Security In Outer Space:

Woomera Manual, Military Operations, & Emerging Issues

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Keti Korkiya is a legal researcher specializing in international law, national security, and emerging technologies. She previously served as a Postgraduate Fellow at the Center on National Security at Georgetown University Law Center, where she contributed to the Cumulative Civilian Harm Project and supported the rollout of the Virginia-Georgetown Manual on the Use of Force and the Woomera Manual on Military Space Operations. Keti has also worked as a research assistant at Georgetown and held roles in both academic and governmental institutions, including the Georgian Institute of Public Affairs, the United Nations High Commissioner for Refugees and the Ministry of Foreign Affairs of Georgia. She holds an LL.M. in National Security Law from Georgetown University, an LL.M. in International Law from the Georgian Institute of Public Affairs, and a Bachelor of Laws from the University of Essex.

About the Organizers

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Note

This report constitutes both a summary and analysis of the discussions and exchanges that took place at the conference "Security in Outer Space – Woomera Manual, Military Operations & Emerging Issues" held at Tillar House in Washington DC on 21 May 2025. Where this document reports or refers to statements made by panelists, 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 panelists' delivery and their presentations. The designations and views expressed in this publication do not necessarily reflect the views or opinions of the organizers.

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Introduction

The 2025 conference, "Security in Outer Space: Woomera Manual, Military Operations, & Emerging Issues," convened experts from legal, technical, military, and commercial sectors to examine the evolving challenges at the intersection of international law, strategic stability, and military activities in outer space. Held under the Chatham House Rule, with two keynotes delivered on-the-record, the event provided a timely forum for dialogue on the operationalization of legal norms, the integration of commercial actors into national security ecosystems, and the risks and responsibilities associated with emerging technologies.

The discussions were framed around the publication of the Woomera Manual on the International Law of Military Space Operations (2024), a major milestone in efforts to clarify how existing legal frameworks apply to military space activities. Panelists and presenters engaged with pressing questions surrounding dual-use and dual-purpose space systems, space-based missile defense, mega-constellations, and public-private cooperation, all within the context of rising geopolitical tensions and the shifting dynamics of great power competition.

Across panels and presentations, speakers emphasized the need to balance innovation with responsibility, competition with cooperation, and ambition with legal and ethical restraint. While views diverged on specific proposals, there was broad consensus on the importance of building a secure, sustainable, and inclusive space environment — one grounded in transparency, shared norms and regulations, and continued international engagement.

This report captures key themes and insights from the conference, summarizing the contributions of each panel and presentation while preserving the spirit of informed and constructive debate that characterized the event.

PANEL I

The Woomera Manual: A Step Toward Clarity in Space Security

As military and dual-use activities in outer space continue to expand, the need for clear legal frameworks governing behavior in this domain has become increasingly urgent. This panel explored the development and significance of the Woomera Manual on the International Law of Military Space Operations, published in 2024, and its implications for space security. The Manual, which is the product of a multi-year collaborative effort by over 50 legal and operational experts, offers a comprehensive analysis of how existing international law applies to military activities in space, including in peacetime, times of tension, and armed conflict.

Panelists emphasized that the Woomera Manual does not seek to create new law, but instead interprets and applies existing legal regimes, such as the Outer Space Treaty, the UN Charter, and international humanitarian law, to contemporary space operations. One speaker described it as a "legal map" rather than a definitive solution, highlighting its role in shaping a shared understanding of legal boundaries in a domain marked by rapid technological change and strategic uncertainty. The Manual was frequently compared to analogous efforts such as the Tallinn Manual on cyber operations and the San Remo Manual on naval warfare.

A key point of discussion was the increasing entanglement of military, commercial, and civilian actors in space, which has blurred traditional legal distinctions and raised new questions about targeting, liability, and attribution. One panelist noted that commercial constellations like Starlink, which have been used to support military operations, could be perceived as legitimate targets under the law of armed conflict — a scenario that underscores the complex legal challenges posed by dual-use systems. Another speaker warned that the utilization of certain capabilities in contexts such as on-orbit servicing, active debris removal, or rendezvous and proximity operations, could be perceived as threatening if conducted in a non-transparent manner, and could heighten mistrust, especially when conducted in sensitive orbits or near critical assets.

The panel also addressed methodological questions around the Manual's legal approach. One speaker highlighted the risks of relying too heavily on analogy in interpreting legal norms, particularly when State practice is sparse or inconsistent. Another emphasized the importance of recognizing legal ambiguity where it exists, suggesting that surfacing disagreement is as

important as identifying consensus. In this context, the Woomera Manual was praised for its transparency in acknowledging where expert views diverge and for providing users with a clear account of competing interpretations.

