Chapter 6

U.S. Policy, Programs, and Diplomatic Initiatives in Response to Space Debris and Counterspace Threats

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Abstract

Since the mid-2000s, the U.S. government has become increasingly concerned about threats to its space capabilities and activities, a concern that has often been contextualized as space becoming more "competitive, congested, and contested." While much of the original focus of this concern was on dealing with environmental threats to satellites, such as space debris and space weather, it has recently shifted to place more emphasis on addressing hostile counterspace threats to U.S. national security satellites from potential adversaries. This paper provides an overview of current U.S. programmatic, policy, and diplomatic initiatives to address both space debris and counterspace threats. It concludes that while there are policy initiatives that focus on addressing both areas, more progress is being made on addressing counterspace threats than the threat posed by space debris. The main reasons for this are likely the lack of a single agency tasked with dealing with space debris and the relationship between the national security space community and Congress.

Introduction

U.S. perceptions of the threats to its space capabilities have gone through many different phases since it first became active in space in the late 1950s. Early on, the most serious threat was perceived to be the counterspace capabilities of its Cold War adversary, the Soviet Union, and this perception had a significant effect on U.S. policies, programs, and diplomatic initiatives during this period. After the Soviet threat faded with the end of the Cold War in the early 1990s, there was a growing realization that the space environment itself posed significant threats to space activities and capabilities, and U.S. policies, programs, and diplomatic initiatives shifted in response.

A series of events in the mid-2000s created yet another a significant shift in perception of outer space threats. In 2005 and 2006, China began testing a new kinetic-kill direct ascent counterspace weapon, and on January 11, 2007,

destroyed a Chinese weather satellite and created more than 3,000 pieces of long-lived space debris.[1] On February 10, 2009, an inactive Russian military communications satellite, designated Cosmos 2251, collided with an active commercial communications satellite operated by U.S.-based Iridium Satellite LLC, and produced almost 2,000 pieces of long-lived space debris.[2] These events indicated that both hostile counterspace threats and environmental threats, such as space debris, needed to be addressed in the space domain. Influenced by these events, the Obama Administration published a new National Space Policy in June 2010 which recognized the changing nature of the space domain and attempted to provide top-level policy direction to address both of these threats.

This essay compares and contrasts the U.S. government's efforts to address the threat of space debris and counterspace capabilities. It first summarizes the directives put in place by the 2010 National Space Policy and the resulting domestic programs and diplomatic initiatives to address space debris, followed by counterspace capabilities. The essay then compares and contrasts the progress, or lack thereof, between the two issue areas and proposes some potential explanations as to why one area is being addressed far more robustly, particularly in implementation of policy, than the other.

U.S. Policy, Programs, and Diplomatic Initiatives to Deal with Space Debris

Over the last three decades, National Aeronautics and Space Agency (NASA) has been a world leader in studying space debris. NASA Scientists such as Dr. Donald Kessler hypothesized in the late 1970s that as the number of human-generated objects in space grew, they could start colliding and creating new orbital debris faster than it was removed by the atmosphere.[3] The Inter-Agency Space Debris Coordination Committee (IADC) was created in the mid-1990s to coordinate research on space debris between NASA and other space agencies, and resulted in the creation of the 2007 IADC Space Debris Mitigation Guidelines, which were subsequently

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1 Brian Weeden, "Anti-satellite tests in space: The Case of China Fact Sheet," 18 May 2015, http://swfound.org/media/115643/china_asat_fact_sheet_may2015.pdf.

2 A summary of the Iridium-Cosmos collision can be found in the SWF Fact Sheet on the event: http://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf.

3 Don provides his personal history and explanation of the Kessler Syndrome here: http://webpages.charter.net/dkessler/files/KesSym.html.

endorsed by the United Nations in 2008.[4]

The massive amount of orbital debris created by the 2007 Chinese ASAT test and the 2009 Iridium-Cosmos collision re-ignited the concern over space debris, and prompted research to look beyond just mitigation to remediation. Studies, including those done by NASA[5] and the Defense Advanced Research Projects Agency (DARPA),[6] concluded that remediation of large space debris objects from LEO and GEO was the only practical method to reduce the long-term threat to operational satellites.

