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Reenergizing Transatlantic Space Cooperation

Opportunities in Security & Beyond

Stephen Ganote · Janie Yurechko · Diana Jack · Connor O'Shea
AVASCENT

Mission Statements

The Scowcroft Center for Strategy and Security works to develop sustainable, nonpartisan strategies to address the most important security challenges facing the United States and the world. The Center honors General Brent Scowcroft's legacy of service and embodies his ethos of nonpartisan commitment to the cause of security, support for US leadership in cooperation with allies and partners, and dedication to the mentorship of the next generation of leaders.

The Scowcroft Center's Transatlantic Security Initiative brings together top policymakers, government and military officials, business leaders, and experts from Europe and North America to share insights, strengthen cooperation, and develop innovative approaches to the key challenges facing NATO and the transatlantic community. This report was produced as part of the Transatlantic Security Initiative's partnership with Airbus, which focuses on enhancing cooperation on critical transatlantic security issues.

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Cover Photo: A SpaceX Falcon 9 rocket, carrying the final Iridium mission this year, launches from Space Launch Complex-4E at Vandenberg Air Force Base, Calif., Jan. 11, 2018. *Credit: (U.S. Air Force photo by Air Force Senior Airman Clayton Wear.)*

September 2019

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Executive Summary

The security partnership between the United States and Europe is now in its eighth decade. It is an alliance that has always required a balancing of national sovereignty with the common institutions and shared mechanisms necessary to address evolving external threats, and in no other domain has this balancing act been more challenging than in space. From the first spark of the space race—the 1957 launch of Sputnik by the Soviet Union—until today, national space assets have been treated as uniquely sovereign. While other national defense and intelligence capabilities were more commonly shared, and in some cases, interoperable between allies and partners, space capabilities were guarded closely, especially by the United States. However, national security crises spurred greater cooperation: the September 11, 2001, terrorist attacks forced the first major rebalancing of space cooperation, as space assets became integral to US-led multinational campaigns in Afghanistan, and then in Iraq, Africa, and elsewhere. Cooperation between the United States and Europe thereafter increased slowly, but steadily, in national security space, while civil and commercial space cooperation boomed. Today, nearly two decades after 9/11, the United States and Europe are again facing national security crises, but this time, they are occurring in a very different space environment. There are many challenges to address.

- **Space is increasingly contested**. Newly aggressive peer and near-peer state powers, including Russia and China, are making unprecedented use of space for military purposes, at a time when the United States and EU are critically reliant on space assets for military and economic purposes.

- **Space is globalizing.** At least nine countries are now capable of launching assets into space, and nearly sixty countries are now operating an orbiting satellite. Simultaneously, a vibrant, ambitious, and fast-changing commercial space industry is developing new technologies and global satellite constellations that promise to provide new capabilities to US and European governments.

- **Space is getting crowded.** The many new space actors and new space assets are crowding the orbital planes around the Earth. Old and new space debris is creating hazards for satellites and humans in space, putting current and planned space missions at risk.

- **Space is hard to regulate.** Addressing security threats, orbital crowding, and debris, supporting space exploration, and bolstering the transatlantic space industrial base are challenging, and made more complicated by legacy regulations and operational disorganization.

It is time for the United States and Europe to take a fresh look at enhancing and expanding cooperation in space security. Together, the transatlantic Alliance needs to recognize and address challenges to space assurance, and take full advantage of the many changes sweeping the space industry. Leaders on both sides of the Atlantic should focus on three key areas, including:

- **increasing space resiliency** through better information sharing and system interoperability;

- **improving space operations** through better training and updated doctrine;

- **strengthening the space supply chain** through improved regulations and industrial cooperation.

While not easy, coordinated US-European action in these areas will help ensure that space assets will be able to address the growing security threats faced by the transatlantic Alliance.

Part One: The Changing Threat Environment and Implications for Space

A Complex History of Cooperation

During the Cold War, the competition with the Soviet Union spurred the creation of the US space program and drove feverish progress in developing space capabilities for the decades that followed.[1] The national security significance underlying the US presence in space has historically made cooperation difficult, even with its closest European allies. While cooperation in the scientific and commercial arenas has largely been fruitful, sharing of the most advanced capabilities remains difficult, due to questions of sovereignty and security on both sides of the Atlantic.[2]

> *"Space business models in Europe and the US are still very different, and could benefit from more interaction between companies making space business... space was previously almost entirely state-driven."*
>
> *Francois Rivasseau, director of security and space policy, European External Action Service 2015.*

Historically, the use of space for scientific discovery and commercial activity has been characterized by close transatlantic partnerships (see Figure 1). Starting with a 1973 memorandum of understanding, the National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) together created, launched, and maintained SpaceLab, and then the International Space Station (ISS) during the 1980s and 1990s, inviting others to join over time. US and European space agencies also worked together on the Hubble Space Telescope, along with smaller missions, including the Cassini/Huygens mission to Jupiter's moon Titan and the Solar Dynamics Observatory.[3] Close civil cooperation continues today and into the future, including the James Webb Space Telescope, upcoming Orion missions to Mars, and more.[4]

1960s	First ESRO Satellite in Orbit (1968)	Moon Landing (1969)
1970s	ESA Formed (1975)	GPS Block I Launched (1978)
1980s	Ariane 5 Greenlighted (1987)	Challenger Explosion (1986)
1990s	Galileo Conceived (1999)	All Spacecraft Added to USML (1999)
2000s	EADS Formed (2000)	9/11/2001
2010s	EU SST Decision (2014)	ITAR Reform (2014)

Figure 1: Key Turning Points in Sovereign European and U.S. Space Programs
Source: Avascent

Likewise, the US and European governments have collectively supported space industry growth, leading to strong transatlantic economic and supply-chain ties for space. Early commercial cooperation is exemplified by the international cooperative Intelsat, created in 1964 to develop

1 Roger D. Launius, "Historical Dimensions of the Space Age" in *Space Politics and Policy* (Dordrecht: Springer, 2004), 3–25.

2 Sheng-Chih Wang, *Transatlantic Space Politics: Competition and Cooperation Above the Clouds* (Abingdon: Routledge, 2013), 7.