Participants discussed how the Manual could serve both operational and diplomatic functions. While acknowledging the limitations of international law in constraining State behavior, especially in an era of geopolitical competition, panelists argued that law still shapes narratives, informs actions, and helps avoid miscalculation. The Manual, they suggested, can serve as a tool for confidence-building and strategic communication, particularly among middle powers and emerging space actors that seek to engage with the rules-based order.

Several speakers also underscored the critical role of civil society and non-State actors in shaping space law and governance. Legal scholars, NGOs, and academic institutions were recognized as key contributors to interpretive projects like the Woomera Manual, as well as to broader initiatives such as terminology databases and interactive policy tools. These resources, it was noted, help democratize access to legal knowledge and foster a more inclusive dialogue on space security.

The panel concluded with reflections on the Manual's role in informing national policy, operational planning, and multilateral engagement. As initiatives to regulate space security —particularly through a multilateral legally binding agreement— prove difficult to achieve in a time of heightened geopolitical tension, interpretive efforts such as the Woomera Manual are expected to become increasingly central to the evolution of space law. The Manual was ultimately presented as a pragmatic and flexible resource — one that invites engagement, rather than asserting finality, and supports the development of norms for responsible behavior in outer space.

PRESENTATION

Next-Gen Missile Warning and Defense: Lessons from Nike and its Progeny

Speaker: Professor Laura Donohue

In a wide-ranging presentation, Professor Laura Donohue, Professor of Law at Georgetown Law, Director of Georgetown's Center on National Security and the Law, and Director of the Center on Privacy and Technology, explored the historical lineage and contemporary ambitions of U.S. missile defense initiatives, framing her analysis around the newly announced "Golden Dome" concept — a sweeping plan for a national anti-missile shield announced by President Trump in early 2025. The initiative, she noted, draws from decades of evolving technology, political rivalry, and strategic aspiration — but it also inherits a legacy of overpromising, technical difficulty, and destabilizing consequences.

Golden Dome, as envisioned in a recent executive order, proposes a layered missile defense system encompassing a space-based sensor architecture, space-based interceptors, autonomous targeting, and comprehensive early warning and launch prevention capabilities. Yet, Professor Donohue warned, this vision echoes earlier programs that ultimately faltered: from Nike Ajax and Hercules to Sentinel, Safeguard, and Reagan's Strategic Defense Initiative. Despite billions spent over 60 years, U.S. systems have historically struggled to deliver reliable results, achieving, at best, a 57% success rate against controlled targets.

Recounting the Nike legacy, Professor Donohue described how Cold War fears, inflated threat assessments, and interservice rivalries led to escalating costs and rapidly obsolete deployments. Systems such as Safeguard were operational for mere months, while nuclear-armed interceptors sparked intense public backlash. More recent programs, such as Brilliant Pebbles, offered ambitious concepts but were ultimately shelved due to technical limitations and fiscal impracticality.

Professor Donohue cautioned that Golden Dome risks repeating these patterns, particularly amid rising geopolitical tensions, the impending expiration of New START, and emerging technologies that complicate interception, including hypersonics, decoys, and orbital maneuvering systems. She further noted that building and defending such systems could provoke an arms race and erode strategic stability.

Legal and normative concerns also played a prominent role. Professor Donohue questioned whether deploying space-based interceptors could jeopardize the Outer Space Treaty and whether modifying one provision might unravel others. She called for updated legal frameworks to accommodate new technologies while preserving the peaceful use of outer space.

Among the key lessons offered were the following:

1. **Persistent Technical Hurdles** – Physics, fuel limitations, and debris risks remain major constraints on orbital interceptors and directed-energy systems.
2. **Escalating Costs** – Proposals such as Golden Dome could cost hundreds of billions of dollars with limited strategic return.
3. **Strategic instability** – Defending missile defense systems may incentivize adversaries to escalate, particularly in the absence of arms control agreements.
4. **Legal Fragility** – Golden Dome could test the limits of international space law and norms.

Professor Donohue concluded by placing current developments within a broader geopolitical context. Several States are advancing counterspace weapons. At the same time, the proliferation of ballistic missile capabilities and nuclear technologies among regional actors increases systemic risks. Whether Golden Dome leads to greater security or further destabilization, Professor Donohue stressed, will depend not just on technical success, but on policy, legal foresight, and diplomatic restraint.

The presentation ultimately called for measured, historically informed decision-making, cautioning against the allure of total defense in an environment shaped by strategic interdependence and technological uncertainty.