The NASA and DARPA studies were two major inputs into the section of the Obama Administration's 2010 National Space Policy focusing on preserving the space environment and the responsible use of space. Within that section, the policy directs U.S. federal agencies to accomplish several specific goals, including continued adoption of and compliance with space debris mitigation guidelines, development of increased measures to detect and warning about potential collisions in space, and the Department of Defense (DOD) and NASA to jointly research and develop technologies and techniques for debris remediation.[7]

Implementation of the policy goals has been mixed, with the most progress occurring on the SSA and space collision warning measures. In 2010, United States Strategic Command's (USSTRATCOM) Joint Space Operations Center (JSpOC) at Vandenberg Air Force Base expanded its screenings for potential on-orbit collisions to include all operational satellites, including commercial and foreign satellites.[8] Under a new SSA Sharing Program, the JSpOC began providing warnings of close approaches (conjunctions) directly to all satellite operators, and created a process for operators to get more detailed data on conjunctions in order to make decisions about maneuvers to reduce the risk of a collision.

More recently, the U.S. government has begun a broader conversation on

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4 An overview of the United Nations work on space debris can be found here: http://www.unoosa.org/oosa/en/ourwork/topics/space-debris.html.

5 J.-C. Liou and N.L. Johnson, "Risks in space from orbiting debris", *Science*, Vol. 311, Issue 5759, 20 January 2006, pp. 340-341.

6 Wade Pulliam, "Catcher's Mitt Final Report," Tactical Technology Office, Defense Advanced Research Projects Agency, May 2011.

7 The White House, "National Space Policy of the United states of America," 28 June 2010: https://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

8 Brian Weeden, "Billiards in space," *The Space* Review, 23 February 2009: http://www.thespacereview.com/article/1314/1.

dealing with the growing congestion on orbit. On May 9, 2014, the House Committee on Space, Science, and Technology convened a hearing on "Space Traffic Management: Preventing a Real Life 'Gravity'."[9] Congress also introduced language in the U.S. Commercial Space Launch Competitiveness Act of 2015 stipulating a study on alternate frameworks for the management of space traffic and orbital activities.[10] In parallel, the White House has held interagency meetings about U.S. federal agency roles and responsibilities for oversight of space activities.

Despite these activities, there has been little to no progress on space debris remediation. Several reasons for this inaction are summarized in a 2011 National Research Council (NRC) study on NASA's Meteoroid and Orbital Debris Program. According to a U.S. government participant in a workshop convened by NRC, a space debris remediation plan was discussed but not implemented in the 2010 National Space Policy due to concerns over costs, lack of specific agency responsibility, and political concerns over the weapons-like concern of some of the remediation techniques:[11]

The DOD's reluctance to move forward on space debris remediation is understandable. While it has the largest space budget of any governmental entity and is extremely reliant on space, cleaning up the space environment is not one of its core missions. Furthermore, the U.S. military is very sensitive to international perceptions that it is weaponizing space, not necessarily because it does not want to do so but because of the political impact such perceptions may have on domestic support in Congress and international support from its allies. Thus, the U.S. national security space community has strong concerns that any military-backed initiative for debris remediation may stimulate domestic policy or geopolitical complications.

NASA's organizational support for space debris remediation has been tepid at best, as a result of both budget concerns and NASA's fiefdom-like structure.

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9 House Subcommittee on Space, "Hearing on Space Traffic Management: How to Prevent a Real-life 'Gravity'," House Committee on Science, Space, and Technology, 9 May 2014: https://science.house.gov/legislation/hearings/space-subcommittee-hearing-space-traffic-management-how-prevent-real-life.

