geneva, both formally and informally, to ensure alignment of work such as that discussed under the current OEWG on PAROS in all its aspects, as well as COPUOS.

One participant from the floor raised the need to thoughtfully navigate AI regulation and its implications on the long-term policies for outer space security. The head of UNOOSA clarified that, while the organisation does not regulate AI, there has been increased attention on 'GeoAI', where AI is applied in Earth observation data processing and the geospatial data products value chain.[20] One example provided was an overview of industry engagements by UNOOSA in efforts to secure satellite imagery through digital identifiers that prevent tampering in the wake of risks of imagery manipulation through artificial intelligence. This is crucial in cases where Earth observation data has security implications when used to enforce regulations, such as in identifying and tracking illegal fishing operations.

The side event highlighted success stories emanating from the application of space technologies to solve challenges across the globe, while equally reiterating calls for inclusive and open dialogue in developing space law to ensure the long-term sustainability of outer space.

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19 International Institute of Space Law and European Centre for Space Law Symposium on Due Regard in Outer Space: Current Legal Implications, Vienna, 14 May 2025.

20 United Nations Office for Outer Space Affairs, Mapping Disaster Resilience: GeoAI Best Practices from The UN-SPIDER Network (2025), https://www.un-spider.org/sites/default/files/UN-SPIDER%20GeoAI%20Compendium.pdf

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Technology demonstration

Commercial space industries have become key stakeholders in space operations. However, the expertise of industry actors has not often been heard in multilateral forums and dialogues. UNIDIR has highlighted the important role of industry representatives, and this year's conference included a technology demonstration. The demonstration provided the audience with an up-close look at the innovations and capabilities being developed by the private sector to support a safe and sustainable outer space environment. The featured technology demonstration was by ClearSpace, a Luxembourg-based space technology company founded in 2018 dedicated to making space operations more sustainable through innovative technology for debris removal and on-orbit servicing.

The demonstration featured a space capture system arm mock-up, a space object display and test model, and a mechanism joint actuator model, which allowed participants to interact with scaled mock-ups of debris-removal hardware. ClearSpace emphasized the importance of developing the capability to rendezvous with and capture uncooperative objects in space. The representative presented a clear sequence of the company's missions, which include capturing and disposing of a defunct object by deorbiting it; the capture–release–repeat mission, designed to demonstrate a reusable capability that supports more sustainable operations; and life extension services, where capture and servicing technologies are applied to prolong the operational lifespan of satellites in both low Earth orbit and geostationary Earth orbit. The representative noted that the development of an autonomous control loop allows the system to detect a target object, identify its features, and assess its position.

The presentation concluded with the representative emphasizing the need for openness and transparency, which he stated are objectives that ClearSpace is committed to. The company stresses the importance of clear frameworks on liability, insurance, and licensing, particularly given the multi-State nature of space activities.

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Starlight session — visions from the edge: storytelling, security, and the final frontier

Science fiction has long shaped how the public imagines space—as a frontier of possibility, peril, and power. The session featured Jingfang Hao, the author of Jumpnauts[21] and Folding Beijing[22], and explored how narrative tools in storytelling can help to bridge technical complexity and imagination while offering new ways to understand emerging space security challenges and uncertainty in a rapidly evolving domain.

Referencing the fictional work Folding Beijing, discussants highlighted the separation between policymakers and practitioners from the world on which their work impacts as they are overwhelmingly occupied with high-level discussions. This pointed out the need to bridge the gap between decision makers and the public by maximising the advantages of technology platforms to gather opinions, to listen more, to bring people together for dialogue and to create more channels for diverse opinions.

The moderator drew attention to some central questions guiding science fiction work on the question of where human civilisation will go in the future — including in space. The author, Jingfang Hao suggested that understanding space and other technological futures requires going back to the origins of civilisations to build on lessons from old wisdom offered by philosophy and culture. The discussion

21 Hao Jingfang, Jumpnauts (2021)
22 Hao Jingfang, Folding Beijing (2012)

presented a futuristic lens, observing how science fiction can foretell the integration and impact of emerging technologies such as super AIs, blockchain, and quantum computing in humanity's future.

Following references from the novel Jumpnauts, the impact and role of technologies in the realm of space-borne conflict was raised. Jingfang Hao highlighted that science fiction allows for mind experimentation that helps to tackle today and tomorrow's governance challenges. By enabling latitude for extremes in scenario planning, it stages methods of resolving global unrest originating from orbital and lunar conflict, the author further explained.