PANEL II

National Security & Outer Space: Perspectives From The Public & Private Sectors

This panel examined the evolving interplay between public and private actors in the context of national security and outer space. With commercial entities playing increasingly central roles in providing capabilities and services relevant to defense and military operations, the conversation focused on the legal, policy, and technological complexities introduced by these public-private partnerships. Panelists explored challenges tied to dual-use and dual-purpose technologies, transparency, regulatory frameworks, and the strategic consequences of commercial integration into national security architectures.

Opening remarks acknowledged the value of frameworks such as the Outer Space Treaty and the recently published Woomera Manual, while recognizing that legal and political structures often lag behind the rapid development of space technology. One panelist warned that this gap between law and operational reality demands a pragmatic approach, suggesting that the integration of space systems into defense planning is now shaped not only by government needs but also by commercial innovation and investment dynamics.

Panelists emphasized the role of language in shaping perceptions of space activities. Terms like "dual-use" and "military" were described as often misunderstood or misapplied. One speaker noted that many commercial technologies are incorrectly labeled as dual-use, leading to inaccurate threat perceptions. Clarifying such terminology is essential for developing effective norms and governance frameworks. A strong call was made for shared understanding, if not shared definitions, of key space security terms.

From the commercial perspective, one panelist highlighted how certain companies are developing capabilities that are instrumental to activities such as debris mitigation, on-orbit servicing, and refueling. These technologies not only enhance space sustainability but also intersect with national security objectives. However, the panelist noted that commercial operators require regulatory clarity and predictable norms to plan effectively and avoid misinterpretation of peaceful operations as hostile acts.

A panelist underscored that most satellites cannot be weaponized in a meaningful way, pushing back against alarmist narratives. The panelist noted that while some systems raise legitimate concerns — such as space-based interceptors or systems capable of autonomous proximity operations — the majority of satellites lack the capabilities to pose offensive threats. This nuance is often lost in political and public discourse, contributing to escalatory dynamics and calls for preemptive defense measures.

The discussion also turned to missile defense initiatives such as the proposed "Golden Dome." Several panelists cautioned that deploying space-based interceptors could constitute a clear instance of weaponizing space, potentially triggering destabilizing responses. A historic example, the Brilliant Pebbles program, was cited to illustrate the strategic and fiscal risks of such initiatives.

Panelists argued that strategic signaling, not just capability development, must be carefully managed. Artificial intelligence (AI) in space systems was discussed as presenting both opportunities and challenges. Panelists agreed that AI could greatly improve space situational awareness and autonomy in orbital maneuvering, but warned against delegating critical targeting or command decisions to AI. Shared rules and clear programming protocols were deemed vital for avoiding unintended consequences in a high-risk domain.

Legal liability and State responsibility under Article VI of the Outer Space Treaty were raised as important considerations. Panelists encouraged national legal systems to provide clarity on how responsibility is assigned to private actors, while ensuring that commercial innovation is not stifled by regulatory overreach. Transparency, compliance, and partnership were highlighted as essential elements of effective space governance.

The session concluded with a round of reflections from panelists, who urged States to do the following:

- Recognize the centrality of commercial innovation to national security.
- Establish scalable and adaptable legal frameworks.
- Avoid irreversible actions that could weaponize space.
- Be intentional and precise in the language used in policy and strategy documents.

Overall, the panel advocated for a cooperative and nuanced approach to space security, in which commercial, civil, and military actors collaborate to develop a sustainable and secure space environment.

KEYNOTE

Outer Space Security: What's On Your Mind?

Speaker: Frank Kendall, Former Secretary of the Air Force

In a candid and incisive keynote, Frank Kendall, former Secretary of the Air Force, shared insights from five decades of military, technical, and policy experience to assess the strategic stakes of space as a warfighting domain. Kendall's remarks reflected deep concern over the trajectory of U.S. space defense policy and emphasized the urgency of confronting hard choices around resilience, arms control, and preparedness for high-intensity conflict.

He began by stating three foundational assessments: (i) space is already militarized and will become more so; (ii) in a major conflict involving the U.S. and China or Russia, space will likely be a decisive theater; and (iii) crucially, China is currently ahead in military space capabilities.

Tracing his career from Cold War missile defense to senior Pentagon leadership, Kendall offered historical context to today's debates. He highlighted how China, having studied U.S. reliance on high-value space-based assets after the Gulf War, has developed a vast arsenal of precision strike tools, anti-satellite weapons, and advanced delivery systems. These include direct-ascent and co-orbital ASATs, hypersonic glide vehicles, and fractional orbital bombardment systems. Russia, he noted, may be pursuing nuclear-armed orbital systems that could devastate low Earth orbit.