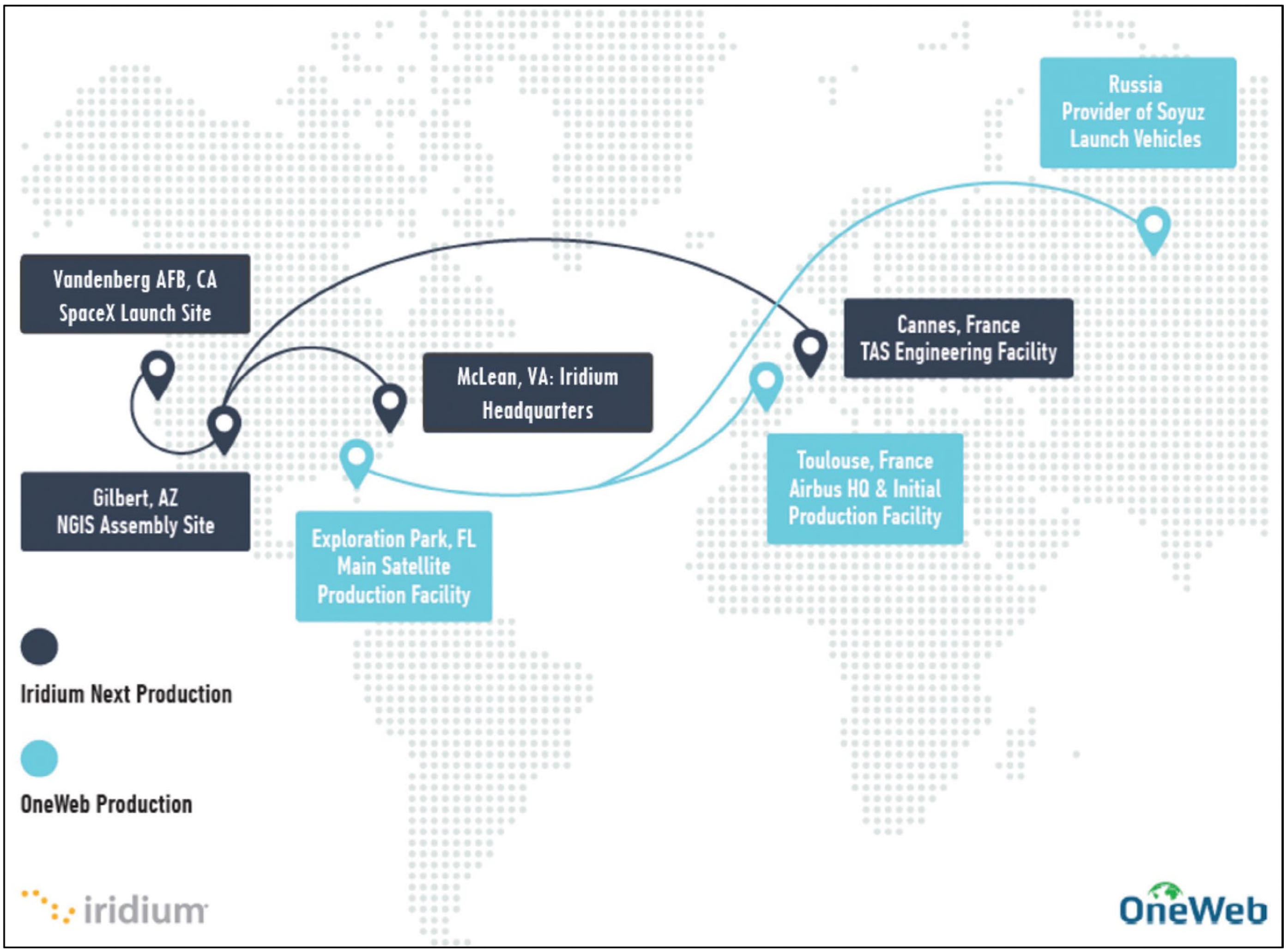
3 Frederic Nordlund, "A Broader View of the Transatlantic Space Cooperation," *Bridges* 10 (2006), https://ostaustria.org/programs-projects-english/74-categories-all/magazine/volume-10-june-29-2006/feature-articles/1183-a-broader-view-of-the-transatlantic-space-cooperation; "Solar Dynamics Observatory," National Aeronautical and Space Administration (NASA), accessed April 30, 2019, https://sdo.gsfc.nasa.gov/.

4 "James Webb Space Telescope," NASA, accessed April 30, 2019, https://www.jwst.nasa.gov/; "Orion Spacecraft," NASA, accessed April 30, 2019, https://www.nasa.gov/exploration/systems/orion/index.html.

the first global satellite-communications network.[5] Today, Intelsat is privately owned, headquartered in Europe, and operating from the United States. Other examples of such cooperative efforts abound, including:

- cooperative partnerships for satellite launch, such as European launch provider Arianespace providing launch services for private US companies and for the James Webb Space Telescope, and US providers such as SpaceX and United Launch Alliance frequently carrying European satellites into space;
- transatlantic supply-chain linkages, such as that utilized by Iridium to build its NEXT constellation, leveraging Thales Alenia Space's manufacturing in Cannes, OrbitalATK's (now Northrop Grumman's) integration services in Arizona, and launching with SpaceX in California;[6]
- governments procuring from suppliers across the Atlantic, such as the UK Royal Air Force signing a memorandum of understanding with Raytheon for support of a new constellation of small satellites with mission planning and data processing; and[7]

Figure 2: The Transatlantic Value Chains for Iridium Next and Airbus-OneWeb *Source: Avascent*



5 "Intelsat History," Intelsat, accessed April 30, 2019, http://www.intelsat.com/about-us/history/.

6 "Orbital Begins Production of 81 Satellites for Iridium NEXT Constellation at its Gilbert, AZ Satellite Factory," Northrop Grumman, press release, March 27, 2014, https://tinyurl.com/y4rm6adj.

7 Annamarie Nyirady, "Raytheon, UK Ministry of Defense Develop New Space Capabilities," *Via Satellite,* July 22, 2019, https://tinyurl.com/y42fv647.

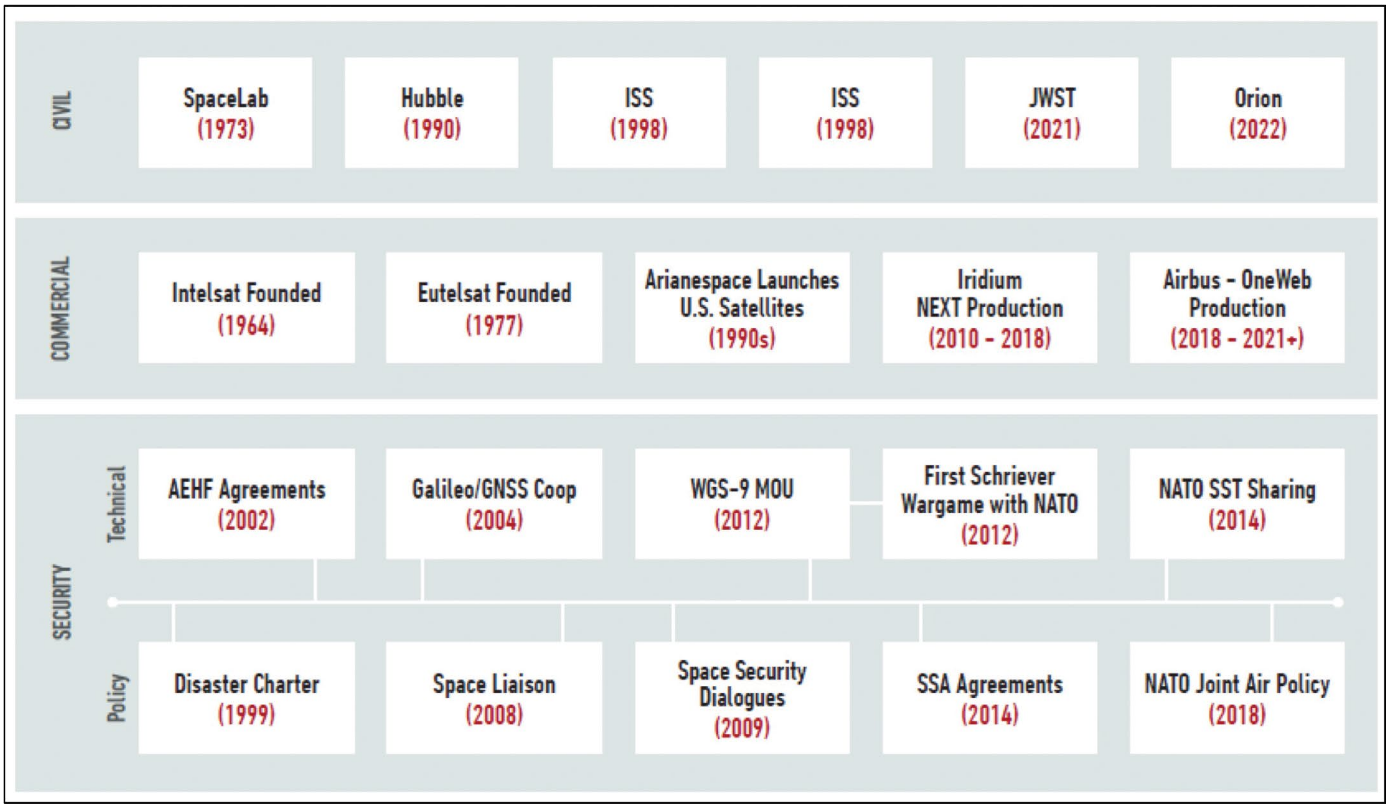


Figure 3: Timeline of Transatlantic Space Cooperation *Source: Avascent*

- joint ventures, such as between European-owned Airbus and US company OneWeb, with a manufacturing site based in Florida, to provide small satellites for global Internet connectivity (see Figure 2).[8]

Clearly, the civil and commercial uses of space have always been, and will continue to be, proving grounds for the transatlantic space partnership.