The conversation also acknowledged some risks of science fiction, such as drawing attention to improbable futuristic problems over more feasible challenges occurring today. One participant from the floor cautioned that fiction's overreliance on drama may exaggerate real-world security concerns—including those that may not exist. Discussants put forward that this drama presents a reflection of real and current human concerns brought to life through human fears and emotions. Jingfang Hao further emphasised that such drama provides the opportunity to forefront dialogue and cooperation in pursuit of common ground in solution development. Another contribution from the floor further emphasised the positive effect of fiction, exemplifying published work which highlighted the influence of science fiction on the early negotiations that birthed the Outer Space Treaty. The influence of Asimov's Laws of Robotics, whose principles are currently applied in the development and automation of technology, though derived from fictional work, was also brought forward as an example.

This session encouraged a measured approach to issues of space security emanating from the increasing complexity of space technology. The author counselled "slow is fast"—to urge a step-by-step approach in the application of emerging technologies. The session concluded by encouraging collaboration, especially among youth, to create new ways of organising and cooperating as they develop new technologies and institutions.

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OS25 youth video competition

UNIDIR, in partnership with the Centre for International Governance Innovation (CIGI), organized the Youth Video Competition for the second consecutive year, inviting individuals aged 18–25 from around the world to submit an original video. The 2025 theme challenged participants to imagine themselves in the year 2050 as key decision-makers in space security governance. This year's competition drew over 150 submissions from across the globe, with four winners ultimately selected from Australia, Bulgaria, Nigeria, and Zambia. Recognizing the importance of amplifying youth perspectives, UNIDIR not only premiered the winning videos during the conference but also provided each winner with a dedicated speaking slot to present their insights and ideas behind their video submission.

Takeaways from the video competition

Each of the winning submissions saw the participant assume a distinct role in their video, including a chief threat negotiator for intergenerational equity in outer space governance, a space diplomat, and policy advisors. The videos addressed several themes centred around maintaining peace, security, and accessibility in outer space. One of the winning videos focused on intergenerational equity and the importance of inclusive governance in space, emphasizing the need for transparency, accountability, and fair access to space resources.

Another video explored the evolving role of the Asia-Pacific region in global space governance. It highlighted the need for regional collaboration in response to challenges like climate change, the commercialization of space, and cyber and nuclear security issues. The submission emphasized the need for integration of space literacy into education across multiple disciplines, and the inclusion of local and indigenous perspectives.

Taking on the role of a policy advisor, one participant addressed the gaps in enforcing existing space laws and treaties. They explained that while legal frameworks such as the Outer Space Treaty and the Moon Agreement provide a foundation for space security, some examples reveal an absence of enforcement mechanisms. To address this, the video proposed an orbital compliance verification protocol to ensure accountability and prevent conflicts in orbit.

Another participant also took on the role of a policy advisor, being involved in real-time crisis management of a near-miss between two mega constellations. The video highlighted how youth-driven AI systems and multilateral protocols can prevent catastrophic events and emphasized the ethical dimension of space security and the value of cross-generational collaboration in decision-making.

The youth video competition provided a unique platform for youth voices and showcased that the future of space security can be shaped by the vision of the next generation of experts. The winning videos collectively emphasized that equity and inclusion must be at the core of governance, ensuring that all generations have a voice. They highlighted the necessity of both regional and global cooperation, enforceable and accountable systems, and the importance of educational awareness, with space literacy integrated across disciplines. These insights from emerging professionals chart a path toward a future where space remains safe and secure.

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Key takeaways

Inclusive and diverse multilateral platforms remain central to shaping a secure space future for all humankind

Several sessions throughout the conference underscored the indispensable role of multilateral conversations among States and space actors. The conversations highlighted the strength of processes in providing platforms to present different perspectives and find common ground. The role of international organisations, such as UNIDIR, ITU, UNOOSA and the Office for Disarmament Affairs, and that of platforms such as COPUOS, the OEWG on PAROS in all its aspects, and the Group of Governmental Experts on further practical measures in advancing space security, were reaffirmed with calls for more frequent dialogue.

The discussions emphasised the need for inclusive approaches that enable the participation of all parties regardless of the maturity of space programmes or technological capacities. The Outer Space Treaty was reaffirmed as a foundational framework for space security governance that is adaptable to emerging realities, while enabling collaboration across organisations, sectors and actors for maintaining a peaceful and sustainable space environment. Emphasis was placed on the role of multilateral dialogue for shaping regulatory evolution to address challenges brought forth by the increasing complexity of space activities.