10 "House Resolution 2262- U.S. Commercial Space Launch Competitiveness Act," United States Congress: https://www.congress.gov/bill/114th-congress/house-bill/2262/text.

11 National Research Council, "Limiting future collision risk to spacecraft," The National Academies Press, 2011: http://www.nap.edu/catalog/13244/limiting-future-collision-risk-to-spacecraft-an-assessment-of-nasas.

Three different NASA field centers – Ames Research Center in California, Johnson Space Center in Texas, and Goddard Space Flight Center in Maryland, have all indicated a strong interest in being the "center of excellence" for space debris within NASA, partly because they see it as a potential source of additional funding. Each of the three centers has a different focus, largely as a function of its broader expertise and mission set, and is competing with the others as to who should be the main player in space debris.

Partly as a result of this competition between centers, and partly due to broader budget constraints, NASA's recent budget submissions reflect an increased rhetorical focus on space debris, but little actual monetary commitment. The term "space debris" did not even appear in the fiscal year (FY) 2009 budget estimate, as it was considered to be a small part of operations and protection for both the Space Shuttle and the International Space Station (ISS).[12] Beginning in FY10, NASA included a specific reference to space debris and outlined efforts to conduct scientific studies to characterize the near-Earth space debris environment, assess its potential hazards to current and future space operations, and identify and implement means of mitigating its growth, but does not provide a dedicating budget line for doing so.[13]

Between 2011 and 2013, NASA did invest a small amount of money in remediation technology. A NASA Innovative Advanced Concepts (NIAC) Phase I award was given out in 2011 to study Space Debris Elimination.[14] Throughout 2011 and 2012, NASA began to review proposals for space debris remediation concepts, culminating in a $1.9 million contract to a company in 2013 to develop the technology for an electrodynamic tether that could remove debris from LEO.[15] However, the funding was not continued past FY14, and in June 2014 NASA formally adopted a policy to limit its space debris remediation efforts to basic research and development of the technology up to,

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[12] National Aeronautics and Space Administration, "Fiscal year 2009 budget estimates." http://www.nasa.gov/pdf/210019main_NASA_FY09_Budget_Estimates.pdf.

[13] National Aeronautics and Space Administration, "Fiscal year 2010 budget estimates." http://www.nasa.gov/pdf/345225main_FY_2010_UPDATED_final_5-11-09_with_cover.pdf.

[14] Daniel Gregory, "Space debris elimination (SpaDE) phase I final report," Raytheon and BBN Technologies, 12 December 2012: https://www.nasa.gov/pdf/716066main_Gregory_2011_PhI_SpaDE.pdf.

[15] Douglas Messier, "Company gets $1.9 million from NASA to develop debris removal spacecraft," *Parabolic Arc*, 12 March 2012: http://www.parabolicarc.com/2012/03/12/company-gets-1-9-million-from-nasa-to-develop-debris-removal-spacecraft/.

but not including, on-orbit technology demonstrations.[16]

Internationally, the United States has focused its diplomatic efforts to address the space debris and the space environment on participation in is the Working Group on the Long-term Sustainability (LTS) of Outer Space Activities under the Scientific and Technical Subcommittee (STSC) of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS). The Working Group on LTS was created in 2010 to examine and propose measures to ensure the safe and sustainable use of outer space for peaceful purposes and for the benefit of all countries.[17] The Working Group on LTS is currently developing a consensus set of voluntary guidelines for enhancing space sustainability based on existing best practices.