However, the cooperation achieved in these areas has not spilled over with as much success into national security space, where certain technologies are critical to security and sovereignty. Even after the end of the Cold War, the United States has been reluctant to transfer technology to other nations, so cooperation has only lurched forward after crises demanded technological progress or sharing. For example, the United States did not support Europe developing its own launch vehicle until the Challenger explosion in 1986 necessitated the use of Ariane capabilities to complement US launch capabilities.[9] Similarly, the United States feared losing its strategic advantage in Global Positioning System (GPS) position and timing, and therefore avoided sharing GPS data and prevented Europe from developing its own Galileo system for years.[10] Finally, as recently as 1999,

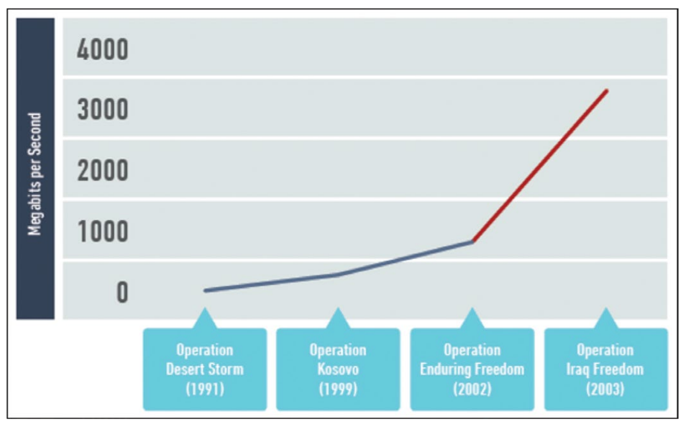


Figure 4: Comparing Data Consumption During the First Gulf War and Operation Iraqi Freedom *Source: https://www.globalsecurity.org/space/systems/bandwidth.htm*

8 "OneWeb Satellites Constellation: Connection for People all over the Globe," Airbus, accessed April 30, 2019, https://tinyurl.com/y7gqd35r

9 Wang, *Transatlantic Space Politics,* 8.

10 Ibid., 10; Nordlund, "A Broader View."

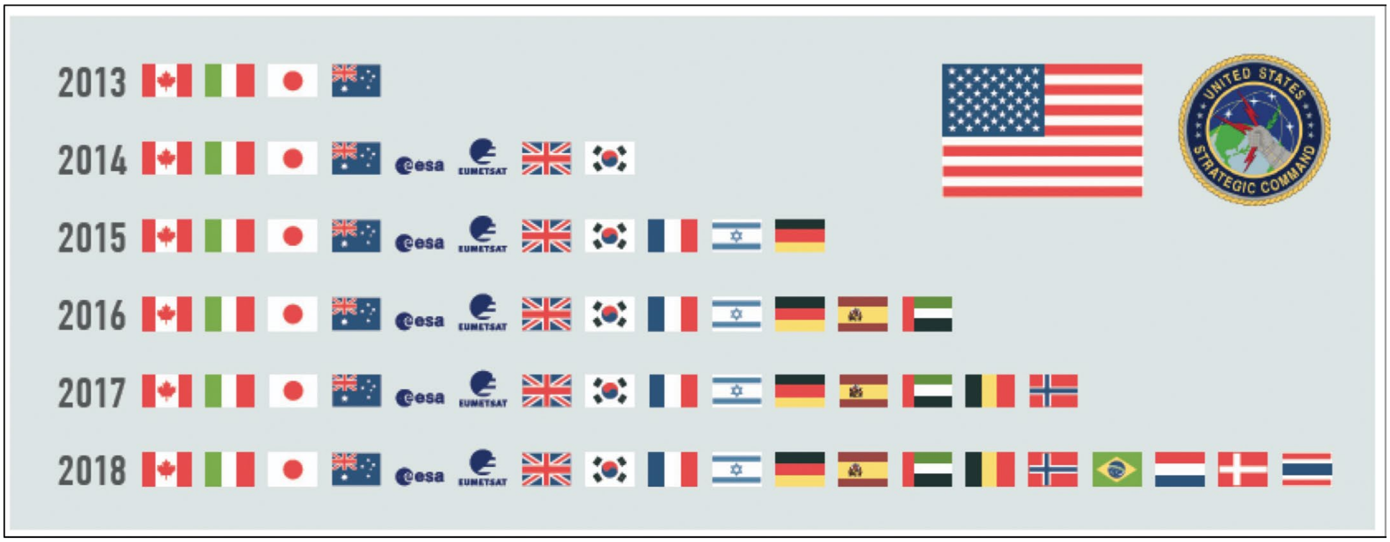


Figure 5: USSTRATCOM's SSA Agreements with Foreign Governments and Agencies *Source: Avascent*

the United States rewrote the International Traffic in Arms Regulations (ITAR) and the US Munitions List to be much more restrictive with respect to space technologies, severely limiting technology sharing and commercial cooperation, even with close European allies.[11] These barriers to operational cooperation and technological development have started to break down.

The September 11, 2001, terrorist attacks changed the paradigm of the transatlantic security alliance, including in space.[12] Unprecedented demand for satellites in allied military operations drove an equally unprecedented sharing of military space assets. In 2002, European partners were provided access to the US Air Force's new Advanced Extremely High Frequency (AEHF) communications satellites (see Figure 3), given the tremendous increase in demand for bandwidth and data during wartime operations.[13] Intelligence, surveillance, and reconnaissance (ISR), communications, air operations, and unmanned aircraft all relied on satellite capabilities, requiring thirty times the bandwidth consumed just ten years earlier during the first Gulf War (see Figure 4).[14] Coalition forces pooled resources, including those offered by commercial providers native to the United States and Europe. For example, Eutelsat's W3A satellite provided critical communications capabilities over the Middle East throughout the campaign. Through operational necessity, the United States and Europe have become more comfortable with national security space cooperation, expressed through arrangements such as:

- hardware and capacity sharing, such as through the United States' Wideband Global SATCOM (WGS) communications network, in which Australia has invested directly, and from which Canada, Denmark, Luxembourg, the Netherlands, and New Zealand receive data and capacity; and[15]
- data sharing, such as through US Strategic Command's (USSTRATCOM) space situational-awareness (SSA) data-sharing program, which now includes eleven Atlantic partners, including Denmark, the UK, France, Canada, Italy, Spain, Germany, Belgium, Norway, ESA, and Exploitation of Meteorological Satellites (Eumetsat) (see Figure 5).

While these are steps in the right direction, satellite-communications (SATCOM) partnerships and SSA data sharing are low-hanging fruit in the realm of national security space. The most consequential—and difficult—arrangements lie ahead, but are imperative in a rapidly changing and increasingly complex space environment.

11 Morgan Dwyer et. al. "The Global Impact of ITAR on the For-Profit and Non-Profit Space Communities," in *Proceedings of the 25th Symposium on Space Policy, Regulations and Economics, October 2012,* Cambridge, MA, 3, https://core.ac.uk/download/pdf/16521238.pdf.

12 Wang, *Transatlantic Space Politics,* 11, 17, 123-124.

13 Adam Baddeley, "US Air Force Looks at European Space," *SIGNAL,* September 2008, https://www.afcea.org/content/us-air-force-looks-european-space.

14 "Satellite Bandwidth," *GlobalSecurity.org*, accessed April 30, 2019, https://www.globalsecurity.org/space/systems/bandwidth.htm.

