

# National Security Space

## :A Federal and Friendly Future for the Final Frontier

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### I. Introduction

“We stand today on the edge of a New Frontier...of unknown opportunities and perils, the frontier of...space.”<sup>2</sup> These words, delivered by John F. Kennedy at his nomination speech during the Democratic National Convention in 1960, not only helped propel him to the office of President of the United States of America in the general election a few months later, they also framed the way in which the United States has viewed space ever since. They are, in a sense, guiding the discussions on the future of national security space in the U.S., even today.

### II. The Final Frontier

If space was, as President Kennedy called it, the “new frontier,” what was the old frontier he was referring to? The boundary of settled land, beyond which lies “unknown opportunities and perils” is the frontier. To a typical American at the time, the “frontier” phraseology would have certainly brought up images of the American West. Although scholars disagree about exact time and location, for the purpose of making this point we’ll consider the area west of the Mississippi River as The West. As for the time period, we’ll consider the Louisiana Purchase in 1803 as the start<sup>3</sup> and 1959, the year before Kennedy’s above-referenced speech when

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<sup>1</sup> The views expressed are the author’s own and not necessarily those of the United States Air Force, Department of Defense, or U.S. Government.

<sup>2</sup> Kennedy, J. F. (2008). Democratic National Convention Nomination Acceptance Address - The New Frontier. In M. E. Eidenmuller, *Great Speeches for Better Speaking*. New York: McGraw-Hill.

<sup>3</sup> Hyslop, Stephen G. (November 3, 2015). The Old West. *National Geographic*, 5.

Alaska and Hawaii were admitted as the 49th and 50th U.S. states, as the end.<sup>4</sup>

Activities of individual Americans and policies and programs of the U.S. government (USG) during this approximately 150-year time period pushed the frontier of civilization as they knew it west from the Mississippi river further and further into land filled with both opportunity and peril.

As an example Laura Ingalls Wilder, born in northwestern Wisconsin just east of the Mississippi River, recorded stories of her life as a child that paint a vivid picture of both the opportunities and perils of frontier living. Her stories of poverty, hunger, and extreme weather - blizzards, droughts, and hailstorms that wreaked havoc on crops, killed livestock, and threatened loved ones - are just some of the natural and man-made hardships of the frontier that are almost unimaginable to people today.<sup>5</sup> However, her stories are far from depressing. Laura's books and the television show they spawned became popular in the U.S. and around the world because they are inspiring. They are filled with examples of heroism, perseverance, the ability to overcome hardship, and the seeming limitlessness of the beauty and resources available to anyone willing and able to take on and overcome the risks.

Regardless of the tremendous hardships, challenges, and risks, Americans like Laura moved further and further west until there was no more frontier left to tame. America now stretched from sea to shining sea,<sup>6</sup> and the west was just another region of the country that provided resources to use and places to live and visit for Americans.

The frontier west, with its boundless opportunity and implicit promise of progress and great reward, provided President Kennedy a fitting analogy with which to frame space, as a new frontier not defined by

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<sup>4</sup> Millner, Clyde A. (1994). National Initiatives. (eds): MillnerA.Clyde, O'ConnorA.Carol, SandweissA.Martha, The Oxford History of the American West (pp: 156-157). New York: Oxford University Press.

<sup>5</sup> Fraser, Caroline. (2017). Prairie Fires: The American Dreams of Laura Ingalls Wilder. New York: Metropolitan Books.

<sup>6</sup> Bates, Katherine Lee. (1893). America the Beautiful. Washington: Library of Congress.

direction (“Go West, young man!”<sup>7</sup>) but by elevation (“I...lifted up mine eyes unto heaven”<sup>8</sup>). This framework allowed Americans to understand the new domain in a way that was familiar and, it should be noted, as a narrative that ends in American victory and success. This was critically important because, with the Soviet Union’s launch of Sputnik on October 4, 1957, space had just leapt from the realm of astronomers and science fiction writers to something with very real, immediate implications for U.S. national interests. The Soviets were now analogous to countries like France and Spain who had colonies in the Americas or to the later Indians and outlaws, all of which needed to be bought-out, pacified, assimilated, or defeated in order to fulfill America’s Manifest Destiny.<sup>9</sup>

### III. Very Brief History of National Security Space Capabilities

To set a discussion of organization in the proper context, let’s go through a very brief history of national security space from an Airman’s perspective.

By the time of President Kennedy’s speech in 1960, the U.S. was confident in the Intercontinental Ballistic Missile (ICBM) capabilities developed largely by the Air Force. In the space race against the Soviets, U.S. ballistic missiles were converted to space launch vehicles, or rockets, including the Thor missile to the Delta rocket and the Atlas and Titan missiles to rocket versions with the same names. Simple satellites with cameras on them were launched into low Earth orbit (LEO) to take pictures of things like the location of Soviet tanks and cloud formations, becoming the first U.S. intelligence, surveillance, and reconnaissance (ISR) and weather satellites. The Air Force put communication nodes, infrared (IR) sensors, and precise signal emitters into space in the following decades, representing the national security space capabilities of communications, early warning, and position-navigation-timing (PNT;

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<sup>7</sup> Cross, Coy F. (1995). *Go West, Young Man!: Horace Greeley's Vision for America*. Albuquerque: University of New Mexico.

<sup>8</sup> The Holy Bible Authorized King James Version. Dan 4:34, Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 2013.

<sup>9</sup> Mountjoy, Shane. (2009). *Manifest Destiny: Westward Expansion*. New York: Infobase Publishing.

most people are more familiar with the abbreviation for the Air Force's PNT system, GPS).<sup>10</sup> Telescopes and radars on earth could see all these satellites in space, so the Air Force started a database to obtain Space Situational Awareness (SSA). The core national security space capabilities of the Air Force can therefore be categorized as follows: launch, ISR, weather, communications, early warning, PNT, and SSA.

The Air Force is not the only agency working national security space in the USG. In addition to capabilities developed by the Navy and other sister services in the Department of Defense (DoD), intelligence organizations such as the National Reconnaissance Office (NRO) and many other federal agencies have also developed, or become users or regulators of, national security space capabilities. As nearly all national security space capabilities have dual use application, they have birthed or influenced nearly all civil and commercial space activities, exactly the pattern witnessed in the taming of the West.

#### **IV. Why a Space Force**

##### **IV.A. Why a Space Force: One Boss**

As a matter of fact, there are currently over 60 departments and agencies in the USG that have responsibility for national security space.<sup>11</sup> This leads to much confusion in terms of 'who's the boss?' type questions. Based on the author's decades of experience as an Astronautical Developmental Engineer (62E3B) and as a Space Operator (13S) in the Air Force, it's only a slight exaggeration to say that nearly every USG agency and private company involved in national security space thinks they are (or should be) the boss.

This problem has been around for quite a while. The GAO (General Accounting Office, changed to Government Accountability Office in 2004) warned of "fragmented responsibilities" in national security space in a

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<sup>10</sup> Dobberfuhl, Phillip M. (H31). U.S. Air Force and Space. (Hoyu Publishing Committee) Hoyu, 45(1), 132-133.

<sup>11</sup> Pence, Mike. (1 March 2019). Mike Pence: It's Time for Congress to Establish the Space Force. The Washington Post, [www.washingtonpost.com](http://www.washingtonpost.com).

1994 report.<sup>12</sup> The Rumsfeld Space Commission concluded in 2001 that America’s military and intelligence agencies are “not yet arranged or focused to meet [our] national security space needs.”<sup>13</sup> The Allard Commission said it most directly in 2008, “No one’s in charge.”<sup>14</sup> In 2016 the GAO repeated their decades-long testimony that, “Persistent fragmentation and overlap in management...[exists because] DOD lacks a single authority to ensure...leadership in national security space.”<sup>15</sup>

Based on number of systems in operation and annual budget allocation, some might be led to believe that the Air Force is in charge of national security space. However, as these reports make clear, that is simply not the case.

Knowing that the lack of a clear leader or boss agency in national security space is the root cause of many of the issues currently present, there have been many proposals and attempts to rectify this issue. For example, one proposed solution in 1995 from the Center for Naval Analyses recommended forming an independent U.S. space service.<sup>16</sup> As is evident from today’s situation, that recommendation was not implemented.

Let’s review another, more detailed example. As a result of the Space Launch Vehicles Broad Area Review (BAR),<sup>17</sup> released in 1999 after examining several launch vehicle anomalies and failures in the previous

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<sup>12</sup> National Security and International Affairs Division. (1994). Report to the Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representatives. Washington: United States General Accounting Office.

<sup>13</sup> Commission to Assess US National Security Space Management and Organization, aka Rumsfeld Space Commission, (11 January 2001). Report of the Commission.