The United States has also established a series of bilateral engagements on SSA data-sharing. Following the 2010 National Space Policy, USSTRATCOM was given authority to lead negotiations with commercial satellite operators and foreign governments on data-sharing agreements. As of April 2016, USSTRATCOM had signed agreements with ten foreign governments, two international organizations, and 50 commercial entities.[18]

U.S. Policy, Programs, and Diplomatic Initiatives to Deal with Counterspace Threats

The U.S. national security space community is increasingly aware of, and concerned by, its reliance on space. Although space has always had a strategic impact on national security, the potential for space to have operational and tactical impacts first glimpsed in the 1991 Gulf War became reality in the post-9/11 campaigns in Afghanistan in Iraq. Today, space capabilities are a critical enabler for the operations of Remotely Piloted Vehicles (RPVs), large numbers of precision-guided munitions (PGMs), and intelligence, surveillance, and reconnaissance (ISR) of the battlefield.

The expanded use of space capabilities by the U.S. military have also

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[16] Debra Werner, "NASA's interest in removal of orbital debris limited to tech demos," *SpaceNews*, 22 June 2015: http://spacenews.com/nasas-interest-in-removal-of-orbital-debris-limited-to-tech-demos/.

[17] Christopher Johnson, "UN COPUOS LTS Guidelines fact sheet," Secure World Foundation, 17 December 2014: http://swfound.org/media/189048/swf_un_copuos_lts_guidelines_fact_sheet_december_2014.pdf.

[18] USSTRATCOM Public Affairs, "USSTRATCOM, UAE sign agreement to share space services, data," USSTRATCOM website, 11 April 2016: https://www.stratcom.mil/news/2016/605/USSTRATCOM_

contributed to the growing vulnerability of those same capabilities. Space capabilities that previously were restricted to strategic missions, such as missile warning or verification of arms control treaties, are now being used for tactical missions in direct support of conventional warfighting. Whereas in the past attacks on these systems were deterred by threat of nuclear escalation, now a potential adversary of the United States has strong incentives to target such systems in a conventional conflict.

The growing reliance on, and vulnerability of, U.S. space assets influenced the national security space guidelines and directives in the 2010 National Space Policy. The policy included directives for bolstering the survivability of space capabilities, increasing space mission assurance, improving the ability to detect, warn, characterize, and attribute threats to space systems, and developing capabilities to respond to changes in the threat environment.[19]

As part of the implementation of these guidelines, the U.S. national security space community eventually decided on a strategy that mixes elements of both the increased survivability of space systems and increased space control to detect, deter, and defeat attacks. In January 2011 the DOD and the Office of the Director of National Intelligence (ODNI) published a new National Security Space Strategy (NSSS) that laid out the initial, high-level concepts for how it plans to deal with what it described as an "increasingly congested, contested, and competitive" environment in space.[20] In October 2012, the DOD published an updated Space Policy that expanded upon the National Security Space Strategy and provided direction on its implementation.[21]

Significant Chinese and Russian ASAT testing and demonstration of potential counterspace capabilities since 2010 have caused a renewed debate over the NSSS and its implementation. China conducted a series of robotic rendezvous and proximity operations (RPO) in LEO in 2010, 2013, and 2014.[22,]

UAE_sign_agreement_to_share_space_services_data/.

19 The White House, "National Space Policy of the United States of America," 28 June 2010: https://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

20 "National Security Space Strategy: Unclassified summary," January 2011: https://fas.org/irp/eprint/nsss.pdf.

21 Department of Defense, "Space Policy," Directive 3100.10, 18 October 2010: http://www.dtic.mil/whs/directives/corres/pdf/310010p.pdf.

22 Marcia S. Smith, "Surprise Chinese satellite maneuvers mystify satellite experts," *Space Policy Online*, 19 August 2013: http://www.spacepolicyonline.com/news/surprise-chinese-satelllite-maneuvers-mystify-western-experts.