15 Baddeley, "US Air Force Looks at European Space."

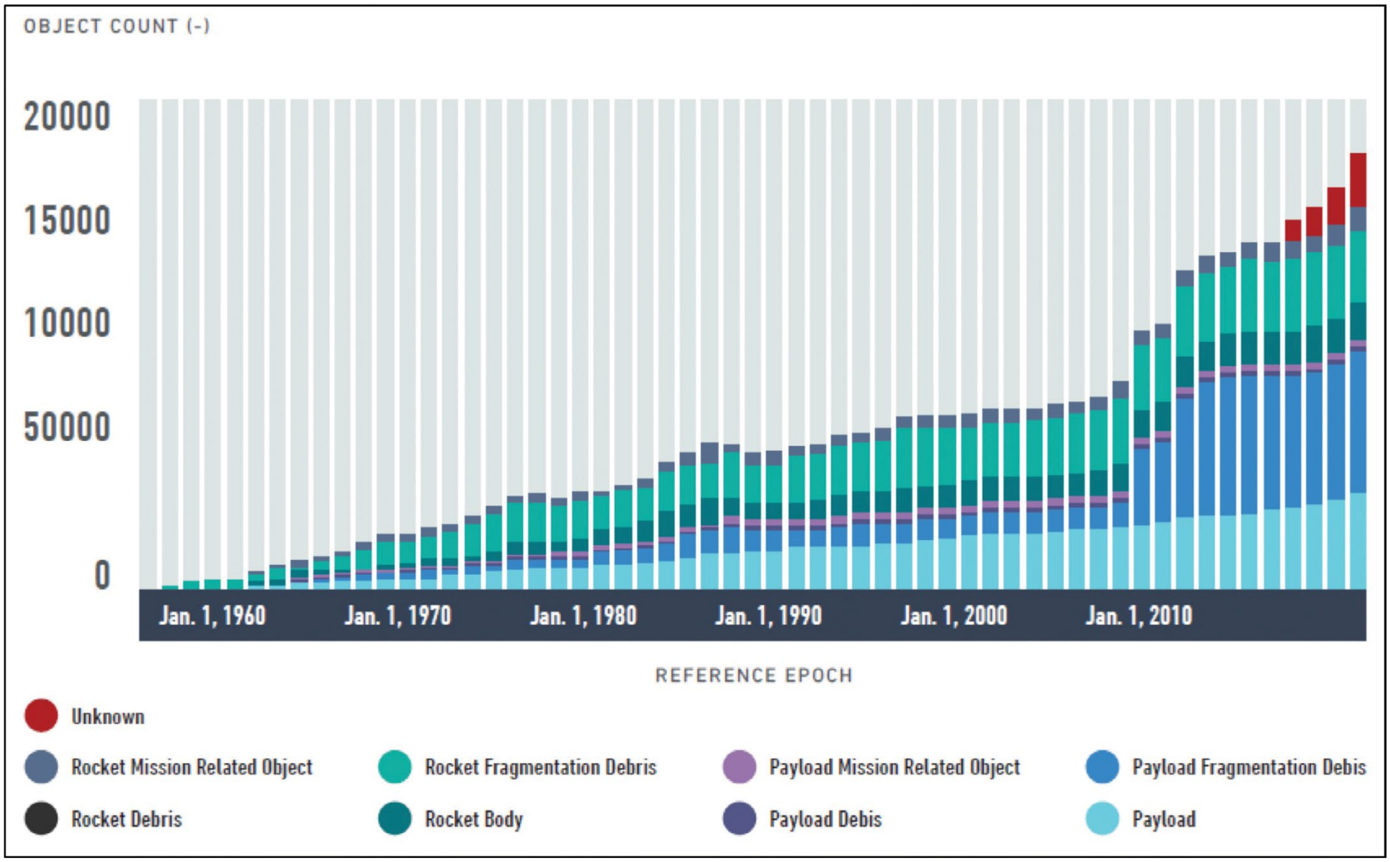


Figure 6: Sharp Increase in Space Debris, Threatening On-Orbit Assets
Source: European Space Agency, "About Space Debris."

Current Challenges to Allied Space Interests

Today, a variety of space assets provide the United States and Europe with sizable economic and security advantages. However, the international terrestrial and outer-space contexts in which these systems operate are changing more rapidly today than at any previous point. The dynamics of use, the geopolitical and technological threat profile, and the innate challenges of space have all surpassed what the current structures were designed to handle, and this has been acknowledged by senior leadership on both sides of the Atlantic.

Perhaps the most dramatic contextual change from the era which produced the current mechanisms of space cooperation is the recent diversification of space actors and applications. Space has become "democratized," with numerous companies, governments, and others using space to a degree never seen before. Investment in privately owned space assets has grown tremendously in the last five years, with companies such as SpaceX, OneWeb, Planet, Rocket Lab, Amazon, Orbital Insight, and others planning thousands of new satellites, launch vehicles, ground systems, and data-analytics offerings.[16] Commercial industry also has ambitions in space exploration (including missions to both the Moon and Mars) and space mining, concepts that current mechanisms failed to consider, raising new legal and sovereignty questions. These new actors are introducing new technologies and processes—such as line manufacturing, artificial intelligence and machine learning—that are disrupting space as well. Government-sponsored space activities have grown just as rapidly, with nearly sixty countries now operating in space. Just in the past year, Australia and Saudi Arabia both announced the creation of new space agencies, the latter committing $5 billion, a sum almost equal

16 Stephen Ganote et al., "Space in 2019: Five Big Things to Watch," *Avascent*, February 22, 2019, http://www.avascent.com/2019/02/space-in-2019-five-big-things-to-watch/; "Seraphim Space Predictions 2019," Seraphim Capital, accessed April 30, 2019, http://seraphimcapital.passle.net/post/102fd5w/seraphim-space-predictions-2019.

to the entire budget of ESA.[17] A diverse set of countries, from India to Indonesia to Nigeria to Norway, is investing in new space assets. In the future, space will be marked not by a scarcity of users and uses, but an abundance.

> *"The addition of any Galileo services in the same spectrum as GPS will significantly complicate our ability to ensure availability of critical military GPS services at a time of crises or conflict."*
>
> *Deputy Secretary of Defense Wolfowitz, 2001*

This immense proliferation of assets and actors brings with it a new set of challenges. Space is becoming more crowded: Over the next few years alone, thousands of satellites are projected to join the approximately three thousand currently in orbit.[18] This explosion in spacecraft, and the introduction of hundreds of new, inexperienced space stakeholders, complicates the management and protection of space assets. When satellites and other space objects reach end-of-life, they often become uncontrolled space debris, which can destroy or impede critical satellites. Space launches, satellite failures, anti-satellite (ASAT) tests, and other events are adding to a growing sea of debris, pieces of which can stay in orbit for thousands of years. Today, ESA and USSTRATCOM both track more than twenty-nine thousand objects in orbit, double the number two decades ago.[19] Concerningly, this number is projected to grow to more than one hundred thousand over the next decade (see Figure 6).[20] This congestion is increasingly causing harm: an Iridium satellite was destroyed by a collision with a defunct Russian satellite in 2016; Capella Space recently reported that one of its satellites narrowly avoided a catastrophic collision with a piece of space debris; and as noted above, debris from a 2019 Indian ASAT test now threatens the International Space Station.[21] Debris interference has even been suspected in the 2019 failure of Intelsat 29e.[22]

In addition to growing competition for physical space, more satellites are competing for finite (and crowded) radio-frequency spectrum. Space stakeholders express growing concern about coordinating transmissions from many thousands of new satellites reliant on similar or overlapping frequency bands, as to avoid jamming signals and degrading capabilities.[23] The advent of 5G is further complicating this issue. This coordination is no trivial matter; the Department of Defense, the most sophisticated and well-resourced space actor in the world, inadvertently jams its own satellites dozens of times a month.[24]

But, proliferation is not the only challenge in twenty-first-century space operations. New and renewed geopolitical threats in space and on Earth are contributing to space becoming contested, as well as congested. Seeking to erode US and European space dominance, strategic competitors such as Russia and China have increased their own space capabilities, particularly their counter-space weaponry (see Figure 7). As the US Defense Intelligence Agency (DIA) warns, both nations "view space as important to modern warfare" and

17 Assaf Kfoury, ed., "KSA: Space Agency," *Tactical Report Weekly* 26, 1 (2019); "Australian Space Agency Launches Operations: A Message form Dr. Megan Clark, AC," Australian Space Agency, June 29, 2018, https://www.industry.gov.au/news-media/australian-space-agency-news/australian-space-agency-launches-operations-a-message-from-head-dr-megan-clark-ac.