<sup>14</sup> Institute for Defense Analyses, aka Allard Commission. (July 2008). Leadership, Management, and Organization for National Security Space: Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space.

<sup>15</sup> U.S. Government Accountability Office. (27 July 2016). Defense Space Acquisitions: Too Early to Determine if Recent Changes Will Resolve Persistent Fragmentation in Management and Oversight. Government Accountability Office: Washington.

<sup>16</sup> Federici, G.A., Wald, B., et al. (May 1995). Commission on Roles and Missions of the Armed Forces: Space Activities. Center for Naval Analyses: Alexandria.

<sup>17</sup> Space Launch Broad Area Review Panel. (1 November 1999). Space Launch Vehicles Broad Area Review Report. Washington: Air Force Space Command and the National Reconnaissance Office.

months, the Secretary of the Air Force (SECAF) was designated the DoD Executive Agent for Space.<sup>18</sup> This was intended to provide unity of effort and centralized direction and control in national security space.<sup>19</sup> There was now one boss for space, at least in the DoD. That role, however, was promptly delegated to an undersecretary, leading experts in the field to conclude that the Air Force did not want to fulfil the leadership role. This action can be considered one of the direct ancestors to the congressional criticism from lawmakers today who have “not been shy about taking shots at the Air Force for doing a bad job managing space.”<sup>20</sup>

Proposing an independent U.S. space service and designating the Air Force as Executive Agent for space are just two of the numerous good faith efforts that have been undertaken over the past decades to solve the chronic ‘who’s the boss?’ issue that afflicts U.S. national security space.

A single Space Force (or Space Corps,<sup>21</sup> or Space Defense Force,<sup>22</sup> or Space Department,<sup>23</sup> all of which have been proposed in recent history) containing all the research, development, acquisition, and operations missions encompassed in the realm of national security space (as opposed to the other two realms: civil space and commercial space) would, in the view of the author, solve the problem. The Secretary/Commander of the organization would be the clear, undisputed ‘boss’ of national security space.

#### **IV.B. Why a Space Force: Organizational Benefits**

Consolidating national security space’s sprawling bureaucracy into one body (boss) could clarify accountability, accelerate decision-making,

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<sup>18</sup> Department of Defense. (3 June 2003). DoD Directive 5101.2, DoD Executive Agent for Space. Washington: Department of Defense.

<sup>19</sup> Chairman of the Joint Chiefs of Staff. (22 October 2018). Joint Publication 3-0: Joint Operations. Washington: Joint Chiefs of Staff.

<sup>20</sup> Erwin, Sandra. (20 March 2019). DT Thompson Angered by Criticism of Air Force Stewardship of Space. ref: Space News: <https://spacenews.com>.

<sup>21</sup> Green, David (2019 (2017)). Stars Are Aligning for New Military Service Focused on Space [recorded by: National Public Radiol]. Washington, D.C, USA.

<sup>22</sup> Brookings Institution. (2019). Assessing Space Security: Threat and Response. Washington: Brookings Institution.

<sup>23</sup> Seligman, Lara. (23 January 2018). Forget Space Corps--A Space Department Is on the Table. Aviation Week: Aerospace Daily & Defense Report.

rationalize the procurement process, improve recruitment, and ease pressure on the broader Air Force.<sup>24</sup>

#### **IV.B.1. Why a Space Force: Organizational Benefits: Acquisitions**

First, let's go over the potential benefits of a new, consolidated organization in the area of acquisition. The DoD space acquisition process is painfully slow and expensive, and has been for quite a while. The result is that we are constantly launching into orbit satellites built with yesterday's technology at tomorrow's price.

The following three examples called out in a 2011 GAO report<sup>25</sup> show initial and current (FY2011) cost estimates and schedule delays. You will find the trend to be true, with vanishingly few exceptions, regardless of the specific year or name of the program: over budget and behind schedule (which leads to technological obsolescence). That recurring result is the exact opposite of what acquisition professionals work for in the Holy Trinity of procurement excellence: cost, schedule, and performance.

SBIRS High (missile early warning system)

1996 initial program cost: \$4.52 billion

2011 estimated program cost: \$18.05 billion

Schedule delay as of 2011: 107 months

- In the 15 years of the program at that time, it was nearly 9 years behind schedule and almost \$14 billion over budget.

WGS (satellite communications system)

2000 initial program cost: \$1.18 billion

2011 estimated program cost: \$3.62 billion

Schedule delay as of 2011: 44 months

- In the 11 years of the program at that time, it was approximately 4 years behind schedule, and the costs had more than tripled.

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<sup>24</sup> Editorial Board. (21 June 2018). Trump's 'Space Force' Is No Joke. It Might Even Work. ref: Bloomberg: [www.bloomberg.com](http://www.bloomberg.com).

<sup>25</sup> U.S. Government Accountability Office. (11 May 2011). Space Acquisitions: DOD Delivering New Generations of Satellites, but Space System Acquisition Challenges Remain. Government Accountability Office: Washington.

AEHF (satellite communications system)

2001 initial program cost: \$6.28 billion

2011 estimated program cost: \$13.88 billion

Schedule delay as of 2011: 68 months

- In the 10 years of the program at that time, it was almost 6 years behind schedule and the costs had jumped into double digit billions of dollars.

There is clearly room for improvement in acquisition processes. Lower costs provide more funds for other programs (or lower budgets).<sup>26</sup> Better on-time delivery prevents cost increases, both on the primary program and the alternate programs that must be extended past their planned lifespan in order to avoid a capability gap, and provides the capability when it's scheduled. Getting the capability on orbit on time avoids the technology gap that materializes with late delivery, so the best and the newest can be provided for users rather than a 5-year or 10-year old set of technology.

The Space Development Agency (SDA) established by then Acting Defense Secretary Patrick Shanahan on 12 March 2019 was the latest in a long line of strenuous efforts aimed at improving cost, schedule and performance in space acquisition. However, according to some specialists, this effort also appears doomed for failure. A Center for Strategic and International Studies (CSIS) expert at a July 2019 panel asked, "Why is it not being organized under the Space Force?" He concluded that, "Creating an SDA off on the side further fragments things and mis-aligns us."<sup>27</sup>

Like this recent example, well intentioned acquisition reform efforts have ultimately failed to accomplish any (let alone all) of the big three procurement goals - reduce costs, reduce timelines, and provide better performance. Putting all the acquisition authorities and responsibilities under one leader could be the answer to acquisition issues that have plagued national security space for so long.

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<sup>26</sup> United States General Accounting Office. (February 1997). Better Use of Limited DOD Acquisition Funding Would Reduce Costs. Washington: United States General Accounting Office.

<sup>27</sup> Erwin, Sandra. (31 July 2019). Analysts: 'Space Defense Force' Would Be a Better Name, Space Development Agency Will Not Survive. ref: Space News: <https://spacenews.com>.



#### **IV.B.2. Why a Space Force: Organizational Benefits: Personnel**

While the machinery and money part of space is important, all the budget in the world being used in a way that provides low-cost, quick, state-of-the-art capabilities won't do a lick of good without competent personnel. "It's not about the money. It's about the people you have [and] how you're led."<sup>28</sup> A brief review of the current personnel situation - the development and utilization of a space cadre - in each of the services is in order to understand the benefits of a Space Force in this area.

For the Air Force, let's turn to U.S. Representatives Mike Rogers (R-Ala) and Jim Cooper (D-Tenn), the ranking members of their respective parties on the House Armed Services Strategic Forces committee who have been the primary proponents of a Space Corps for several years. Rep. Rogers commented on the state of Air Force space personnel development as follows. "Space professionals are not managed in a holistic manner within the Air Force. There is no formal Air Force space career field outside of space operations (13S) and a real cultural problem where rated pilots are prioritized and promoted above space professionals. Only two hours in each of the year-long Air Command and Staff College area (sic) [is] dedicated to space, and we can't fill senior billets at [the] Air Force Space and Missiles Systems Center. Protecting, prioritizing and promoting space professionals is best done within a Space Corps."<sup>29</sup> In addition to the Space Operations (13S) career field, the Air Force also has Astronaut (13A), Multi-Domain Command & Control Officer (13O), and an Astronautical specialty shredout (i.e. subcategory) in the Developmental Engineer (62E#B) career field that should be counted as space-related, if not full time/full-career, career fields.<sup>30</sup>

The Army is the largest user of space-based assets in the DoD, and nearly every piece of equipment Soldiers use, such as GPS devices and cell phones, are space enabled.<sup>31</sup> The core of the service's space cadre is the

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<sup>28</sup> Jobs, Steve. (1999). Digital 50. TIME.