[23] In May 2013, China tested what appears to be a counterspace capability that could reach GEO, a region long thought to be "off limits" to ASAT attack, and the region with U.S. national security satellites that support critical missile warning, nuclear command and control, and intelligence missions.[24] Russia conducted its own RPO activities in both LEO and GEO across four different launches in 2013 and 2014, all of which demonstrated capabilities that could be used for counterspace purposes.[25]

Likely as a result of these activities, the Department of Defense initiated a Space Strategic Portfolio Review (SPR) in May 2014.[26] The goal of the SPR was to assess whether the DOD's investments align properly with overarching policy and strategy goals in light of the evolving threat environment. The SPR reportedly concluded towards the end of summer 2014, although the first public acknowledgement of its existence was not until spring 2015.[27] Although the results of the SPR are classified, Pentagon officials have characterized them as three broad conclusions: the need to identify threats in space, being able to withstand aggressive counterspace programs, and countering adversary space capabilities:[28]

The conclusion of the SPR brought a significant shift in tone in public statements by U.S. officials. Starting in August 2014, senior military leadership began to talk publicly about the inevitability of conflict on earth extending to space and the need for the military to prepare to defend itself in space.[29] A similar shift in tone can also be seen in academic writings from U.S. military

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[23] Brian Weeden, "Dancing in the dark: The orbital rendezvous of SJ-12 and SJ-06F," *The Space Review*, 30 August 2010: http://www.thespacereview.com/article/1689/1.

[24] Brian Weeden, "Through a glass, darkly: Chinese, American, and Russian anti-satellite testing in space," *The Space Review*, 17 March 2014: http://www.thespacereview.com/article/2473/1.

[25] Brian Weeden, "Dancing in the dark redux: Recent Russian rendezvous and proximity operations in space," *The Space Review*, 5 October 2015: http://www.thespacereview.com/article/2839/1.

[26] Dyke Weatherington, testimony before the House Committee on Armed Forced, Strategic Forces Subcommittee, 25 March 2015: http://docs.house.gov/meetings/AS/AS29/20150325/103106/HHRG-114-AS29-Wstate-WeatheringtonD-20150325.pdf.

[27] Mike Gruss, "Disaggregation giving way to broader space protection strategy," *SpaceNews*, 26 April 2015: http://spacenews.com/disaggregation-giving-way-to-broader-space-protection-strategy/.

[28] Mike Gruss, "U.S. spending on space protection could hit $8 billion through 2020," *SpaceNews*, 2 July 2015: http://spacenews.com/u-s-spending-on-space-protection-could-hit-8-billion-through-2020/.

[29] John E. Hyten, speech at the Space and Missile Defense Symposium, 12 August 2014:

journals calling for renewed focus on fighting wars in space and offensive space control.[30, 31]

Congress also began to take more notice of the counterspace issue. The National Defense Authorization Act (NDAA) for FY15, the primary piece of legislation that authorizes and directs the activities of the U.S. military, called on the U.S. national security space community to report to Congress on how it plans to deter and defeat adversary attacks on U.S. space systems.[32] It specified a focus on the role of offensive space operations, and that the majority of the $32.3 million allocated to the Space Security and Defense Program for FY15 must be used for "the development of offensive space control and active defensive strategies and capabilities."

The DOD began implementing the recommendations of the SPR in its FY16 budget request. According to DOD officials, the request included between $5 and $8 billion in reprogrammed money between 2016 and 2020 for "space protection" initiatives, although that number cannot be publicly verified because the vast majority of spending was for classified activities.[33] The FY17 budget request reportedly contains $5.5 billion for space protection over the next five years, including $350 million for space control and offensive counterspace programs and $3.8 billion in undisclosed and classified programs.[34]

In addition to the budget increases, the U.S. national security space community has also been making organizational changes as a result of the SPR. In January 2015, USSTRATCOM and the National Reconnaissance Office (NRO) established the Joint Space Doctrine and Tactics Forum (JSDTF).[35] The

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http://www.afspc.af.mil/library/speeches/speech.asp?id=751.

30 B. T. Cesul, "A global space control strategy," *Air and Space Power Journal*, November-December 2014: http://www.airpower.maxwell.af.mil/digital/pdf/articles/2014-Nov-Dec/V-Cesul.pdf/.