18 Caleb Henry, "Amazon Planning 3,236-Satellite Constellation for Internet Connectivity," *SpaceNews*, April 4, 2019, https://spacenews.com/amazon-planning-3236-satellite-constellation-for-internet-connectivity/.

19 "How Many Space Debris Objects are Currently in Orbit?" European Space Agency (ESA), accessed April 30, 2019, http://www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space/How_many_space_debris_objects_are_currently_in_orbit; "Space Operations: Space Debris: the ESA Approach" ESA, 2017, accessed April 30, 2019, 3, https://download.esa.int/esoc/downloads/BR-336_Space_Debris_WEB.pdf.

20 "Space Debris and Space Traffic Management," Aerospace, November 14, 2018, https://aerospace.org/story/space-debris-and-space-traffic-management.

21 Payam Banazadeh, "Denali's Near Miss and the Growing Problem of Space Debris," *Capella Space*, February 11, 2019, https://www.capellaspace.com/denalis-near-miss-and-the-growing-problem-of-space-debris/; Caleb Henry, "India ASAT Debris Spotted Above 2,200 Kilometers, Will Remain a Year or More in Orbit," *SpaceNews*, April 9, 2019, https://spacenews.com/india-asat-debris-spotted-above-2200-kilometers-will-last-a-year-or-more/.

22 Caleb Henry, "Intelsat-29e Declared a Total Loss," *SpaceNews*, April 18, 2019, https://spacenews.com/intelsat-29e-declared-a-total-loss/.

23 Jeff Foust, "Low Earth Constellations Could Pose Interference Risk to GEO Satellites," *SpaceNews*, October 26, 2015, https://spacenews.com/low-earth-orbit-constellations-could-pose-interference-risk-to-geo-satellites/.

24 Sydney J. Freedberg Jr., "US Jammed Own Satellites 261 Times; What if Enemy Did?" *Breaking Defense*, December 2, 2015, https://breakingdefense.com/2015/12/us-jammed-own-satellites-261-times-in-2015-what-if-an-enemy-tried/.

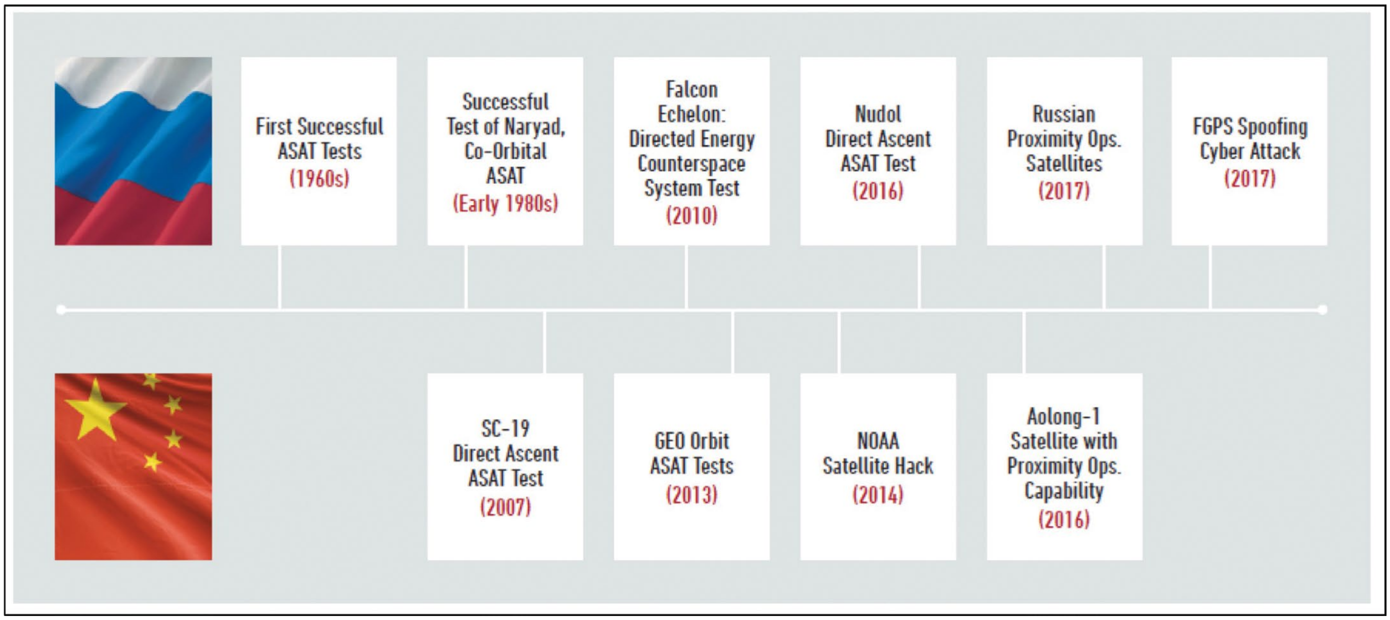


Figure 7: Russian and Chinese Development and Demonstration of Space Threatening Capabilities
Source: Avascent

desire the "means to reduce U.S. and allied military effectiveness."[25] For example, in traditional, kinetic weaponry, Russia has transformed Cold War technology into a direct-ascent ASAT system code-named Nudol (see Figure 7).[26] China, a comparatively new major space player, achieved its first successful anti-satellite weapons test in 2007 and has been investing aggressively in a wide range of space capabilities ever since.[27] Other nations, too, have been suspected of developing ASAT technologies.[28] Russia and China, and likely others, have also nurtured non-kinetic and co-orbital ASAT technologies and techniques; these are harder to detect, characterize, or attribute. Among unclassified examples, China was able to effectively hack US National Oceanic and Atmospheric Administration (NOAA) weather satellites in 2014, while Russia spoofed GPS signals in the Black Sea in 2017 and was accused of parking a "ghost satellite" next to an operating commercial satellite the previous year.[29]

The significance of these issues is compounded by the reliance of US and European militaries, and the societies they protect, on space-enabled systems for applications as diverse and important as missile defense, communications, and hurricane tracking. Space also has an enormous second-order impact. For instance, in the United States, GPS increases the efficiency of precision agriculture by an estimated 10–15 percent, and enables billions of dollars of commerce.[30] This dependence shows every sign of continuing; the European

25 "Challenges to Security in Space," Defense Intelligence Agency, January 2019, III, https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf.

26 Amanda Macias and Michael Sheetz, "Russia Conducted Another Successful Test of an Anti-Satellite Missile, According to a Classified US Intelligence Report," CNBC, January 18, 2019, https://www.cnbc.com/2019/01/18/russia-succeeds-in-mobile-anti-satellite-missile-test-us-intelligence-report.html.

27 Todd Harrison, Kaitlyn Roberts, and Thomas G. Roberts, *Space Threat Assessment 2018,* Center for Strategic and International Studies, April 2018, https://csis-prod.s3.amazonaws.com/s3fs-public/publication/180823_Harrison_SpaceThreatAssessment_FULL_WEB.pdf?w0Hlq5eiJvbk_7hPbqifSrBNUqZEDfca.

28 Jeffrey Lewis, "They Shoot Satellites, Don't They?" *Foreign Policy,* August 9, 2014, https://foreignpolicy.com/2014/08/09/they-shoot-satellites-dont-they/.