<sup>29</sup> Houck, Caroline. (23 August 2017). The Army's Space Force Has Doubled in Six Years, and Demand Is Still Going Up. ref: Defense One: [www.defenseone.com](http://www.defenseone.com).

<sup>30</sup> HQ AFPC/DP3DW. (30 April 2018). Air Force Officer Classification Directory (AFOCD). Joint Base San Antonio-Randolph: Air Force Personnel Center.

<sup>31</sup> Brading, Thomas. (30 July 2019). Army Looks at Cadets to Bolder Army Space Force. ref: Army News Service: [www.army.mil](http://www.army.mil).

approximately 300-person Functional Area 40 (FA40) Space Operations Officer career field. While there are multiple ways to enter, typically at the four year mark, an officer can apply for a branch transfer into the Army space force.<sup>32</sup>

The Navy has placed emphasis on space-based capabilities as a key enabler of naval operations since 1959 and remains critically reliant on them today. But the service has not developed an educated, experienced, and qualified professional space cadre.<sup>33</sup> The service flags individuals with space experience within each of the communities, but leaves officers in their original communities, to form a Space Cadre Cross-Designator community,<sup>34</sup> which is another way to say there is no dedicated space career field.

The Marine Corps space cadre includes dedicated Space Operations Officers (13 billets) and Space Operations Staff Officers (50 billets). The Space Operations Officers focus on Marine Corps participation in national space processes while Staff Officers focus on operational commands and support to the warfighter.<sup>35</sup>

The services' space cadres typically started out as an ad hoc group of scientists, engineers, and operators or support personnel in space-related career fields, such as communications or missiles. Those groups were formalized when, based on the 2001 Rumsfeld Space Commission, Defense Secretary Donald Rumsfeld implemented 10 of the 13 DoD recommendations, including direction for all services to build a cadre of space professionals.<sup>36</sup>

To summarize, there are no space-only career fields in the Navy. The Army, Air Force, and Marines have operator-oriented career fields, none of

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<sup>32</sup> U.S. Army Space and Missile Defense Command. (2010). *The Army Space Cadre: Space Professionals (FA40) and Space Enablers*. Redstone Arsenal: U.S. Army Space and Missile Defense Command.

<sup>33</sup> Faulkenberry, Matthew E. (June 2014). *Critical Review of the Navy Space Cadre*. Monterey: Naval Postgraduate School.

<sup>34</sup> Naval Network Warfare Command. (2013). *Naval Space Handbook*. Virginia Beach: Naval Network Warfare Command, 2.

<sup>35</sup> *Ibid.*, pp. 62-64.

<sup>36</sup> Department of Defense. (3 June 2003). *DoD Directive 5101.2, DoD Executive Agent for Space*. Washington: Department of Defense.

which are organizationally structured to lead to upper level leadership positions in the respective services.

The Air Force has the most significant space cadre, with the Space Operator (13S) career field making up the bulk of it. Would it be reasonable to expect an Airman in one career field to demonstrate proficiency at flying F-15 fighter jets, KC-46 tankers the size of commercial passenger jets, and H-60 helicopters? Of course, the answer is no, and thankfully, an “Air Operator” career field does not actually exist.<sup>37</sup> However, that’s what the Air Force expects of the Space Operations career field, for an Airman to be proficient in acquiring WGS communications satellites, launching Delta IV Heavy rockets, and operating PAVE PAWS radars for SSA. It’s easy to see that as a result, Space Operators naturally become a jack of all trades, master of none. At the same time, the broad-but-shallow focus on acquisitions and operations necessarily leads to a lack of strategic thinkers, doctrine development, and all the 1,000-pound-brain issues that a full force would be able to work toward by developing its personnel properly.

In a Space Force we can expect to see the intentional development of personnel to cultivate depth and breadth of experience, and the ability to specialize or rise in the leadership hierarchy at appropriate points in a career for a better mix of masters of the trade along with the do-it-all jacks.

#### **IV.C. Why a Space Force: National Interests**

Organizational benefits leading to improvements in cost, schedule, and performance of space acquisitions and a more capable cadre of space professionals are, by themselves, possibly enough reason for a major organizational change. After all, everyone loves saving money and having better people. However, there is another, even more compelling reason to stand up the Space Force: the massive increase in U.S. national interests in space.

Returning to President Kennedy’s analogy, space is no different than so many other frontiers that were initially the purview of governments. Those governments then intentionally paved the way for the inevitable takeover of the frontier by subsequent entrepreneurs who were poised to

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<sup>37</sup> U.S. Air Force. (19 August 2019). Explore Careers and Find Your Purpose. ref: Air Force Careers: [www.airforce.com/careers/](http://www.airforce.com/careers/)

take advantage of the new opportunities.<sup>38</sup> Thus it is with space. Although manmade satellites have been orbiting Earth since 1957, until recently they mostly had two characteristics that made them uninteresting to the public: they were government owned, and they were unmanned.

#### **IV.C.1. Why a Space Force: National Interests: Money**

Think of a typical reaction to seeing graffiti on a pillar supporting an overhead highway. It is probably somewhat saddening, maybe cause for a negative commentary on the neighborhood and some vague complaints about punks these days. Compare that to coming home and seeing the same graffiti on your own house. The likely heated reaction would be personal and emotional. “How could this happen to me!?” “Call the cops!” “We need to do something about this menace to our peace and property!”

As the above example attempted to illustrate, the interest in private assets in space is exponentially higher than public assets. If a military communications satellite has a problem, regardless of the cause, not many people outside of the national security space community show much interest. But if people can’t watch their favorite TV show because something happened with the commercial satellite that broadcasts it, that’s a problem that draws attention from a wide spectrum of power brokers.<sup>39</sup>

Private activity in space has increased tremendously in recent years. To get a feel for the scale of the increase in commercial activity in space, let’s look at the global commercial revenue in the space industry at four interesting points in time.

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<sup>38</sup> Drukier, Cindy. (17 July 2015). Once the Domain of States, Private Sector Now Dominates 76 Percent of Space Economy. ref: The Epoch Times: [www.theepochtimes.com](http://www.theepochtimes.com).

<sup>39</sup> James, Meg. (19 July 2019). CBS Stations Blacked Out for DirecTV Customers after Deal with AT&T Fails. Los Angeles Times. ref: Los Angeles Times: [www.latimes.com](http://www.latimes.com).

1957: \$0

2001: \$61 billion<sup>40</sup>

2017: \$383.5 billion<sup>41</sup>

2040: \$3,000 billion or \$3 trillion (forecast)<sup>42</sup>

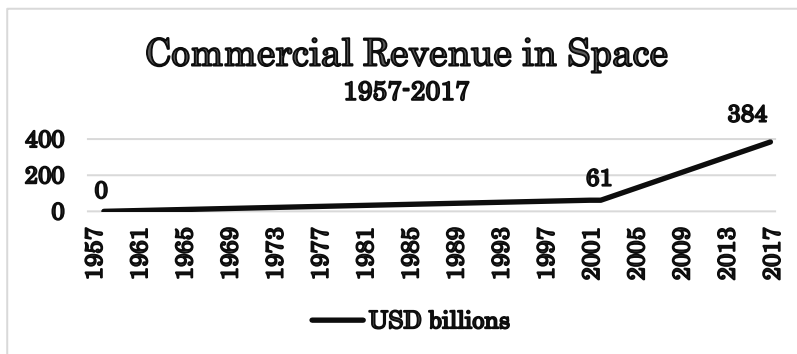


Chart 1

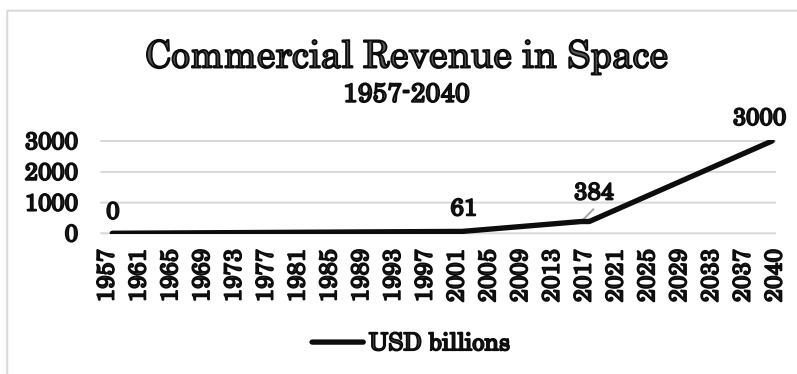


Chart 2

Created by the author based on Federal Aviation Administration. (2012). NextGen Implementaiton Plan. Washington: U.S. Department of Transportation;

The Space Report 2018. (19 July 2018), Space Foundation Report Reveals Global Space Economy at \$383.5 Billion in 2017. Colorado Springs: The Space Foundation; Higginbotham, Brian. (11 October 2018), The Space Economy: An Industry Takes Off. Washington: U.S. Chamber of Commerce, Above the Fold.