Kendall praised recent steps to improve resilience, including satellite disaggregation and progress by the Space Development Agency (SDA). But he warned that the U.S. lags in counterspace capabilities, and that bureaucratically fragmented responsibilities across military and intelligence silos are impeding progress. If conflict breaks out, Kendall emphasized, it will not be a slow escalation. Rather, space would likely experience an immediate, large-scale first strike. Automation and AI, he argued, will be essential to manage the speed and complexity of an attack and any response.

He offered a sober critique of the "Golden Dome" missile defense proposal, recently endorsed by the Trump administration. Drawing from his experiences with the Strategic Defense Initiative, Kendall described the technical and strategic flaws of space-based missile shields. He emphasized

that offensive systems will always have an advantage, citing options available to the offense including spoofing, decoys, and direct attacks on sensors. Any effective defense must anticipate and design against all the potential offensive countermeasures. He warned that Golden Dome could escalate arms races and provoke adversaries who interpret it as an enabler for a first strike capability.

Beyond technology, Kendall pointed to erosion in arms control norms and the weakening of measures designed to ensure nuclear stability. China's rapid nuclear buildup and the abandonment of key treaties with Russia have increased the risk of miscalculation. Recalling the Cold War's existential tensions, he urged renewed diplomacy, noting that the U.S., Russia, and China are not even talking to each other about these subjects.

In conclusion, Kendall outlined two strategic paths: one based on incremental norm-building around transparency and responsible behavior; the other focused on directly reducing existential risks such as nuclear war. He advocated for realism, investment in counterspace capabilities, and diplomatic efforts to reduce the likelihood of catastrophic escalation.
His remarks served as a call to action: to think seriously about the structure and doctrine of space forces, to resist false hopes in impenetrable defenses, and to reengage in arms control as a core pillar of space security.

PANEL III

Global Satellite Constellations: Opportunities and Challenges

As the deployment of large-scale satellite constellations accelerates, questions of access, equity, governance, and dual-use implications have come to the forefront. This panel examined the regulatory, operational, and legal challenges associated with mega-constellations, considering their potential to enhance global connectivity and resilience, as well as their capacity to exacerbate geopolitical tensions and physical and electromagnetic risks in orbit.

One panelist called for a shift in mindset: rather than viewing mega-constellations through the lens of national prestige or technological competition, they should be approached as shared infrastructure built atop limited global commons — including orbital space, spectrum, and launch access. While such constellations offer crucial services such as climate monitoring and internet access in underserved areas, their proliferation raises concerns about crowding, dual-use ambiguity, and equitable participation by developing States. The panel emphasized that regulatory regimes must evolve to reflect these dynamics, with one speaker asking whether success should be measured not by size, but by the partnerships a constellation enables.

The panel explored technical and operational measures to mitigate challenges such as radio-frequency interference, optical pollution, and orbital collision risk. Speakers noted that space is only as crowded as our technology makes it, stressing the importance of cooperative space traffic management, ephemeris data sharing, and common standards for maneuver coordination. They also highlighted efforts by major operators to address light pollution and engage with astronomers, though concerns remain about the uneven adoption of best practices across the commercial sector.

Multiple panelists discussed the critical need for clear regulatory guidance, especially on dual-use systems and their vulnerability in armed conflict. One panelist drew parallels between maritime escalation procedures and proximity operations in space, suggesting the development of “space rules of engagement” to better distinguish between benign and hostile actions. Another explored the legal status of commercial assets used for military purposes, including questions around self-defense rights, proportionality under international humanitarian law, and attribution in the event of attacks.

The panel also examined the implications of mega-constellations for global equity. Speakers noted that while services may be globally available, the ability to develop and operate such systems is concentrated in the Global North. Several participants argued for greater emphasis on partnerships, data sharing, and inclusive governance frameworks to ensure access and participation by emerging space actors. The concept of "shared ownership" — through technical collaboration, capacity building, and joint ventures — was proposed as a means to democratize space benefits without requiring full sovereign capabilities.

Panelists emphasized that many commercial operators welcome predictable regulation to ensure a level playing field and prevent irresponsible behavior by less-resourced entrants. However, regulatory fragmentation and the emergence of "flags of convenience" remain significant risks. One speaker described the need for consolidated and forward-looking governance structures.

The panel concluded on a cautiously optimistic note. Speakers reflected on the profound value of mega-constellations for civilian and humanitarian applications, and called for a renewed commitment to cooperation, transparency, and inclusive rule-making to ensure that these systems serve global, not just strategic, ends.

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