Space Traffic Management and the United States Data Sharing Environment

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I. Introduction

The theme that space is congested, contested, and competitive is increasing in it prominence in the discourse of space security and space sustainability. Media accounts love to profile narratives of errant space junk wreaking havoc in outer space, but these accounts are often written more for the catchy headlines and their clickbait appeal than for real concern with substance. However, there has been consistent movement in the civil, military, and commercial arenas that indicates a genuine concern with the long term sustainability of the outer space environment and security of space assets. As a result of this stakeholder concern, space traffic management (STM) has become an issue on the agenda of numerous national and international entities. As more actors participate in space activities, problems of congestion will increase. As the IAA's *Cosmic Study on Space Traffic Management* made clear, effective, holistic space traffic management can only be achieved through a network of legal, policy, and technical mechanisms that facilitate a cooperative effort to maximize the sustainability of the space environment. However, as can be seen from the fiasco at the Multilateral Negotiation on the European Union's Code of Conduct for Space Activities held in July of 2015 in New York, there currently seems to be a lack of cooperation among states on space issues, making such holistic coordination seem unreachable as well.[1]

As a major space actor, the United States has a great deal to lose if the space environment degrades significantly. As a result, the United States is currently investigating mechanisms with which to manage its own space actors'

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1 The author had the privilege of serving as an observer of the International Institute of Space Law to this "negotiation." The negotiation itself was derailed almost immediately. See generally, Michael Krepon, Space Code of Conduct Mugged in New York," Arms Control Wonk, Aug. 4, 2015, http://krepon.armscontrolwonk.com /archive/4712/space-code-of-conduct-mugged-in-new-york.

on-orbit activities. This project is a complex, regulatory one that requires a legal structure that deploys effective jurisdiction over United States space objects in orbit and their operators, that effectively arranges for interagency coordination, and that creates proper authorization and appropriations for maintaining technical competence to carry out the mission. One of the core capabilities for any such system is effective data sharing among stakeholders. This paper argues that it is a prerequisite for establishing effective space traffic management and that an open source data policy both protects national security and furthers the goal of developing an international governance system of space traffic management.[2]

This paper will proceed first by briefly explaining the concept of space traffic management and illustrating how an effective data sharing regime is central to deploying such a system. It will then describe the current structure of the data sharing environment within the United States and note the gaps between military, civil, and commercial space situational awareness (SSA) data. This description will be followed with suggestions for creating a more effective SSA data sharing environment in the United States. The paper will argue that an open data policy will be the best way to manage data sharing and ensuring responsible, sustainable, and safe space operations. Finally, the paper will argue that the adoption of an open data sharing environment could be the necessary precursor to realizing the ultimate goal of international coordination of space traffic.

II. Space Traffic Management and Its Discontents

While there may be an infinite number of orbits around the Earth, there is not an infinite amount of space in Earth orbit. When the infinite number of orbits have been diminished down to the number of orbits that have value for human activities, we can see that it is likely that as the number of spacecraft increases so to does the likelihood that spacecraft might converge orbits with other space objects. This analytic act is backed up by empirical evidence that

2 Since the original delivery of this paper, the US Congress has passed and the President signed the US Space Launch Competitiveness Act. Pub. L. 114-90 (Nov. 25, 2015). Title I, section 110 requires that the secretaries of Transportation and Defense to prepare a report on "study the feasibility of processing and releasing safety-related space situational awareness data and information to any entity consistent with national security interests and public safety obligations of the United States." *Id.* at §110; See *also id.* at §109. This legislation shows the changes in the way that the United States is thinking about space security and that it is contemplating the idea of open sourcing its data. Of course, this is not meant to assert that there is any connection between this paper and the legislation, though it is hoped that the testimony referenced in footnote 1 was at to some extent instrumental in the development of this part of the legislation. Since this paper was presented before the legislation at the IAC, it has not been substantially reworked in light of this legislation.

spacecraft do collide with other objects. While most of these collisions are of the nature of spacecraft with space debris, the Cosmos-Iridium collision serves as a reminder that large objects can converge in space.[3] This is, of course, the problem that space traffic management seeks to address. Whereas debris mitigation guidelines seek to create uniform standards for reducing the creation of space debris, STM seeks to go a step further and create mechanisms for international coordination of the placement and movement of objects in space.