<sup>40</sup> Federal Aviation Administration. (2012). NextGen Implementaiton Plan. Washington: U.S. Department of Transportation.

<sup>41</sup> The Space Report 2018. (19 July 2018). Space Foundation Report Reveals Global Space Economy at \$383.5 Billion in 2017. Colorado Springs: The Space Foundation.

<sup>42</sup> Higginbotham, Brian. (11 October 2018). The Space Economy: An Industry Takes Off. Washington: U.S. Chamber of Commerce, Above the Fold.

We can see a very slow increase in the first approximately 50 years from 1957 to 2001, followed by a huge 529% increase in the next roughly 15 years from 2001 to 2017 (see Chart 1). If the projections of major US financial institutions are to be believed, current activity will increase by an order of magnitude in the next 25-year period to 2040 (see Chart 2). Note that previous forecasts have generally underestimated the growth of commercial activity in space. For example in 2004 a growth forecast projected \$112 billion by 2030 under fair weather growth conditions.<sup>43</sup> The actual global figure was already more than triple that in 2017.

In case the above is not enough to make the point that commercial space activities are growing rapidly, consider that in 1957 government activity comprised 100% of the space economy. Although government space budgets have been increasing, as of 2017 the share of the overall space economy made up by direct government funding had fallen to 24%.<sup>44</sup>

A further indicator is the striking pace at which total private investment in space is growing. Private investment, as defined by one widely accepted analysis, includes private equity, venture capital, acquisitions, prizes, grants, and public offerings. From 2000 to 2005, the industry took in about \$1.1 billion in private investment. In the five-year period from 2012 to 2017, that number was more than \$10.2 billion.<sup>45</sup> The 10-fold increase in private investment reflects the new opportunities in the commercial space sector and new startup ventures that did not exist a little over a decade ago.

#### **IV.C.2. Why a Space Force: National Interests: People**

Private dollars are not the only thing that makes space interesting to the general public. The other thing that draws people's interest is *people* in space. Machines working in space can be tremendously profitable and

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<sup>43</sup> Whealan-George, Kelly. (October 2013). *The Projected U.S. Economic Impacts of the Space Industry 2030*. College of Arts & Sciences. Prescott: Embry-Riddle Aeronautical University.

<sup>44</sup> Sanchez, Christopher. (accessed 19 August 2019). *The Space Economy*. ref: Wandering Alpha: <https://wanderingalpha.com>.

<sup>45</sup> Bryce Space and Technology. (2018). *Start-Up Space: Update on Investment in Commercial Space Ventures*. Alexandria: Bryce Space and Technology, Formerly Tauri Group Space and Technology.

useful, even indispensable, but they can't hold a candle to the interest in people in space.

By the time Galileo discovered new worlds in our solar system, European explorers were finding new worlds on the other side of the Atlantic Ocean. With hundreds of ships and thousands of explorers, colonists, soldiers, and adventurers making the journey to the New World, it is no surprise to see stories, regardless of their unrealistic scientific foundations, start to emerge about human space travel. In 1622, for example, Charles Sorel wrote of "great Ensigns" and "all manner of structures" that might carry people to the Moon.<sup>46</sup> Francis Godwin published *The Man in the Moone* in 1638 in which the hero traveled back and forth between Earth and the Moon by a flock of geese.<sup>47</sup> Cyrano de Bergerac provided commentary on voyages to space by rockets, possibly the first to come up with the idea, in his 1657 *Comic History*.<sup>48</sup>

In more modern America, Buck Rogers and Flash Gordon were space traveling adventurers popular in the 1930s and 1940s. In the 1950s there more than 300 toys being sold that were inspired by popular space shows on television such as Space Patrol, Captain Video, Tom Corbett, and Rocky Jones.<sup>49</sup> Even Belgium was in on the game with Tintin traveling through space to be part of humanity's first manned mission to the Moon.<sup>50</sup>

Human space flight launched from the pages of fiction and imagination to reality when Yuri Gagarin journeyed into outer space on 12 April 1961.<sup>51</sup> Then, on 20 July 1969,<sup>52</sup> an estimated 20% of the world's 3.6 billion people watched<sup>53</sup> Neil Armstrong step off the ladder of his

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<sup>46</sup> Miller, Ron. (1993). *The Dream Machines*. Malabar: Krieger Publishing Co., p. 9.

<sup>47</sup> *Ibid.*, p. 11.

<sup>48</sup> *Ibid.*, pp. 12-14.

<sup>49</sup> Tumbusch, T.N. (1990). *Space Adventure*. Radnor: Wallace-Homestead Book Co.

<sup>50</sup> Herge. (30 March 1950 - 29 December 1953). *Destination Moon and Explorers on the Moon*. Tintin Magazine.

<sup>51</sup> Siddiqi, Asif A. (2000). *Challenge to Apollo: The Soviet Union and the Space Race, 1945-1974*. Washington: NASA.

<sup>52</sup> Harland, David. (1999). *Exploring the Moon: The Apollo Expeditions*. London, New York: Springer.

<sup>53</sup> NASA. (Archived 17 April 2015). *Apollo 11 Mission Overview*. Washington: NASA.

spacecraft and set foot on the surface of the Moon in what was truly “one small step for man, one giant leap for mankind.”<sup>54</sup>

Since then, popular culture has continued to focus on humans in space. Using movies as a proxy for pop culture, there have been several blockbusters in the U.S. that are based on historical events in space. *The Right Stuff* (1983, \$22M<sup>55</sup>) looks at the early space program.<sup>56</sup> *Apollo 13* (1995, \$355M) dramatizes the aborted, near-fatal crewed mission to the Moon’s surface.<sup>57</sup> *Hidden Figures* (2016, \$236M) tells the story of the early space program through the eyes of female African-Americans.<sup>58</sup> *First Man* (2018, \$106M) provides a biography of the famously private Neil Armstrong.<sup>59</sup>

Sticking with only movie examples, fictional pop culture productions about space have also continued to feature people. *Star Wars* (1977, \$776M) depicts a typical farm kid who was swept up into a grand, interstellar conflict between good and evil (and generated sequels and offshoots that are still box office hits today).<sup>60</sup> *Star Trek: The Motion Picture* (1979, \$82M) was the first of several movies based on the television series that followed a daring captain and his crew on their adventures travelling through space to discover new worlds.<sup>61</sup> *Armageddon* (1998, \$554M) had NASA recruiting a group of misfits for a mission in space to save the world from the impact of a giant asteroid.<sup>62</sup> *Gravity* (2013, \$723M) depicts two astronauts working to get back to Earth after an accident leaves them stranded in space.<sup>63</sup>

While neither of the above film lists are by any means comprehensive, there is a point to listing them and nudging the reader to think of their

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<sup>54</sup> Jones, Eric M. (1969). *One Small Step*, time 109:25:23. *Apollo 11 Surface Journal*. Washington: NASA.

<sup>55</sup> Cumulative Worldwide Gross Box Office numbers for the eight films listed are sourced from the IMDb database at [www.imdb.com](http://www.imdb.com).

<sup>56</sup> Kaufman, Philip (director). (1983). Warner Bros. Pictures. *The Right Stuff* [film].

<sup>57</sup> Howard, Ron (director). (1995). Universal Pictures. *Apollo 13* [film].

<sup>58</sup> Melfi, Theodore (director). (2016). Fox 2000 Pictures. *Hidden Figures* [film].

<sup>59</sup> Chazelle, Damien (director). (2018). Universal Pictures. *First Man* [film].

<sup>60</sup> Lucas, George (director). (1977). Twentieth Century Fox. *Star Wars* [film].

<sup>61</sup> Wise, Robert (director). (1979). Paramount Pictures. *Star Trek: The Motion Picture* [film].

<sup>62</sup> Bay, Michael (director). (1998). Touchstone Pictures. *Armageddon* [film].

<sup>63</sup> Cuarón, Alfonso (director). (2013). Warner Bros. Pictures. *Gravity* [film].



own examples of space movies. Something glaring is missing from these lists, and it would be largely missing from almost any other similar list in almost any pop culture medium: unmanned spacecraft. There is no “The Little Weather Satellite That Could” or “First Signal: The GPS Story” or other such children’s books, movies, television shows, etc. that have achieved wide popular success. Machines in space are just plain not as interesting as people in space.

Allow me to share a personal example that illustrates this point. I was at Cape Canaveral Air Force Station, Florida for a GPS launch in July 2011. The last flight of the Space Shuttle had launched shortly before and was scheduled to return shortly after our Air Force satellite launch. There was a huge contingent of media and general public in the area for the last NASA Space Shuttle mission.