The importance of acknowledging the complementary roles of both legally binding and non-legally binding approaches was also spotlighted in the context of PAROS. While there may not have been convergence on the preferred governance approach moving forward, panellists noted the complementarity of approaches and the need to find common understanding. Opportunities like the merged OEWG on PAROS in all its aspects were therefore seen as a promising approach to reconcile divergent views and advance common space security governance.

Emerging technologies demand forward-looking regulatory clarity, transparency and strategic foresight

Emerging technologies including AI, quantum computing, and autonomous systems are rapidly reshaping how space is accessed, how its benefits are derived and how operations are conducted. Panellists observed that, while these technologies offer significant advancement of space activities, they also introduce new vulnerabilities and ethical dilemmas. The importance of cybersecurity preparedness, refined data ethics, and human-in-the-loop oversight were stressed by panellists as critical factors in the application, advancement and governance of these technologies. There was also acknowledgment that the lack of universally accepted definitions and legal frameworks for some emerging technologies presents a gap that must be addressed effectively to ensure responsible deployment.

As these technologies evolve and become more intertwined with space security, they are changing how actors perceive space threats, while also increasing the complexity of space operations. Panellists referred to challenges such as uncoordinated rendezvous and proximity operations and other dual-purpose capabilities, as well as the increasing concerns around dual-use systems, calling for clear common definitions, doctrinal transparency, and strategic information-sharing to mitigate misperceptions and escalation risks. However, several discussions across both days agreed that the gaps in regulations and lack of common definitions should not hinder dialogue to regulate the deployment of these technologies.

Effective cislunar space governance requires new thinking and proactive governance frameworks

As lunar exploration accelerates, panellists called for clearer legal and policy frameworks to address risks of competition over lunar resources. The complexity of cislunar space, amid the reawakened interest in lunar exploration, was acknowledged as requiring a tailored approach to develop lunar-centric governance regimes. The discussions emphasised the importance of borrowing lessons from other international treaties, such as the Antarctic Treaty, and building upon existing lunar governance principles established in the Outer Space Treaty, as useful precedents to develop comprehensive measures to deter militarisation and weaponisation. The need for more multilateral coordination focused on the Moon, improved adherence to information-sharing, and involving emerging space States and commercial actors in decision-making were also emphasised.

Balance between innovation and responsibility are essential to safeguard our shared space environment

Innovation in new space technologies by both commercial companies and governments has created some concerns, particularly regarding how these technologies might be used, raising questions that are now central to space security. For commercial actors, panellists raised questions about their liability, targetability, and compliance with international law as they are increasingly supporting national security interests. For State actors, panellists highlighted the risks of misperception and operational and doctrinal unpredictability of entanglements such as the space–nuclear nexus and space-based defence systems.

It was reiterated that there must be mechanisms to ensure that commercial actors pursue innovation in a responsible manner to ensure safety, clarity and prevent departure from shared norms. Some of the mechanisms proposed included adherence to principles of international humanitarian law, proactive engagement with States through various scenario-based exercises, regulatory sandboxes, and openness in procurement. The need for capacity-enhancement frameworks was also highlighted, as such mechanisms help to uphold the principle that space remains accessible for all.

Youth perspectives offer visionary approaches to space governance

The Youth Video Competition showcased innovative ideas imagining the state of space governance in 2050. The themes explored in the videos included upholding intergenerational equity, regional cooperation, coordinated enforcement of space law, and ethical AI applications. By showcasing how they would tackle new space governance challenges, young people were able to voice their perspectives which emphasised the importance of transparency, education and inclusive decision-making. Their contributions reaffirmed that the future of space security must be shaped by diverse voices and forward-looking strategies.

Annex: conference programme

2025 OUTER SPACE SECURITY CONFERENCE

Day 1 – 09 September 2025

Welcome remarks

Robin Geiss, Director, UNIDIR

Keynote conversation — bridging vision and responsibility: challenges and opportunities for a secure space future

Robin Geiss, Director, UNIDIR
Doreen Bogdan-Martin, Secretary-General, ITU
Aarti Holla-Maini, Director, UNOOSA

OS25 youth video premiere

Panel I — Fact or fiction? exploring emerging technologies and their impact on outer space security

Panellists

Ioana Bratu, Co-Director, Amsterdam Law and Technology Institute, Vrije University Amsterdam
Zhanna L. Malekos Smith, Senior Associate, Center for Strategic and International Studies; Adjunct Professor, New York University
Laetitia Cesari, Consultant, UNIDIR
Simon Cleobury, Head of Arms Control and Disarmament, Geneva Centre for Security Policy