STM can be understood as "the set of technical and regulatory provisions for promoting safe access into and out of space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference."[4] This broad definition covers a great deal of ground encompassing legal and operational mechanisms of control as well as all types of interference. While a broad definition is desirable at the outset, it also portrays the complexity of establishing such a system, especially at the international level. This is because it brings in too many moving parts, so to speak, making all encompassing law-making a difficult. The difficulty is the result of the nature of international law and politics wherein different states have different interests in the development of such a regime. The complex a regime is, the more difficult agreement and implementation become. In this context, dominant space actors are loathe to lose control of their space assets to an overriding system, while emerging space actors fear such a system might inhibit their technological progress.

Because complex international regimes are difficult to adopt, progress is often incremental in nature. This is especially so in light of the effects of post Cold War globalization, which restructured international power and diversified the number of states with stakes in international politics. One of the effects of this restructuring has been an increase in the number of space faring nations.[5] Formal lawmaking for outer space activities has slowed dramatically,[6] and, as the EU Code of Conduct negotiation illustrates, there is a great deal of contestation over both the content and the process for any new laws. This is why states often turn to less formal processes that scholars have deemed soft law.[7]

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3 See *generally*, Brian Weeden, *2009 Cosmos-Iridium Collision: Fact Sheet* (Secure World Foundation, Nov. 10, 2010) at http://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf.

4 International Academy of Astronautics, *Cosmic Study on Space Traffic Management* (International Academy of Astronautics, 2006), 10.

5 Spacefaring, here, is used to denote states that have on orbit assets, as opposed to indigenous launch capabilities.

6 See *generally*, Sergio Marchisio, "The Evolutionary Stages of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)," J. Space L. 31 (2005): 219.

7 See *generally*, Kenneth W. Abbott and Duncan Snidal, "Hard and Soft Law In International Governance," *International Organization,* 54, no. 3 (2000): 421-56 and

While the term soft law is somewhat contentious,[8] it does describe the current way in which states are seeking to increase stability in space. Soft law is incremental in nature. It first seeks agreement on principles without the power of law, and these principles are then either widely adopted or ignored by states. Those principles that are widely adopted indicate the value choices that states agree on, and are therefore more likely to be followed by states and also to eventually achieve some sort of binding force, either through their integration into international agreements or through the development of custom.

Soft law, though, is not the only path to incremental lawmaking. A great deal of international law comes through the domestic law practice of states. States, serving as laboratories for regulation, often lead the way in the development of international law. An example of this is in the content of the Outer Space Treaty's Article VI requirement of "authorization and continuing supervision."[9] States have repeatedly looked to each others' domestic legislation with respect to licensing regimes. These regimes have grown in such a way that Article VI, must now be read in terms of state licensing, which sets out what best practices under the treaty are.

STM in the current geopolitical context is a needed regime, but it is one that is likely to grow from mechanisms other than formal lawmaking. This means that initial efforts will need to find common ground among state actors in order to make headway in achieving the goal of STM, and avoiding issues that result in impasse among nations. It is submitted here that this common ground is likely to start with data sharing. STM is completely dependent on data. Neither legal nor technical solutions to STM are possible without good data. STM at its core presupposes a knowledge of the position of objects in space. However, states do not currently share this data openly meaning that no international system can even begin to form, despite the fact Data sharing

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P. J. Blount, "Renovating Space: The Future of International Space Law," *Denv. J. Int'l L. & Pol'y* 40 (2012): 515-686.

8 One finds oneself in a circular argument with soft law. Soft law is essentially regulatory content that is nonbinding in nature, but if it is non-binding it lacks a constitutive element of law (i.e. binding force), but if it indeed regulates then it fulfills legal ends. Regardless of whether one thinks soft law is law, soft law as a source of limitation on state action is indeed a reality, making some of the debate moot except in theoretical terms. In terms of policy, when states agree to nonbinding political agreements at least one scholar has argued that this gives states an obligation to give notice before they depart from those agreements. See Bin Cheng, "United Nations Resolutions on Outer Space:'Instant' International Customary Law?," *Indian Journal of International Law* 5 (1965): 23.

9 "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies," October 10, 1967, Art. VI.

is the bedrock for STM.[10] It should be noted here that a distinction between data sharing and open data sharing is being made. States do currently share data on the basis of bilateral agreements without each other, but this is different from open data sharing in which data is distributed freely to any entity without specific authorization.

The coordinating process of the International Telecommunications Union (ITU) is instructive here. As the only formalized system that results in some degree of space traffic management, the ITU process illustrates the importance of data sharing. The ITU is said to allocate orbital positions along the geosynchronous orbit, but this system is partial at best because the ITU's role is more coordinator than regulator. This system has been widely critiqued for its inequity and its openness to abuse.[11] These critiques are rooted in the fact that the ITU process is a "coordinating" function. The ITU, while maintaining a great deal of legitimacy, is vested with no binding power when it allocates an orbital slot. There is a dispute resolution process, but states are not required to submit to it. Indeed, the entirety of the process serves to create an information exchange point for states through the master register, which records data from states and makes it available to other states. Through the high legitimating power of the ITU, this exchange point creates a working system, albeit an imperfect one, in which states can interact. Data sharing is at the heart of the ITU system, and effective data sharing is a prerequisite to the establishment of an international STM regime.