29 Mary Pat Flaherty, Jason Samenow, and Lisa Rein, "Chinese Hack U.S. Weather Systems, Satellite Network," *Washington Post,* November 12, 2014, https://www.washingtonpost.com/local/chinese-hack-us-weather-systems-satellite-network/2014/11/12/bef1206a-68e9-11e4-b053-65cea7903f2e_story.html?utm_term=.ceca07de700a; David Hambling, "Ships Fooled in GPS Spoofing Attack Suggest Russian Cyberweapon," *NewScientist*, August 10, 2017, https://www.newscientist.com/article/2143499-ships-fooled-in-gps-spoofing-attack-suggest-russian-cyberweapon/.

30 Precision agriculture is a farming-management concept based on observing, measuring, and responding to inter and intra-field variability in crops; Sandra Erwin, "Lawmakers to Form Bipartisan Caucus to Promote the Economic, National Security Benefits of GPS," *SpaceNews*, March 11, 2019, https://spacenews.com/lawmakers-to-form-bipartisan-caucus-to-promote-the-economic-national-security-benefits-of-gps/.

Global Navigation Satellite Systems (GNSS) Agency estimates that, by 2022, there will be nearly one GNSS device for every human being.[31]

All of these challenges and sensitivities present unprecedented threats to US and European space assets—whether commercial, civil, or military—and to broader security, space dominance, and economic welfare. Add to this the current fraught geopolitical context, in which Russia is resurgent, China has reached near-peer status, and other nuclear countries such as North Korea are flexing military muscles, and it becomes clear that the transatlantic security partnership faces new, urgent questions about its capabilities in space. In light of these developments, the United States and France have announced changes to domestic governmental agencies, such as "space forces" and the US Department of Commerce's new Office of Space Commerce, but these organizational adaptions fail to fully address the international implications of changes in space, and to leverage partner capabilities.[32] These questions must be addressed quickly and cooperatively.

> *"Export of space-related items to our allies and closest partners presents a low risk to national security and should be subject to fewer restrictions than exports to other countries."*
>
> *Risk Assessment of U.S. Space Export Policy (DOD and DOS) (2012)*

31 "Satellite Navigation: New Ways to Find Our Way," European Patent Office, accessed April 30, 2019, https://www.epo.org/mobile/news-issues/technology/space/satellite-navigation.html.

32 Eric Berger, "To Protect its Satellites, France Outlines Ambitious Space-Weapons Program," *Ars Technica*, July 25, 2019, https://arstechnica.com/science/2019/07/france-says-it-will-create-its-own-space-based-weapons-program/.

Part Two: Energizing Transatlantic Security Cooperation in Space

Given the evolving threat environment in space and the rapidly increasing pace of change, the United States and Europe together should to take a fresh look at enhancing space cooperation, and do so quickly. This starts with identifying and reducing barriers that impede space cooperation.

Transatlantic partners must take three main steps to improve their cooperation in the short term.

1. Increase information sharing and system interoperability for enhanced resiliency
2. Mature and grow space training and doctrine
3. Reform regulations throttling the supply chain, and strengthen industrial cooperation

1. Increase Information Sharing and System Interoperability for Enhanced Resiliency

The threats that US and European space assets face from space debris and ASAT capabilities demand greater resiliency, or the ability to withstand or rapidly recover from attack, malfunction, or disruption. Resiliency can be achieved in two major ways: through redundancy of systems to prevent single points of failure, and through greater defense of those assets. In recent years, the United States and Europe have cooperated to strengthen the resiliency of their space systems by sharing SSA data and by increasing the interoperability of their respective systems. Through USSTRATCOM's aforementioned SSA Sharing Program, European partners receive information on space debris and other threats to satellites, and ESA's space-debris tracking data are shared with the United States. Additionally, US allies undertake stints at the newly renamed Combined Space Operations Center (CSpOC) at Vandenberg Air Force Base, where SSA, as well as missile warning, position, navigation, and timing (PNT, e.g., GPS and GNSS), and other missions are commanded. Such exchanges promote common knowledge across allied space operations, as well as camaraderie and trust. In fact, in July 2019, the UK announced its intention to engage more deeply at CSpOC, sending eight people to support operations and spending $34 million to launch a new constellation of small satellites for battlespace awareness, to be launched by US-based Virgin Orbit.[33] Still, there is room for improvement in both information sharing and interoperability.

Recommendation: Ongoing US and European efforts to improve the resiliency of space assets and operations should be augmented with several deeper cooperative efforts.

- Research, development, and manufacturing with European partners across a wider array of mission areas. To use PNT as an illustration, sovereign efforts should be combined to design stronger GNSS receivers, prevent and detect jammers, and develop GNSS backups (e.g., terrestrial-based eLoran, SATCOM triangulation) that can be used by both partners.
- Both the United States and the EU should formally integrate each other's capabilities into space resiliency plans. Integrating both partners' efforts here will benefit all allied governments and militaries, as well as the diverse civil and commercial players that rely on space (e.g., logistics and PNT).

2. Mature and Grow Space Training and Doctrine

In an increasingly tense geopolitical context, formalized security cooperation becomes even more vital: NATO and other groups of allies have played key roles in many new contexts since the Cold War, and today should be no different. Yet, the US political commitment to NATO and other multilateral institutions has slipped, and transatlantic cooperation in training and doctrine in the space domain remains uncoordinated and insufficient. Key NATO mission areas (such as ballistic missile defense and signals intelligence) are

33 Sandra Erwin, "U.K. Deepens Space Ties with US, Announces Investments in Small Satellites, Responsive Launch," *SpaceNews,* July 18, 2019, https://spacenews.com/u-k-deepens-space-ties-with-u-s-announces-investments-in-small-satellites-responsive-launch/.

supported by a patchwork of sovereign US, French, German, Italian, and British space assets and data resources. NATO and its member states have recognized the need for better joint doctrine development in a number of recent reports, but a clear, holistic, and specific NATO space policy remains elusive.[34]

> *"In the air, we have exchange pilots and we cooperate on exercises and we certainly deploy together… Maybe someday we will be in the same position to do so in space."*
>
> *First European Space Liaison*
> *Col. Richard McKinney (2008)*

Training also remains a point of weakness: nearly two decades after the US Air Force held its first Schriever Wargame (the first large space wargame), there continues to be little in the way of large, joint training or exercises for space. This first wargame was set in 2017, and envisioned conflict with a near-peer space adversary; the partnership is now confronted with technological threats well beyond what was likely contemplated at the time.[35] There has been some halting progress: the Schriever exercises have in recent years come to include Germany and France, as well as the traditional "Five Eyes" participants (the United States, UK, Canada, Australia, and New Zealand); European officers are educated at the National Security Space Institute at Peterson Air Force Base; and the European Union Satellite Center provides some joint training on the other side of the Atlantic. These are positive first steps, but senior officials recognize that they do not yet meet the scale or interconnectedness required for growing global space-security challenges.[36]

Recommendation: Expand the scale and scope of cooperative space wargames, training, doctrine, and education by taking:. several concrete actions.

- Based on a complete assessment of NATO member-state space capabilities and requirements, defense planners should **develop a NATO Space Policy document** and accompanying structured space engagement, with guidance on how to meet those requirements through shared and interoperable assets.

- As part of this new space policy, defense planners should suggest **a more regular allied training regime that includes updated doctrine**.

- Recognizing the benefits of coordinated space warfighting, **more allies should join in the US "Space Flag" exercises**, making it equivalent to Red Flag in the air domain.[37]

- While eight countries met or came very close to meeting the guideline of spending 2 percent of gross domestic product (GDP) for defense guideline stipulated by NATO in 2018, the remaining twenty members have a ways to go.[38] Allies can make more progress toward their defense-spending targets by **ramping up investment in dual-use space assets**.