The Air Force launch crew typically performed a dry run about two days prior to a satellite launch, so I was in my Cocoa Beach hotel, changed into my flight suit, ready to go to the base and smooth out any final bugs during the dry run. The elevator stopped on my way down to the lobby, and a woman with curly hair and her, I guessed, 11-year old son got in the elevator. As soon as the woman saw me, she literally lost her ability to speak. “A-a-a-a-a, Are... (look nervously at son) Are you... No, it couldn’t be... (scream) Are you an...” It was pretty easy to see what she was trying to ask, so I offered, “I am an Astronautical Developmental Engineer.” Based on her reaction, I’m sure all she heard was “ASTRONAUT!” She blubbered and gushed the rest of the trip down in the elevator and into the lobby and finally asked if I’d take a picture with her son. I obliged with a nice thumbs-up pose and told him, “Stay in school. Don’t do drugs.” I then got in the car, headed to the base for the practice launch, and never saw them again.

That woman had driven from New Jersey to Florida with her son just to see the Space Shuttle, or anything remotely related to it (like, I suppose, an astronaut who was not in space on the mission but still wandering around the Cape Canaveral area for some reason). Although my Air Force GPS satellite was much more relevant to and useful in her daily life than the last Shuttle mission, she was not there for the GPS launch. She was there for the people going into space.

If government-operated scientific, Navy, and Coast Guard ships are interesting, how much more interesting to the general public are private ships on the seas and oceans - for the operators, the buyers and sellers of cargo on huge container vessels and small boats, the passengers on cruise ships and ferries, leisure and competitive sail boat captains and crew, commercial fishermen, offshore drillers, and so forth? As the space equivalents of these activities increase in popularity, so does public interest in them.

On 21 June 2004, just months after the one-hundredth anniversary of the Wright Brothers' first powered flight, Scaled Composites sent Mike Melvill to space in SpaceShipOne, marking the world's first manned private spaceflight.<sup>64</sup> They successfully repeated the feat twice later that year to win the Ansari X Prize, a competition that offered \$10 million to the first non-governmental organization to launch a manned reusable spacecraft into space twice within two weeks.<sup>65</sup>

Since then, several companies have started or planned to start a commercial space tourism service. For example, as of this writing, Virgin Galactic has enabled five people, including the first woman, to earn commercial astronaut wings with successful flights to space in December 2018 and February 2019.<sup>66</sup> Flights beyond Earth orbit include personal spaceflights around the Moon.<sup>67</sup> A commercial voyage around the Moon is slated for 2023 and will feature Japanese entrepreneur Yusaku Maezawa, founder of online fashion retailer Zozotown.<sup>68</sup>

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<sup>64</sup> Belfiore, Michael. (2007). *Rocketeers: How a Visionary Band of Business Leaders, Engineers, and Pilots is Boldly Privatizing Space*. New York: Smithsonian Books.

<sup>65</sup> BBC News. (7 October 2005). *SpaceShipOne Rockets to Success*. ref: BBC News: [news.bbc.co.uk](https://www.bbc.com/news/technology-5184444).

<sup>66</sup> Bartels, Meghan. (22 February 2019). *Virgin Galactic Reaches Space Again, Flies Test Passenger for 1st Time*. ref: Space.com: [www.space.com](https://www.space.com/41811-virgin-galactic-reaches-space-again).

<sup>67</sup> Clark, Sphen. (27 February 2017). *SpaceX to Send Two Private Citizens around the Moon and Back*. ref: Spaceflight Now: [www.spaceflightnow.com](https://www.spaceflightnow.com/).

<sup>68</sup> Quackenbush, Casey. (18 September 2018). *SpaceX Introduces Japanese Billionaire as First Private Passenger to Fly Around the Moon*. ref: TIME: [https://time.com](https://time.com/5311111-space-x-japanese-billionaire/).

Two private orbital habitat prototypes are currently in Earth orbit,<sup>69</sup> with larger and more distant (i.e. Mars) versions planned to follow.<sup>70</sup> Solar sailing, with “enormous” potential for cargo and manned missions,<sup>71</sup> has moved from pipe dream to reality.<sup>72</sup> One list of companies with plans for various tourist, cargo delivery, or passenger flight in/through space includes Virgin Galactic, Space Adventures, XCOR Aerospace, RocketShip Tours, ARCSPACE, PlanetSpace-Canadian Arrow, British Starchaser Industries, and SpaceX.<sup>73</sup>

This is only one non-comprehensive list, but it does give a flavor of some of the private companies currently in various phases of planning, development, or operations of private spaceflight. Some of these and other commercial enterprises will surely fail, but as the number of participants, and the success rate of their endeavors, keeps growing, it is reasonable to believe that some of these companies will succeed in offering a financially viable product in the near future.

This discussion of the current generation of commercial ventures doesn't even include private-public partnership examples that have already had success in space tourism. For example, between 2001 and 2009 seven private citizens (American, South African, British, and Canadian) made self-funded trips to the International Space Station (ISS).<sup>74</sup> NASA has announced that the ISS will be open to private astronauts again, with the first mission as early as 2020.<sup>75</sup>

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<sup>69</sup> Speed, Richard. (15 May 2019). NASA Wheels Out Habitation Prototypes while SpaceX Encounters Problems with Parachutes. ref: The Register: [www.theregister.co.uk](http://www.theregister.co.uk).

<sup>70</sup> Clifford, Catherine. (19 September 2018). Look Inside a Deep Space Habitat for NASA to Take Astronauts to Mars. ref: CNBC: [www.cnbc.com](http://www.cnbc.com).

<sup>71</sup> Wright, Jerome. (1992). *Space Sailing*. Philadelphia: Gordon and Breach Science Publishers.

<sup>72</sup> Gohd, Chelsea. (2 August 2019). Solar Sail Success! LightSail 2 is Officially Soaring on Sunlight: Bill Nye Thinks It's "Romantic." ref: Space.com: [www.space.com](http://www.space.com).

<sup>73</sup> World Heritage Encyclopedia. (2019). List of Private Spaceflight Companies. ref: World Heritage Encyclopedia: [www.worldlibrary.org](http://www.worldlibrary.org).

<sup>74</sup> Solovyov, Dmitry. (4 March 2010). Russia Halts Space Tours as U.S. Retires Shuttle. ref: Reuters: [www.reuters.com](http://www.reuters.com).

<sup>75</sup> NASA Press Release 19-044. (7 June 2019). NASA Opens International Space Station to New Commercial Opportunities, Private Astronauts. ref: NASA: [www.nasa.gov](http://www.nasa.gov).

As alluded to in section IV.B.2. Why a Space Force: Organizational Benefits: Personnel, current DoD Joint Doctrine, the guidance that governs activities and performance of joint operations, does not address personnel recovery in space. Joint Publication 3-14 Space Operations only mentions personnel from the perspective of operators or users of space assets.<sup>76</sup> There is no current doctrine on how to respond to an incident or disaster in commercial manned space activities.

More simply, despite noteworthy growth in manned space activity, there is no plan for responding to natural or man-made (including nefarious actors) trouble in space. To leave this area of significant national interest, people in space, completely without protection is unconscionable.

#### **IV.C.3. Why a Space Force: National Interests: Strategic Considerations**

Besides the rapidly increasing activity in commercial space, both in dollars and in people, there is a further national interest in space: strategic considerations. Let's start with an example from the past.

When Neil Armstrong and Buzz Aldrin walked on the moon 50 years ago, it represented more than just the satisfaction of seeing a dream-come-true, real, live Flash Gordon with your own eyes. Some have made the argument that it had the more significant effect of presaging victory in the Cold War. The Soviet launch of Sputnik in 1957 caused panic in America. The thinking went that, if communism could blast ahead of Western democracies in futuristic science, then maybe the future really did belong to the Soviets. America's successful mission to the moon 12 years later demonstrated that we were far ahead of the USSR. The result was both President Reagan's confidence and the Soviets' fear that American scientists really could build the Star Wars program. No moon landing, no fall of the Berlin Wall.<sup>77</sup>

The far reaching consequences of our actions (or inaction) today is a point that need not be belabored. Let's look at two strategic considerations

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<sup>76</sup> Joint Publication 3-14. (10 April 2018). Space Operations. Washington: Joint Chiefs of Staff.

<sup>77</sup> Bottum, Joseph. (13 July 2019). The Moon Is a Harsh Mistress. ref: The Washington Free Beacon: <https://freebeacon.com>.

that will become reality in the near to medium term: The Moon and rare earth elements.