III. The United States and Data Sharing

The United States is a major space actor, and it holds an elite status among spacefarers. As such, it has a great deal to lose if the space environment becomes compromised through congestion from functional space objects and space debris. Indeed, the calls for STM are rooted in a need to maintain predictable space operations for civil, military, and commercial uses. The US has, as a result, begun conversations on the development of STM at the domestic level. For instance, in May of 2014 the Space Subcommittee of the US House of Representatives held a hearing on STM.[12] This hearing served an exploratory role into the process of developing such a regime, and legislation

10 Russia and China do not publish SSA data publicly, and the EU does not plan on doing so either. Matthew C. Smitham, The Need for a Global Space-Traffic-Control Service: An Opportunity for Us Leadership, Maxwell Papers (Air War College, 2012).

11 See Lawrence D. Roberts, "Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union, A," Berk. Tech. LJ 15 (2000): 1095.

12 Space Traffic Management: How to Prevent a Real Life "Gravity," May 9, 2014, http://democrats.science.house.gov/hearing/space-traffic-management-how-prevent-real-life-%E2%80%9Cgravity%E2%80%9D. See *supra* note 1.

is not yet likely, but it did shed light on a number of issues connected with STM and the complexities in establishing STM at even the domestic level.[13]
A central issue for the United States is the dispersion of power across actors. Competency to regulate, in both a formal 'legal' sense and an informal 'control' sense, is dispersed across a number of government agencies, and there is not a clear control point for space activities. NASA controls civil space activities; the Department of Defense (DoD) controls government space activities; and a conglomerate of federal agencies regulate commercial activities. These agencies include the Federal Aviation Administration (FAA), which licenses launch, reentry, and spaceport activities; the Federal Communications Commission (FCC), which licenses telecommunication frequencies; the National Atmospheric and Oceanic Administration (NOAA), which licenses remote sensing activities; and the State Department (DoS) which coordinates international interactions. Importantly, all of these entities have jurisdiction over specific space activities, but none have overriding jurisdiction over space actors. This is problematic as there is no agency that has the positive authority to require a space actor to, for instance, move a satellite to avoid a collision. More importantly, there is no federal regulatory agency that collects and maintains the data needed to know whether a space object needs to be moved.
These jurisdictional ambiguities are important, because all three types of operators (i.e. commercial, civil, and military) require predictability, but the nuances of US federal government mean that there will be an administrative and legislative battle to allocate jurisdiction among agencies for STM. In the meantime, however, predictability can be increased through data sharing so that all operators are informed about the space environment. Currently, DoD collects and maintains space situational awareness (SSA) data as part of its mission to ensure its own space operations. This data is shared with other actors on an agreement by agreement basis. This is due to the fact that DoD collects military sensitive data and keeps that data classified. However, DoD has created agreements with partners to share the data. These data sharing arrangements ensure national security in two ways. First, they establish the terms of the sharing to ensure the secrecy of the shared data. Second, they create stability by informing other actors about the space environment. Significantly, DoD recently completed one such agreement with the Space Data Association (SDA), a conglomerate of commercial space actors that have pooled data to better inform their operations. This is the first such arrangement that DoD has made with a non-satellite operator.[14]

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13 See *supra* note 2 for information on US legislation that was adopted after this paper was presented that requires government agencies to prepare reports on possible approaches to STM.

14 SDA, "Space Data Association: SDA and U.S. Department of Defense Sign Space Situational Awareness Agreement," Aug. 8, 2014,

One of the reasons that this agreement is important is that both SDA and DoD are trying to get better data. One would think that DoD would not need SDA's data, but despite the fact that US DoD has the most advanced SSA capabilities in the world, these capabilities are incomplete and the system is increasingly out of date.[15] Though DoD has recently had a private contractor break ground on its fan-fared Space Fence system, it is likely years – if not decades – away from completion.[16] The problem of incomplete data does not just injure commercial actors, it also compromises national security goals.

A solution to this issue would be the adoption of an open data policy in which the US creates a regime for sharing the most data possible with all space actors, governmental and commercial. In such an arrangement, DoD would be authorized to share a maximum amount of data in a statutorily defined way that protects military sensitive data. In the interest of developing the most complete data set possible, this proposed regime would require US space actors to also take part in contributing data with proper protections for commercially sensitive data as well. This would give other federal agencies the information they need when executing their functions. For instance, SSA data could become an important part of the FAA's payload review process.