3. Reform Regulations Throttling the Supply Chain, and Strengthen Industrial Cooperation

Reacting to the problematic transfer of US satellite technology to China, the United States placed all space-related technologies on the US Munitions List (USML) in 1999.[39] In the twenty years since, it has made some progress in adjusting what has been widely regarded as a regulatory overreach, particularly as satellite operators of all types increasingly rely

34 *NATO Standard AJP-3.3: Allied Joint Doctrine for Air and Space Operations, Edition B Version 1,* North Atlantic Treaty Organization (NATO), April 8, 2016; "NATO's Joint Air Power Strategy," NATO, June 27, 2018, https://www.nato.int/cps/en/natohq/official_texts_156374.htm; Madeline Moon, rapporteur, "The Space Domain and Allied Defense," NATO Parliamentary Assembly Defense and Security Committee Sub-Committee on Future Security and Defense Capabilities, October 8, 2017.

35 "Air Force Gains Insight from First Space Wargame," *Space Daily*, January 29, 2001, http://www.spacedaily.com/news/milspace-01d.html.

36 Neville Clayton, "*US Allies in Space Operations" (presentation, Mitchell Institute for Aerospace, Washington, DC, October 26, 2018).*

37 Red Flag is the US Air Force's largest, premier air wargame, designed to allow US and allied pilots to experience realistic operational scenarios, environments, and threats. Space Flag is designed to bring together airmen and allies to enable a similar level of refining and practicing tactics, techniques, and procedures for the space domain.

38 *Defense Expenditure of NATO Countries (2011-2018),* NATO, July 10, 2018, https://tinyurl.com/y65x4j5a.

39 "US Government Announces Reforms to Space and Satellite Systems Export Controls," Skadden, Arps, Slate, Meagher & Flom LLP, May 13, 2014, https://www.skadden.com/insights/publications/2014/05/us-government-announces-reforms-to-space-and-satel.

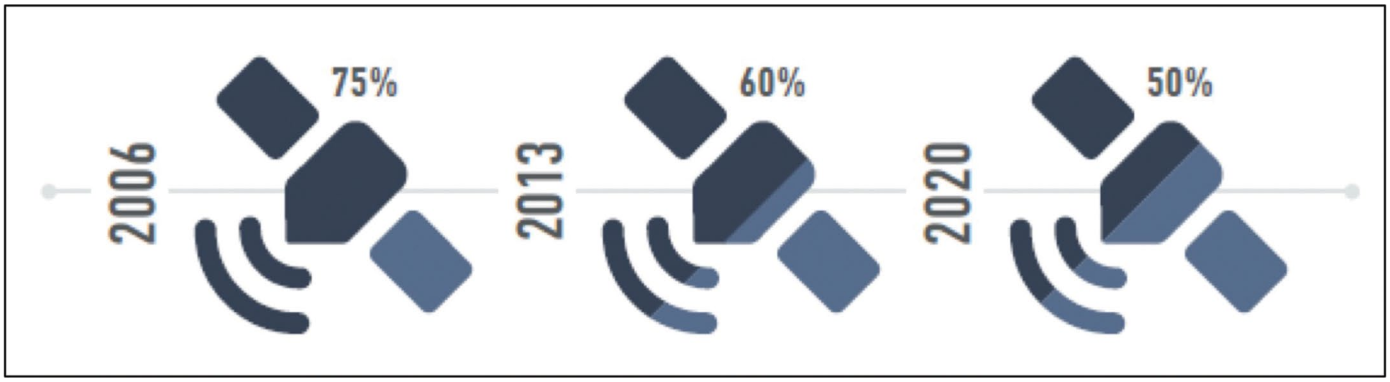


Figure 8: U.S.-Produced Content on European Satellites Decreasing as a Result of EU Sourcing Domestically; USML Tightening *Source: Noble, 2008; Avascent*

on transatlantic supply chains and industrial knowledge for space technologies and inputs (see Figure 8).[40] In 2014, the Departments of State, Defense and Commerce moved certain commoditized technologies—specifically those that did not present clear security issues—off the USML to the less restrictive Export Administration Regulations (EAR) list.[41] Subsequent changes transferred some space products to the EAR based on levels of classification and performance parameters.[42] H Thales engineering processes for the Iridium NEXT constellation.[43] Other space companies have undergone intense scrutiny when seeking international investment.[44] While the threat of supply chains being infiltrated by adversaries is real, both the United States and the EU should work to reverse restrictive policy trends.

Recommendation: Keeping in mind the national security sensitivities associated with any space-related technologies, the following actions should be taken.

- The United States and European Union should **redouble efforts to streamline excessive regulatory barriers** to trade arising from ITAR and the Wassenaar Arrangement.[45] The National Space Council and Wassenaar Plenary should continue to work in concert to remove unduly restrictive rules where possible.[46]

- The US Departments of Defense, State, and Commerce should work to **develop a "trusted partner" regime**, essentially a "white list" for allied nations whose industrial bases are vital and complementary to that of the United States, to allow for easier exportation by US companies. The EU should also look for areas to break down barriers to European exports to the United States. Such trust-building mechanisms, and the removal of trade barriers, will strengthen the resiliency and depth of transatlantic supply chains, while benefiting both parties economically.

- The United States and Europe should look to **promote more public-private partnerships**, as these provide an opportunity to generate more

40 Michael J. Noble, "Export Controls and United States Space Power," *Astropolitics* 6, (2008), 251–321.

41 *Report to Congress: Section 1248 of the National Defense Authorization Act for Fiscal Year 2010: Risk Assessment of the United States Space Export Control Policy,* Departments of Defense and State, 2012.

42 US Department of State, *Amendment to the International Traffic in Arms Regulations: Revision of US Munitions List Category XV,* Federal Register, May 13, 2014, https://www.govinfo.gov/content/pkg/FR-2014-05-13/pdf/2014-10806.pdf; US Department of Commerce industry and Security Bureau, *Revisions to the Export Administration Regulations (EAR) Control of Spacecraft Systems and Related Items the President Determines No Longer Warrant Control Under the United States Munitions List (USML),* Federal Register, May 13, 2014, https://www.govinfo.gov/content/pkg/FR-2014-05-13/pdf/2014-10807.pdf.

43 Jim Wolf, "US Lawmakers Stir Satellite Row with France," Reuters, March 16, 2012, https://www.reuters.com/article/usa-france-satellite-idUSL2E8EF3IL20120316.

44 Greg Autry, "Commercial Space Startups Should be Wary of Some Foreign Investment," *SpaceNews*, September 29, 2018, https://spacenews.com/op-ed-commercial-space-startups-should-be-wary-of-some-foreign-investment/.

45 *Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies: Public Documents, Volume II, List of Dual-Use Goods and Technologies and Munitions List,* Wassenaar Arrangement Secretariat, December 2018, https://www.wassenaar.org/app/uploads/2018/12/WA-DOC-18-PUB-001-Public-Docs-Vol-II-2018-List-of-DU-Goods-and-Technologies-and-Munitions-List-Dec-18.pdf.

46 Marcia Smith, "Space Council Adopts Recommendations at its March 26, 2019 Meeting," *SpacePolicyOnline.com*, March 26, 2019, https://spacepolicyonline.com/news/space-council-adopts-recommendations-at-its-march-26-2019-meeting/.

shared space capabilities among transatlantic allies. One model is the GovSat joint venture between the government of Luxembourg and the company SES, which carried the US Air Force's Commercially Hosted Infrared Payload (CHIRP), while providing secure satellite-communication services to enable connectivity for theatres of operation, border control, ISR, and more.[47]

- Space supply-chain and **industrial base issues should become regular topics of discussion at NATO Industry Forum days**, supporting information sharing and best-practices development.

- Finally, the EU-US Space Dialogue, now in its thirteenth round, can play an important role in resolving some of the more vexing technology-sharing and foreign-investment issues—but only if it receives the political support and resources sufficient to enable a more resilient transatlantic space enterprise. **Redoubled high-level engagement** is vital for the difficult policy and regulatory challenges that lie ahead.