#### **IV.C.3.a. Why a Space Force: National Interests: Strategic Considerations: The Moon**

The Outer Space Treaty, signed in 1967, is a fairly simple document (around 2,200 words) that does not allow a country to “own” territory in space, forbids the creation of military bases on the moon and other celestial bodies, and prohibits the placement of weapons of mass destruction in space.<sup>78</sup> That basic framework, however, leaves many questions unanswered regarding how to operate in space.

Which countries will take the lead and which will follow? What kinds of military equipment and activities are permitted? Who will set the rules and mediate disputes? The answer may simply lie in first-mover advantage, and that whoever reaches these untapped frontiers first will set the rules for decades, generations, and even centuries to come - and possibly even carry out a resource grab of galactic proportions.<sup>79</sup>

The moon raises not just questions of authority, or even who-can-get-humans-back-there-first prestige contests with China. The real key is who occupies the prime areas and who controls the water.

When Buzz Aldrin landed at Tranquility Base, he describes his surroundings as “magnificent desolation.”<sup>80</sup> After gaining the strategic advantage from being the first to land on the moon, there wasn’t much more U.S. interest in the rocks and dust, the desolation, on that body for many years.

However, data from a U.S. military spacecraft, launched on a Titan II from Vandenberg Air Force Base, California in 1994, provided observations that NASA suggested revealed enough water in polar craters

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<sup>78</sup> Bureau of Arms Control, Verification, and Compliance. (Signed 27 January 1967, Entered into force 10 October 1967). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. Washington, London, Moscow: U.S. Department of State.

<sup>79</sup> Toosi, Nahal. (13 June 2019). The New Moon Race: Who Owns the Moon? ref: Politico: [www.politico.com](http://www.politico.com).

<sup>80</sup> Aldrin, Buzz, Abraham, Ken. (2010). Magnificent Desolation: The Long Journey Home from the Moon. New York: Three Rivers Press.

of the Moon to support a human colony and a rocket fueling station.<sup>81</sup> This led to serious efforts to verify the existence of water on the Moon. An Indian spacecraft in 2008 hosted a U.S. sensor designed by the Naval Air Warfare Center to detect the presence of solid ice on the Moon. NASA subsequently confirmed the presence of ice at the Moon's poles, particularly abundant at the South Pole,<sup>82</sup> and estimates there could be at least 1.3 trillion pounds of "water ice" just at the North Pole (much more, obviously, at the South Pole).<sup>83</sup>

The presence of significant quantities of water on the Moon changes it from useless "desolation" to incredibly valuable "fuel station." The components of water are hydrogen, which is a fuel, and oxygen, which can be combined with fuel to burn and produce thrust for a rocket. The U.S. Delta IV Heavy<sup>84</sup> and Japan's H-IIA<sup>85</sup> are examples of current rockets that use hydrogen as fuel.

Fuel required to climb out of earth's gravity is very heavy. For example, on its mission to the Moon, Apollo-11 weighed just under 6.5 million pounds at launch, 6 million of which was its fuel and propellant.<sup>86</sup> The fuel requirement restricts the size of payloads (satellites, people, etc.) and increases costs for launches into space.

However, if ice at the Moon's poles can be converted into fuel, it makes travel between the Moon and a space station practical, as well as missions to Mars, the mining of near-earth asteroids (more on this in the next section), and other space-based activities.

The large ice deposits on the South Pole of the Moon are in deep craters that are not exposed to the sun. In order to extract the ice and

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<sup>81</sup> Williams, David R. (10 December 2012). Ice on the Moon: A Summary of Clementine and Lunar Prospector Results. ref: NASA Goddard Space Flight Center: <https://nssdc.gsfc.nasa.gov>.

<sup>82</sup> Tavares, Frank. (21 Aug 2018). Ice Confirmed at the Moon's Poles. ref: NASA: [www.nasa.gov](http://www.nasa.gov).

<sup>83</sup> Crusan, Jason. (2 March 2010). NASA Radar Finds Ice Deposits at Moon's North Pole. ref: NASA: [www.nasa.gov](http://www.nasa.gov).

<sup>84</sup> ULA. (accessed 19 August 2019). Delta IV. ref: United Launch Alliance: [www.ulalaunch.com](http://www.ulalaunch.com).

<sup>85</sup> JAXA. (2003). About H-IIA Launch Vehicle. ref: Japan Aerospace Exploration Agency: <https://global.jaxa.jp>.

<sup>86</sup> Nelson, Craig. (2009). Rocket Men: The Epic Story of the First Men on the Moon. New York: Viking Penguin.

convert it into fuel, processing plants would likely need to be erected on crater tops exposed to the sun. The three crater top areas that fit the criteria do not encompass a wide area, approximately a few football fields,<sup>87</sup> which makes them possibly the most strategic points on the Moon.

While the Outer Space Treaty prohibits territorial ownership, U.S. missions to the Moon may have planted the seeds of policy. Citing U.S. and international law, including the Outer Space Treaty, NASA laid out 1 to 3 kilometer (0.62 to 1.2 mile) buffer zones around U.S. government “hardware and other property on the surface of the moon.”<sup>88</sup> This is a de facto, if unintentional, precursor to U.S. policy and the operational space doctrine of “presence equals possession.” All that may be needed in the future is to declare a safety zone around an area of operation to render the territorial ownership ban effectively meaningless - the first one to reach an area can become the exclusive operator in the area.

China landed a probe on the far side of the Moon in January 2019. While that mission’s operational area, worthless from a strategic perspective, can now be assumed to effectively be under Chinese control, the mission also demonstrated China’s ability to perform technically challenging space operations,<sup>89</sup> indicating it is also capable of South Pole missions.

The successful 1960s lunar competition with the USSR was about landing first. The current competition with China, the winner of which is by no means guaranteed, is about position and resources.<sup>90</sup> Ceding resources on the moon, and all the missions that they can enable, to administration by other, non-benevolent countries is clearly not in U.S. national interests.

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<sup>87</sup> Robinson, Mark. (1 February 2018). On the Rim! ref: Arizona State University: <http://lroc.sese.asu.edu>.

<sup>88</sup> NASA. (20 July 2011). NASA's Recommendations to Space-Faring Entities: How to Protect and Preserve the Historic and Scientific Value of U.S. Government Lunar Artifacts. Washington: National Aeronautical and Space Administration.

<sup>89</sup> Schwartz, Matthew S. (3 January 2019). China Becomes First Country to Land on Far Side of Moon, State Media Announce. ref: NPR: [www.npr.org](http://www.npr.org).

<sup>90</sup> Foster, Harry. (27 January 2019). Why American Needs a Presence on the Moon. The National Interest.

#### **IV.C.3.b. Why a Space Force: National Interests: Strategic Considerations: Rare Earth Elements**

On 13 June 2010 the Japanese spacecraft Hayabusa returned to Earth with samples collected from the near-Earth asteroid Itokawa.<sup>91</sup> This represented the proof of concept for asteroid mining missions. Subsequently, the U.S. established a legal framework that protects Americans' rights to space resources recovered from celestial bodies with the passage of the SPACE Act in 2015.<sup>92</sup>

Without going into a discussion on the merits of projections for profit to be found in an industry in which a single asteroid could be valued at \$700 quintillion<sup>93</sup> and “will” produce the world’s first trillionaire,<sup>94</sup> and skipping past a review of the infrastructure required on the Moon and elsewhere to make the industry viable, let us consider the strategic possibilities of off-Earth mining.

Rare metals have countless applications on Earth: batteries, cell phones, military equipment, fluorescent lights, etc. Demand has skyrocketed in the last two decades, but more than 80 percent of U.S. rare earths are imported from China.<sup>95</sup> China knows they are the new Saudi Arabia - they have used rare earths as a weapon in the past,<sup>96</sup> and they are prepared to do so again.<sup>97</sup>

Just as relying on Russian rocket engines to propel U.S. national security space payloads into orbit, relying on a Chinese supply of rare

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<sup>91</sup> JAXA. (16 November 2010). Identification of Origin of Particles Brought Back by Hayabusa. ref: Japan Aerospace Exploration Agency: <https://global.jaxa.jp>.

<sup>92</sup> McCarthy, Kevin (R-CA-23). (2015). Public Law No: 114-90 Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015. 114th Congress (Title IV Sec. 402). Washington: U.S. Code.

<sup>93</sup> Peixe, Joao. (25 June 2019). The Golden Asteroid That Could Make Everyone on Earth a Billionaire. ref: OilPrice.com: <https://oilprice.com>.

<sup>94</sup> Kramer, Katie. (3 May 2015). Neil deGrasse Tyson Says Space Ventures Will Spawn First Trillionaire. ref: NBC News: [www.nbcnews.com](http://www.nbcnews.com).