An open data policy, would set the foundation for determining how to structure an effective STM regime domestically. Interagency sharing as well as public-private sharing will enhance all actors ability to manage their own space operations which furthers the goal of predictability in space operations.

IV. International Open Data

As stated above, international law making is often incremental and can often find its seeds in domestic law making. For example, the concept of nondiscriminatory access found in the Remote Sensing Principles finds its sources in United States remote sensing law.[17] Indeed, legal innovation from the United

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www.businesswire.com/news/home/20140808005645/en/Space-Data-Association-SDA-U.S.-Department-Defense.

15 See Brian Weeden, Going Blind: Why America Is on the Verge of Losing Its Situational Awareness in Space and What Can Be Done About It (Secure World Foundation, 2012), http://swfound.org/media/90775/going_blind_final.pdf and Matthew C. Smitham, The Need for a Global Space-Traffic-Control Service: An Opportunity for Us Leadership, Maxwell Papers (Air War College, 2012).

16 Juliet Van Wagenen, "Race to the Space Fence: Lockheed Martin, US Air Force Break Ground on New Space Surveillance System," Via Satellite, March 24, 2015, www.satellitetoday.com/technology/2015/03/24/race-to-the-space-fence-lockheed-martin-us-air-force-break-ground-on-new-space-surveillance-system/.

17 See Joanne Irene Gabrynowicz, "Perils of Landsat from Grassroots to Globalization: A Comprehensive Review of US Remote Sensing Law with a Few Thoughts for the Future, The," Chi. J. Int'l L. 6 (2005): 45.

States, has routinely found its way into the laws of other states and influenced the creation and content of international law.

The adoption of an open data policy by the US should not exclude international actors. Instead it should freely share its data with all space actors and encourage reciprocity. If such a policy has been properly structured to maintain only militarily sensitive data as classified, then such sharing is not problematic to the United States. A great deal of SSA data is already in the public domain. Private observers are able to track military satellites and release the data they collect.[18] This means that only the most sensitive of information should be protected. Sharing with other state parties on a nondiscriminatory basis (to crib a phrase from the Remote Sensing Principles) places the US in a cooperative stance in regards to other space actors. Such a cooperative stance, would encourage actors to also share their data. International cooperation is called for across the treaty regime, which adds legitimacy to an open data policy. Instead, of fragmented data sets, space actors globally would be using a data set built from numerous sources.

As argued above, information sharing is a precondition to establishing STM, and there is no international institution that has – or likely will have – the capabilities and resources to establish and maintain an SSA system in the near term. Any such system will have to be based on capabilities possessed by individual states, and the United States, as an elite space actor, is in a unique position to establish an open data policy that functions at a global level. The integration of multiple data sources can only increase all space actors' ability to operate in space with the requisite predictability. This not only enhances the United States concerns with national security, but it also supports the commercial space industry within the US. US policy has the ability to shape best practices at the international level, through cooperative efforts. A globally integrated SSA data set will not solve the problems of orbital congestion any more than the ITU's Master Register has solved the issue of GEO congestion. It will, though, help states to better coordinate their activities to avoid harmful interference as required uner Art. IX of the outer space treaty.[19]

There of course is risk in such a policy. Anti-satellite (ASAT) attacks depend on precise knowledge of a space object's location, and open data reveals much of the information that a state might need to accomplish an ASAT attack. However, it is submitted here that states that have ASAT capabilities also have the ability to gain that information from a variety of sources, or in other words location in space is not the secret that it once was. Additionally, the states with these capabilities – namely Russia and China – also have a great deal to lose from the degradation of the space environment. An open

18 See *for example* Justin Ray, "X-37B spaceplane's orbit discovered," *Spaceflight Now (*May 27, 2015) at http://spaceflightnow.com/2015/05/27/x-37b-spaceplanes-orbit-discovered/.

19 Outer Space Treaty, *supra* note 9.

data regime may open risk, but that risk is minimal when compared to the risks involved with massive degradation of the space environment from satellite collisions, which would undercut civil, military, and commercial goals in outer space.

V. Conclusion

STM is a goal that is, legally speaking, far off, but the proper groundwork can begin to be laid. The groundwork requires cooperation among states, and the United States is in a unique position to lead this effort and help craft a regime that supports US national interests as well as supports global stability and predictability in the space environment. The open sourcing of data can be an important first step in establishing a global STM regime.