> *"NATO neither owns nor directly operates any satellite, rather it only uses ground stations/terminals and user interfaces for satellite communication. The Alliance's space-based capabilities are solely dependent upon national inventories or private space companies."*
>
> *Pawel Fleischer,*
> *Atlantic Council Future NATO Fellow (2016)*

47 "Air Force Space Command Extends Hosted Payload Contract," SES Government Solutions, press release, https://ses-gs.com/press-release/air-force-space-command-extends-hosted-payload-contract/.

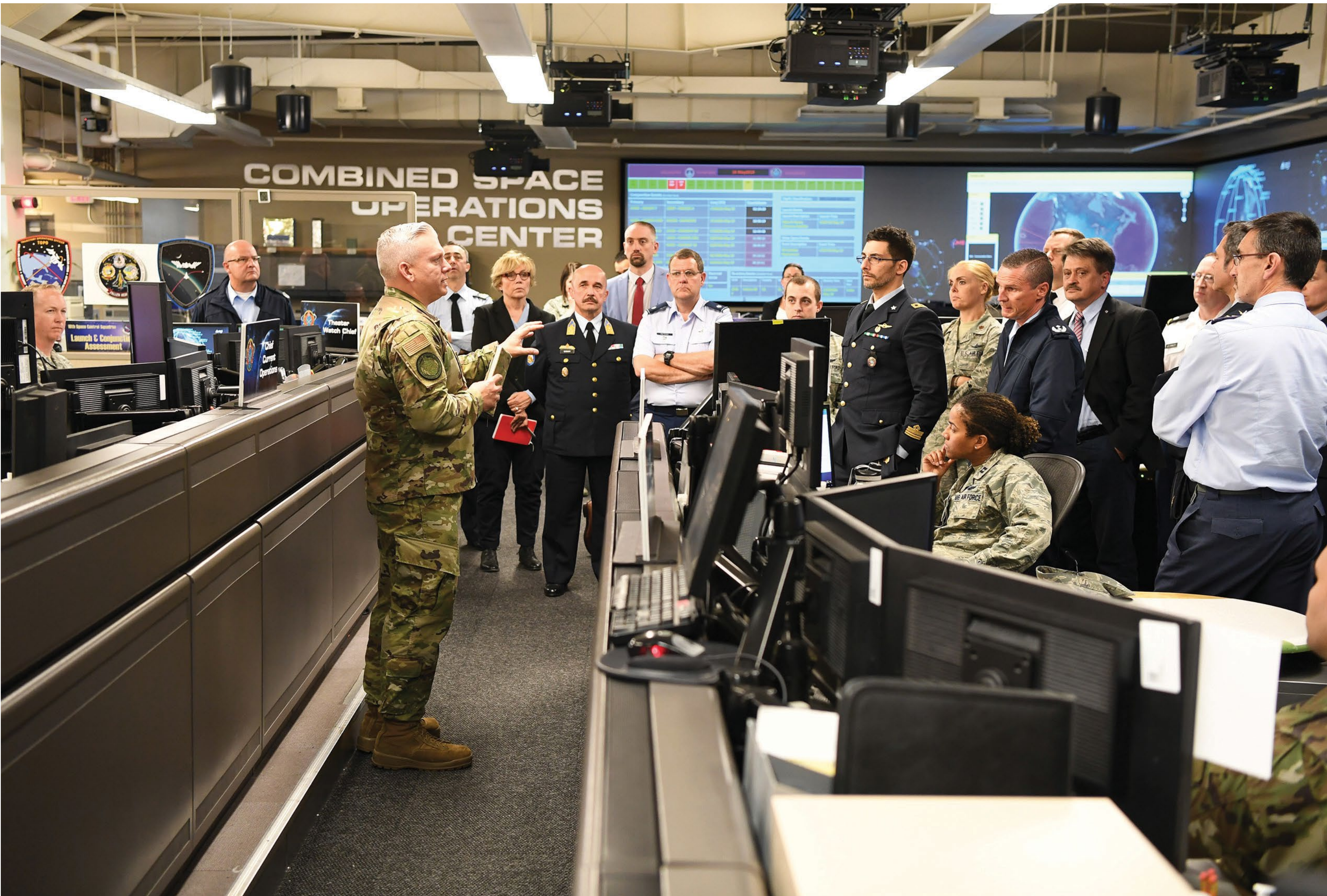
Conclusion

Major changes in the space threat and technology environments over the past two decades have created a clear urgency for greater transatlantic cooperation in space security. Given the scale of the pressures posed by rival military powers to what had been an uncontested domain—along with the complications introduced by new space actors (governments and commercial)—the United States no longer has the luxury of pursuing twenty-first-century strategic objectives in space through nation-centric mechanisms and mindsets.

To achieve needed progress, US and European leaders must directly address obstacles to space cooperation: legal, political, and cultural. They must be clear about the strategic, economic and scientific benefits that will result from overcoming these obstacles. In some areas, such as training and space situational awareness, the best recommendation is to stay on the same positive trajectory, with some new urgency and creativity. Other changes require a fundamentally different mindset, such as developing a new NATO Space Policy and fostering cooperation within the transatlantic supply chain.

As in the transatlantic Alliance itself, overcoming longstanding processes and habits that impede greater security cooperation in the space domain will always be a work in progress. The ongoing push to evolve key space cooperation mechanisms will reinforce mutual security and prosperity and will ultimately prove to be well worth the effort.

NATO space command tour photo: Col. Scott Brodeur, Director, Combined Space Operations Center (CSpOC), discusses space operations and capabilities with North Atlantic Treaty Organization (NATO) officials during a tour of the CSpOC at Vandenberg AFB, Calif., May 16, 2019. (U.S. Air Force photo by Maj. Cody Chiles)



Appendix

ACRONYM	TERM	DEFINITION
AEHF	Advanced Extremely High Frequency	Communications satellites that operate at high frequencies
ASAT	Anti-Satellite	Weapons or systems used to disrupt, destroy, or otherwise impair satellite operations
CFIUS	Committee on Foreign Investment in the United States	A US government committee that oversees foreign investment which may raise national security concerns
CHIRP	Commercially Hosted Infrared Payload	An experimental missile warning sensor onboard a commercial satellite, launched in September 2011
CSpOC	Combined Space Operations Center	An organization located at Vandenberg Air Force Base that leads global joint space forces
EAR	Export Administration Regulations	Regulations guiding export laws
ESA	European Space Agency	An intergovernmental European organization, historically focused on space exploration
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites	An intergovernmental European organization to maintain and leverage meteorological satellites
GNSS	Global Navigation Satellite System	Satellite constellations that leverage positioning and timing data for an array of applications (e.g., surveillance, mapping, and more)
ISS	International Space Station	A space station initially launched in 1998 and co-led by a variety of international players
ITAR	International Traffic in Arms Regulations	Regulations on exporting military technology
NSS	National Security Space	A country's approach to using space capabilities for national security reasons
PNT	Position, Navigation, and Timing	The concept of using three different capabilities to enable other applications (e.g., GPS)
SSA	Space Situational Awareness	Detection and tracking of space objects and threats; battle management in space
WGS	Wideband Global SATCOM	High-capacity communications satellites, largely used for high-end military communications

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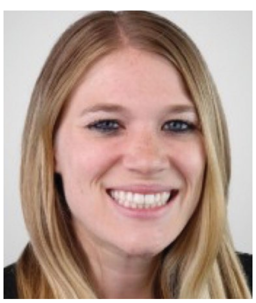

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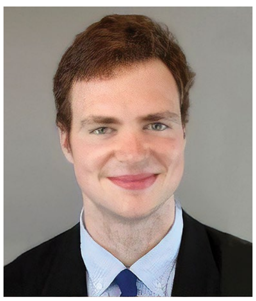

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