Moderator

Thomas G. Roberts, Assistant Professor, International Affairs and Aerospace Engineering, Georgia Institute of Technology

Lightning talk — OS25 youth video competition winner

Emily Karakoleva

Panel II — Mapping space security: threats to space systems and consequences for space and earth

Panellists

Guoyu Wang, Dean, Academy of Air, Space Policy and Law, Professor, Law School, Beijing Institute of Technology
Beatrice Hainaut, Research Fellow, Institute for Strategic Research
Regina Peldzsus, Specialist, Space Security, European External Action Service
Rogel Mari Sese, Chair, Department of Aerospace Engineering, Ateneo de Davao University
Andrey Yurievich Malov, Senior Expert, Centre for Military and Political Studies, Moscow State Institute of International Relations

Moderator

Sarah Erickson, Project Coordinator, Space Security and WMD Programmes, UNIDIR

Lightning talk — OS25 youth video competition winner

Andre Kwok

Panel III — From principles to practice: evolving approaches to space security and PAROS in all its aspects

Panellists

Shen Jian, Ambassador for Disarmament Affairs, Deputy Permanent Representative, Permanent Mission of the People's Republic of China to the United Nations Office at Geneva and Other International Organizations in Switzerland
Clive Hughes, Head of Space Security and Advanced Threats, Foreign Commonwealth and Development Office
Claudio Leopoldino, Counsellor, Permanent Delegation of Brazil to the Conference on Disarmament
Emilie Esbens, Desk Officer for Space, Department of Nuclear Disarmament and Non-Proliferation, Ministry of Foreign Affairs
Konstantin Vorontsov, Deputy Director, Department for Non-Proliferation and Arms Control, Ministry of Foreign Affairs of the Russian Federation
Marjolijn Van Deelen, Special Envoy for Space, European External Action Service

Moderator

Almudena Azcárate Ortega, Researcher, Space Security and WMD Programmes, UNIDIR

Technology demonstration

Speakers

Kees Van Der Pols, Head of Product and Mission Operations, ClearSpace

Moderator

Peter Martinez, Executive Director, Secure World Foundation

Day 2 – 10 September 2025

Opening remarks

Izumi Nakamitsu, Under-Secretary-General and High Representative for Disarmament Affairs

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Panel IV — The security of cislunar space and beyond

Panellists

Antonino Salmeri, Director, Lunar Policy Platform
Zhao Yun, Professor, University of Hong Kong
Martina Elia Vitoloni, Doctoral Candidate and Researcher, McGill Institute of Air and Space Law
Louisa Handel-Mazzetti, Assistant Professor, Dutch Defence Academy

Moderator

Victoria Samson, Chief Director, Space Security and Stability, Secure World Foundation

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Lightning talk — OS25 youth video competition winner

Adeboye Oluwafemi Malumi

Starlight session — Visions from the edge: storytelling, security, and the Final Frontier

Speakers

Jingfang Hao, Science fiction writer and Hugo Award winner; Chief Executive Officer, Beijing Spacetime Culture and Technology Inc.

Moderator

Sarah Erickson, Project Coordinator, Space Security and WMD Programmes, UNIDIR

Panel V — Strategic unpredictability in the space domain: navigating intersections, escalation, and restraint

Panelist

Laura Grego, Senior Scientist and Research Director, Global Security Program, Union of Concerned Scientists
Sarah Erickson, Project Coordinator, Space Security and WMD Programmes, UNIDIR
James Black, Deputy Director, RAND
Riqiang Wu, Professor of International Relations, Tsinghua University
Andrey Belousov, Minister Plenipotentiary, Deputy Permanent Representative, Permanent Mission of the Russian Federation to the United Nations Office and other international organizations in Geneva

Moderator

Jessica West, Senior Fellow, Centre for International Governance Innovation

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Lightning talk — OS25 youth video competition winner

Kondwani Mbale

Panel VI — Commercial actors and space security: evolving challenges, roles and responsibilities

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Panellists

Jessie Ndaba, Chief Executive Officer/Managing Director, Astrofica Technologies
Anirudh Sharma, Chief Executive Officer, Digantara
Melissa de Zwart, Professor, Space Law and Governance, University of Adelaide
Jinyuan Su, Professor, Wuhan University Institute of International Law

Moderator

Chelsea Mai, Research Assistant, Space Security and WMD Programmes, UNIDIR

Concluding remarks

James Revill, Head of Programme, Space Security, WMD Programmes, UNIDIR
Peter Martinez, Executive Director, Secure World Foundation

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