<sup>95</sup> Borzykowski, Bryan. (10 July 2019). Wyoming May Hold the Key to the Rare Earth Minerals Trade War with China. ref: CNBC: [www.cnbc.com](http://www.cnbc.com).

<sup>96</sup> Krugman, Paul. (10 October 2010). Rare and Foolish. ref: The New York Times: [www.nytimes.com](http://www.nytimes.com).

<sup>97</sup> Rogers, Jason; Stringer, David; Ritchie, Martin. (29 May 2019). China Gears Up to Weaponize Rare Earths Dominance in Trade War. ref: Bloomberg: [www.bloomberg.com](http://www.bloomberg.com).



earths, which are “essential to the national defense”<sup>98</sup> is not a sustainable position.

Mining rare earths from the moon and asteroids would be “tremendously valuable on Earth.”<sup>99</sup> Untethering the U.S. supply of rare earth metals and minerals from China and becoming self-reliant would provide U.S. leaders with the same strategic freedom of action that U.S. oil production independence has provided with regard to OPEC.

#### **IV.C.4. Why a Space Force: National Interests: Threat**

Avicenna (possibly quoting Aristotle) said, “Beyond the circle of the moon there is no evil.”<sup>100</sup> Put differently, the laws of physics govern space, and they are agnostic to the righteous desires or evil intent of man. This was, of course, millennia before people on the ground “slipped the surly bonds of Earth And danced the skies..., trod The high untrespassed sanctity of space..., and touched the face of God.”<sup>101</sup>

From the advent of human activity in a domain - from Cain’s jealous murder of Abel on the land,<sup>102</sup> to Blackbeard the pirate on the sea,<sup>103</sup> to the 1970 hijacking of JAL Flight 351 by the Japanese Red Army in the air<sup>104</sup> - there have been nefarious actors and the need for defense against them. Space is no different from any other physical domain.

U.S. national interests in space are threatened in many ways. This section will cover only threats posed by China, realizing that other actors can and do conduct similar activities.

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<sup>98</sup> Trump, Donald. (22 July 2019). Text of a Letter from the President to the Senate Committee on Banking, Housing, and Urban Affairs and the House Committee on Financial Services. Washington: White House.

<sup>99</sup> Bridenstine, Jim. (18 July 2019). NASA Administrator. (Quintanilla, Carl, interviewer on CNBC program Squawk Alley)

<sup>100</sup> Anderson, James F. (1953). *An Introduction to the Metaphysics of St. Thomas Aquinas*: University of Notre Dame, Department of Philosophy. Chicago: Henry Regnery Company.

<sup>101</sup> Magee, John G. (February 1942). *High Flight*, 3 September 1941. compiled: MacLeish, Archibald, *Poems of Faith and Freedom*. Washington: Library of Congress.

<sup>102</sup> The Holy Bible Authorized King James Version. Gen 4:1-16, Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 2013.

<sup>103</sup> The Editors of Encyclopaedia Britannica. (Last Updated 12 July 2019). Blackbeard: English Pirate. ref: Encyclopaedia Britannica: [www.britannica.com](http://www.britannica.com).

<sup>104</sup> National Police Agency. (2005). *Movements of the Japanese Red Army and the "Yodo-go" Group*. Focus Vol. 271.

A recent Pentagon threat assessment of China's military cites "space" 86 times,<sup>105</sup> indicating the gravity with which professional military leaders view the current threats. Political leaders share the same view. For example, the Vice President expressed alarm at the National Space Council by saying, "China...revealed their ambition to seize the lunar strategic high ground and become the world's preeminent spacefaring nation."<sup>106</sup>

The concern about China in space is also shared by experts outside of career and elected government officials. An independent space analyst called China an "imminent threat" and said, "If anything [the China threat] is under-appreciated and underplayed in the U.S. I suspect that is because the U.S. military might not want to call attention to its own vulnerabilities regarding its space assets."<sup>107</sup>

China is heavily investing in development of at least three antisatellite (ASAT) missile systems. It is also developing satellites that can touch other satellites in orbit (rendezvous and proximity operations, or RPO) that can be used to disable a satellite, to damage it by, for example tearing off a solar array to affect its power source, or to collect intelligence by intercepting incoming and outgoing signals.<sup>108</sup>

China is also pursuing new jamming and "directed energy" weapons that can interfere with satellites in order to "blind and deafen" the U.S.<sup>109</sup> They are training with missiles that could damage or destroy satellites and will probably have a ground-based laser that can blind optical sensors

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<sup>105</sup> Office of the Secretary of Defense. (02 May 2019). Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2019. Washington: Department of Defense.

<sup>106</sup> Pence, Mike. (26 March 2019). Remarks by Vice President Pence at the Fifth Meeting of the National Space Council. Huntsville: White House.

<sup>107</sup> Goswami, Namrata. (25 April 2019). Statement of Dr. Namrata Goswami Independent Senior Analyst and Author 2016-2017 Minerva's Grantee before the U.S. China Economic and Security Review Commission Hearing on "China in Space: A Strategic Competition?". Washington: U.S.-China Economic and Security Review Commission.

<sup>108</sup> Harrison, Todd; Johnson, Kaitlyn; Roberts, Thomas G. (April 2019). Space Threat Assessment 2019. Washington: Center for Strategic & International Studies.

<sup>109</sup> Office of the Secretary of Defense. (02 May 2019). Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2019. Washington: Department of Defense.

on satellites in low-Earth orbit by 2020.<sup>110</sup> China is also believed to have the capacity to attack satellites in geosynchronous orbit 22,000 miles above Earth, which would wreak havoc on critical U.S. space capabilities like weather and early missile warning.<sup>111</sup>

One organization sums up the China threat as follows: sustained effort to develop a wide range of counterspace technologies, multiple tests of ground-based direct ascent ASATs (developing 3 types), multiple demonstrations of RPO that can be used in kidnapping a satellite or intelligence collection, strong electronic warfare (e.g. jamming) and defensive electronic warfare capabilities, and strong focus on doctrinal and organizational integration of counterspace.<sup>112</sup>

The National Space Council is not the only body worried about China's lunar activities. The former director of Air University's Space Horizons Task Force believes that China's aim to create a position of industrial and logistical advantage on the moon and its environs is part of their attempt to gain a strategic position to control the key terrain and centers of value in the vast space economy, and to usurp America's rule-making authority. Occupying the strategic positions would make it too costly for the United States to do anything but accept a second-class status. That is a strategic and military threat, perhaps even an existential threat.<sup>113</sup>

The threat from China is not new. The People's Liberation Army has been looking for asymmetric advantages since the 1970s. This thinking was expressed clearly in an influential Chinese publication in 2000, "For countries that can never win a war with the U.S. by using the method of tanks and planes, attacking the U.S. space system may be an irresistible and most tempting choice."<sup>114</sup>

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<sup>110</sup> Defense Intelligence Agency. (11 February 2019). Challenges to Security in Space. Bethesda: Defense Intelligence Agency.

<sup>111</sup> Raymond, Jay. (14 April 2015). Warfighters Lunch, Air Force Lt. Gen. Jay Raymond, 14th Air Force Commander. Colorado Springs: Space Symposium.

<sup>112</sup> Weeden, Brian. (6 December 2018). Space Domain Trends and Threats. Washington: Secure World Foundation.

<sup>113</sup> Garretson, Peter. (11 July 2019). Space Force's Jupiter-Sized Culture Problem. War on the Rocks.

<sup>114</sup> Wang, Cheng. (5 July 2005). The US Military's 'Soft Ribs,' A Strategic Weakness. Beijing: Liawang (Outlook).

#### **IV.D. Why a Space Force: Conclusion**

“The security and economic well-being of the United States and its allies and friends depend on the nation’s ability to operate successfully in space. To be able to contribute to peace and stability in a...dangerous and complex global environment, the U.S. needs to remain at the forefront in space, technologically and operationally, as we have in the air, on land and at sea. Specifically, the U.S. must have the capability to use space as an integral part of its ability to manage crises, deter conflicts and, if deterrence fails, to prevail in conflict.”<sup>115</sup>

It is necessary “to maintain U.S. presence in outer space, like that of coast guards or the navies of the world, to ensure that stability and peace are maintained in the high seas and territorial waters so that free trade can flourish.”<sup>116</sup>

There is a strong argument that the U.S. government, to include its military, is constitutionally obligated to protect not only military space assets but also commercial and private sector activities in space.<sup>117</sup> To provide presence and be fully capable of enforcing laws is part of U.S. national interest. What happens when legally derived entitlements are threatened by a rival nation or party? Who comes to their aid?<sup>118</sup> “It is the sense of Congress that the Department of Defense plays a vital and unique role in protecting national security assets in space.”<sup>119</sup> With no single DoD organization fulfilling that role currently, a Space Force is the clear, concise answer.