31 Adam P. Jodice, and Mark R. Guerber, "Space combat capability…do we have it?" *Air and Space Power Journal*, November-December 2014: http://www.au.af.mil/au/afri/aspj/digital/pdf/articles/2014-Nov-Dec/V-Jodice_Guerber.pdf.

32 House Resolution 3979 – Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015, United States Congress: https://www.congress.gov/bill/113th-congress/house-bill/3979/text.

33 Mike Gruss, "Hyten: Continuing resolution would delay space protection efforts," *SpaceNews*, 17 September 2015: http://spacenews.com/hyten-continuing-resolution-would-delay-space-protection-efforts/.

34 Mike Gruss, "The Pentagon's next spending wave," *SpaceNews*, February 15 2016.

35 U.S. Strategic Command Public Affairs, "Defense, Intelligence communities collaborate for

purpose of the JSDTF was to improve collaboration and coordination between the military and intelligence communities on space operations, and in particular to spark development of tactics, techniques, and procedures for responding to attacks on space capabilities. In September 2015, the DOD announced the creation of a Joint Interagency Combined Space Operations Center (JICSpOC) in Colorado Springs to further the efforts of the JSDTF.[36] The JICSpOC would have an initial funding of $16 million in FY2016 to experiment with implementing the concepts developed by the JSDTF that could then be incorporated into the operational procedures for the JSpOC.

In October 2015, the Secretary of the Air Force (SecAF) was designated the new Principal Department of Defense Space Advisor (PDSA).[37] Previously, the SecAf had been designated the Department of Defense Executive Agent for Space (EA4S), a position created in 2003 to oversee the development of DOD space capabilities, programs, and budgets. In 2010, the EA4S received additional authority to oversee the Defense Space Council to coordinate national security space programs. The change to PDSA keeps these existing responsibilities, but adds a new independent role to advise the Secretary of Defense on the priorities for the entire national security space enterprise in order to help overcome bureaucratic inertia and implement change.[38]

Diplomatically, U.S. initiatives to deal with counterspace threats have been rather muted. The 2010 National Space Policy reversed the Bush Administration's opposition to any new legal agreements that could limit U.S. freedom of action in space,[39] and returned to the historical norm of considering proposals and concepts for arms control measures if they are "equitable,

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space resiliency," U.S. Strategic Command, 2 September 2015: https://www.stratcom.mil/news/2015/576/Defense_Intelligence_communities_collaborate_for_space_resiliency/.

36 Mike Gruss, "DoD, intelligence agencies invest $16M in JICSpOC," *SpaceNews*, 11 September 2015: http://spacenews.com/dod-intelligence-agencies-investing-16m-in-jicspoc/.

37 Aaron Mehta, "AF Secretary gains new authorities," *Defense News*, 8 October 2015: http://www.defensenews.com/story/defense/air-space/space/2015/10/08/secaf-gains-new-space-authorities-james-pentagon/73575366/.

38 Robert Work, "Designation of the Principal DoD Space Advisor," Memorandum, 5 October 2015: http://www.af.mil/Portals/1/documents/SECAF/Principal_DoD_Space_Advisor.pdf?timestamp=1444241369236.

39 The White House, "U.S. National Space Policy," 31 August 2006: http://marshall.wpengine.com/wp-content/uploads/2013/09/U.S.-National-Space-Policy-31-Aug-2006.pdf.

effectively verifiable, and enhance the national security of the United States and its allies."[40] But so far, this change has not resulted in any serious discussions of legally-binding arms control measures.

The main diplomatic focus has been on non-legally binding space security initiatives. In 2011, the UN Secretary General convened a Group of Governmental Experts (GGE) on Transparency and Confidence-building Measures (TCBMs) in Outer Space Activities.[41] Fifteen space experts from different countries produced a consensus report in 2013 with recommendations for improving cooperation in space and on reducing the risks of misunderstanding, mistrust, and miscalculations.[42] The GGE report represented the first time the United States, Russia, and China all agreed on a space security initiative within the UN system. However, the GGE's report served only as a set of recommendations, and there is currently much discussion about how, or if, those recommendations will be implemented.[43]

An international space security initiative that was originally thought to be a potential follow-through on the GGE report, the draft International Code of Conduct for Outer Space Activities (ICOC), has faltered. The ICOC began in 2007 as negotiation between the 28 member states of the European Union (EU).[44] The EU reached consensus on the document in 2008, but failed to garner additional non-EU signatories. In 2010, the EU launched a set of consultations on the ICOC, which used the EU code of conduct as a first draft. Regional consultations were held throughout 2012 and 2013, and culminated in what was intended to be the final official negotiations in New York City in July 2015. However, a strong diplomatic blocking effort led by Russia and joined by

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40 The White House, "National Space Policy of the United States of America," 28 June 2010: https://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

41 Christopher Johnson, "The UN Group of Governmental Experts on Space TCBMs fact sheet," Secure World Foundation, April 2014: http://swfound.org/media/109311/swf_gge_on_space_tcbms_fact_sheet_april_2014.pdf.

42 UN General Assembly, "Group of Governmental Experts on Transparency and Confidence Building Measures for Outer Space Activities," A/68/189, 29 July 2013: http://www.un.org/ga/search/view_doc.asp?symbol=A/68/189.

43 Theresa Hitchens, "Forwarding multilateral space governance: Next steps for the international community," Center for International & Security Studies at Maryland, August 2015: http://www.cissm.umd.edu/sites/default/files/ForwardingMultilateralSpaceGovernance%20-%20080615.pdf.

44 Christopher Johnson, "Draft International Code of Conduct for Outer Space Activities Fact Sheet," Secure World Foundation, February 2014: http://swfound.org/media/166384/swf_draft_international_code_of_conduct_for_outer_space_activities_fact_sheet_february_2014.pdf.

China, combined with concerns from many developing countries over references to the right of self-defense in space and the process being held outside the UN system, led to the initiative grinding to a halt and an uncertain future.[45]

In addition to these multilateral initiatives on space security, the United States has also engaged in a number of narrower initiatives. Since 2010, the United States has conducted a series of bilateral dialogues on space security with at least fifteen other countries, including both traditional allies and emerging space powers.[46] In 2014, the United States also joined with the United Kingdom, Canada, Australia, and New Zealand in creating a Combined Space Operations (CSpO) initiative to enhance joint space planning and operations,[47] and is reportedly in discussions with France, Germany, and Japan to potentially broaden the agreement at some point in the future.

Comparisons and Conclusions

A comparison of the U.S. response to the space debris and counterspace threats reveals both similarities and differences. Both issues seem to align to the punctuated equilibrium model of public policy, where policy change is driven in large part by external factors.[48] In the case of space debris, the slow accumulation of scientific consensus over time did not result in significant political action until the 2009 Iridium-Cosmos collision provided policymakers with a concrete example of the dangers. In the case of counterspace threats, the recent actions taken by the United States appears to have been sparked by Russia and Chinese testing of new or rekindled counterspace capabilities.

The most significant difference between the two issues is in implementation through specific programs and allocation of funding. The old

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[45] Michael Krepon, "Space code of conduct mugged in New York," Armscontrolwonk,com, 4 August 2015: http://www.armscontrolwonk.com/archive/404712/space-code-of-conduct-mugged-in-new-york/.

[46] Frank Rose, "Remarks at the 70th UN General Assembly Joint Ad Hoc Meeting of the First and Fourth Committees to Address Possible Challenges to Space Security and Sustainability," U.S. Department of State, 22 October 2015: http://usun.state.gov/remarks/6917.

[47] Colin Clark, "U.S., Closest Allies Sign Space Operations Agreement," *Breaking Defense*, 20 May 2014: http://breakingdefense.com/2014/05/us-closest-allies-sign-space-operations-agreement/.

[48] Paul Cairney, "Policy concepts in 1000 words: Punctuated equilibrium theory," Politics and Public Policy, 29 October 2013: https://paulcairney.wordpress.com/2013/10/29/policy-concepts-in-1000-words-

axiom of "follow the money" holds true. Money, in terms of budget, is a scarce resource, and budget allocations are a significant indicator of which issues are truly considered important by an organization.

On the issue of space debris, there has been no appreciable movement towards allocating significant funding to specifically deal with space debris. NASA continues to fund basic research on the space debris population, but the amount is too small to break out into a separate budget line. Likewise, the small amount of money NASA has spent on funding research and development of debris mitigation technologies is just one small part of a much bigger funding line for space technology in general. All told, NASA's entire annual budget dedicated to space debris probably amounts to several million dollars, a paltry sum out of a total annual budget of nearly $19 billion.

While the DOD has recently reallocated a significant amount of money to deal with space threats, the vast majority of it appears to be directed at the counterspace threats and not dealing with space debris. A U.S. Government Accountability Office report published in October 2015 estimated that the DOD spends approximately $1 billion per year on SSA,[49] but much of the motivation for that spending is the broader SSA mission to collect intelligence on foreign space capabilities and detect threats to U.S. space assets. Even if the entire amount were spent on tracking space debris, it would still represent around 1/20th of the estimated $22 billion reportedly spent on U.S. national security space each year.[50]

The most glaring gap in current U.S. government efforts to address space debris is the lack of any progress on space debris remediation. Despite near consensus in the scientific community on the need for remediation, the U.S. does not have a strategy to develop the technology to do remediation, nor is there a strong push from either the DOD or NASA to request funding from Congress to support development or operation of space debris remediation capabilities. The lack of a request is likely because space debris does not clearly fall into either organization's "job bucket", resulting in a lack of organizational motivation to take on a mission that might result in cuts to other missions that

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punctuated-equilibrium-theory/.

[49] Cristina T. Chaplain, "Space situational awareness: Status of efforts and planned budgets," U.S. Government Accountability Office, 8 October 2015: http://www.gao.gov/assets/680/672987.pdf.

[50] "The Space Report 2015," The Space Foundation, April 2015: http://www.spacefoundation.org/sites/default/files/downloads/The_Space_Report_2015_Overview_TOC_Exhibits.pdf.

are deemed higher priorities or an unfunded mandate.

This lack of organizational push to deal with space debris stands in stark contrast to the national security community's budgetary and programmatic push for more space protection efforts. The DOD has clear organizational mission and responsibility to protect its space assets. The DOD has also demonstrated significant competence in working with Congress to convince key committees of the need for increased spending on space protection. A recent news article cites one Congressional staffer as having said there were more classified briefings on counterspace threats in 2013 and 2014 than the last decade combined.[51] These briefings are also designed to take advantage of the current Republican control of Congress, as it is the party most likely to be concerned about national security threats and amenable to increased military spending.

All told, it is clear that dealing with outer space threats has become a much more important issue for the U.S in recent years. The basic type of outer space threats the U.S. faces are not new; but having to deal with both hostile and environmental threats at the same time does create new challenges in prioritization and allocation of resources, including both budget and political capital. While there has been recognition of the importance of both types of threats and strong policy directives provided from the top, the follow-through and implementation has been decidedly more focused on counterspace threats than environmental. This is likely due to organizational and political factors, including the lack of clearly defined responsibilities, budget constraints, and a political predilection for national security. The counterspace threats cannot be ignored, but discounting or losing focus on the environmental threats could have significant consequences for all elements of the United States to continue to use space in the future.

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[51] Mike Gruss, "Pentagon proposes accelerated schedule for SBSS follow-on," *SpaceNews*, 2 February 2015: http://spacenews.com/pentagon-proposes-accelerated-schedule-for-sbss-follow-on-satellites/.