#### **V. Future National Security Space Activities**

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<sup>115</sup> Commission to Assess US National Security Space Management and Organization, aka Rumsfeld Space Commission, (11 January 2001). Report of the Commission.

<sup>116</sup> Goswami, Namrata. (22 June 2018). The US ‘Space Force’ and Its Implications. ref: The Diplomat: <https://thediplomat.com>.

<sup>117</sup> CD01 Staff for Bridenstine. (6 November 2016). This is Our Sputnik Moment. Speech by Congressman Jim Bridenstine. ref: OK Grassroots: <http://okgrassroots.com>.

<sup>118</sup> Goswami, Namrata. (22 June 2018). The US ‘Space Force’ and Its Implications. ref: The Diplomat: <https://thediplomat.com>.

<sup>119</sup> McCarthy, Kevin (R-CA-23). (2015). Public Law No: 114-90 Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015. 114th Congress (Title IV Sec. 402). Washington: U.S. Code.

This section will not cover the current situation or projected future of either the relaunched U.S. Space Command, the DoD's 11th combatant command (notably, a geographic, not functional, combatant command),<sup>120</sup> or the proposed Space Force, which would be the sixth branch of the armed forces and is projected to be authorized by Congress in some form in the fiscal 2020 National Defense Authorization Act.<sup>121</sup> Both are at a stage where commentary or projections about them in this paper will quickly become obsolete, possibly even prior to publication.

This section will, however, discuss several planned or possible near, mid, and long term future national security space activities in the DoD and the subset of those that can and/or should be accomplished with allies such as Japan, to include some practically unrealistic but technically feasible potential programs.

## **V.A. Future National Security Space Activities: DoD**

### **V.A.1. Future National Security Space Activities: DoD: Near**

In the near term, we can expect mainly upgrades or planned replacements for the current systems operating in space. There are plans to do so<sup>122</sup> for every category of national security space.

- Launch: NSSL - lower cost (retain high reliability) rockets with reduced launch timelines (also referred to as responsiveness)
- ISR/Early Warning: Next Gen OPIR/FORGE/EGS - upgraded replacements for the current satellites and ground terminals
- Weather: EWS/EWS-G - next generation replacements for the current system
- Communications: ESS/PTS/PTES - new programs for greater protection in the AEHF system; EPS - replacement for the current polar satellites;

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<sup>120</sup> Sven, Jennifer. (21 August 2019). Space Command to Relaunch This Month, Officials Say. ref: Stars and Stripes: [www.stripes.com](http://www.stripes.com).

<sup>121</sup> Insinna, Valerie. (23 May 2019). Senate Authorizers Approve Space Force but Switch Up Its Organizational Structure. ref: Defense News: [www.defensenews.com](http://www.defensenews.com).

<sup>122</sup> U.S. Government Accountability Office. (27 March 2019). Space Acquisitions: DOD Faces Significant Challenges as It Seeks to Accelerate Space Programs and Address Threats. Washington: U.S. Government Accountability Office.

FAB-T FET - replacement for current terminals that allow the President to communicate with senior military leaders during strategic situations (e.g. nuclear war); and undetermined improvements to both the MUOS and WGS satellite systems

- PNT: MGUE Increment 2 - improved GPS receiver; GPS III F - next round of technology, intended to increase anti-jam to “meet increased demands of both military and civilian users”<sup>123</sup>
- SSA: Space Fence - undetermined improvements to the current system

### **V.A.2. Future National Security Space Activities: DoD: Mid**

In the mid-term future, a new satellite architecture proposed by the DoD<sup>124</sup> would consist of several layers based around a mesh network of small communications satellites. The new architecture includes development of deterrent capability, SSA, a resilient common ground-based space support infrastructure, command and control systems, and artificial intelligence-enabled global surveillance.<sup>125</sup>

This proposed architecture would include several layers that are different from the current national security space capability categories:

- Space transport layer: a global mesh network providing 24/7 data and communications.
- Tracking layer: provides tracking, targeting, and advanced warning of missile threats
- Custody layer: provides all-weather custody of all identified time-critical targets
- Deterrence layer: provides SSA (and we can assume some functions not released to the public)
- Navigation layer: provides alternative PNT services in case GPS is blocked or unavailable

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<sup>123</sup> Los Angeles Air Force Base. (21 November 2012, current as of April 2018). Fact Sheet, GPS III F Satellites. ref: United States Air Force: [www.losangeles.af.mil](http://www.losangeles.af.mil).

<sup>124</sup> Department of the Air Force. (1 July 2019). Future Space Communications (FCS); Solicitation Number: FA9453-17-S-0005-CALL-009. ref: Federal Business Opportunities: [www.fbo.gov](http://www.fbo.gov).

<sup>125</sup> Strout, Nathan. (3 July 2019). The Pentagon's New Space Agency Has an Idea about the Future. ref: C4ISR Net: [www.c4isrnet.com](http://www.c4isrnet.com).

- Battle management layer: a C3 network augmented by artificial intelligence that provides self-tasking, self-prioritization, on-board processing, and dissemination
- Support layer: ground C2 facilities and user terminals, as well as rapid-response launch services

### **V.A.3. Future National Security Space Activities: DoD: Long**

Longer term future DoD plans for the space domain include the ability to “maximize warfighting capability [in] space, outpace future threats, [and] defend our vital national security interests in space.”<sup>126</sup> Air Force reports also suggest a national security role in space beyond Earth’s orbit, such as missions to the Moon, Mars, and deep space, to protect U.S. interests from - or at least U.S. positioning in relation to - “new competition.”<sup>127</sup> For specific national security space activities projected both within and beyond Earth’s orbit, the reader should refer to sections IV.C.1 - IV.C.4 National Interests above and infer the capabilities required to protect those national interests and maintain a peaceful and stable domain in which they can develop and prosper.

### **V.B. Future National Security Space Activities: Cooperative with Japan**

The DoD “will work with allies and partners to enhance space capabilities.”<sup>128</sup> Which specific allies? Japan. Why Japan? Because “ours is the most important bilateral relationship in the world, bar none.”<sup>129</sup> The following is a discussion of near, mid, and long term planned and potential cooperative national security space activities.

#### **V.B.1. Future National Security Space Activities: Cooperative with Japan: Near**

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<sup>126</sup> U.S. Department of Defense. (1 March 2019). DOD Submits U.S. Space Force Proposal. ref: U.S. Department of Defense: [www.defense.gov](http://www.defense.gov).

<sup>127</sup> NASIC Public Affairs Office. (December 2018). Competing in Space. Wright-Patterson AFB: National Air and Space Intelligence Center.

<sup>128</sup> Joint Chiefs of Staff. (2018). Fact Sheet: Space in the National Military Strategy. Washington: Department of Defense.

<sup>129</sup> U.S. Embassy, Tokyo. (24 Jan 2019). U.S.-Japan Space Forum: Japan-U.S. Space Cooperation in the Second Space Age. Washington: The Maureen and Mike Mansfield Foundation.

In the short term, there are cooperative activities currently planned and current unilateral space activities with the potential to add a dimension of combined operations. One such activity that has been discussed for several years from minister/secretary level meetings such as the U.S.-Japan Security Consultative Committee (2+2)<sup>130</sup> to working level meetings that don't make the news is SSA.

Japan has an unclassified SSA data sharing agreement with the U.S. and is preparing to expand its own SSA capability. The Ministry of Defense (MOD) plans to build a deep space radar to monitor geostationary orbit over the Asia-Pacific region and to establish a national SSA operations center run by JASDF that also incorporates data from near-Earth assets operated by JAXA. This center is expected to work closely with the Combined Space Operations Center (CSpOC).<sup>131</sup>

The CSpOC transitioned from JSpOC (Joint, U.S.-only) in July 2018, opening federal doors to friendly personnel in order to “enhance cooperation between the U.S. and its allies in safeguarding the space domain.”<sup>132</sup> It is likely only a matter of time before Japan joins the U.K., Canada, Australia and other allies with personnel in the Multinational Space Collaboration Office in Vandenberg AFB, California.

Besides getting better at keeping track of who's doing what, and where, in space (i.e. SSA) and sharing that information with each other, another near term future U.S.-Japan cooperative effort is a hosted payload project. Japan's QZSS system currently augments the U.S. Air Force's GPS system, covering an area stretching from roughly Siberia to Australia in latitude and India to Hawaii in longitude.<sup>133</sup> QZSS is especially useful in, for example, urban jungle situations because its orbits are limited to Asia and

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<sup>130</sup> Minister for Foreign Affairs Kishida, Minister of Defense Onodera, Secretary of State Kerry, Secretary of Defense Hagel. (3 October 2013). *Toward a More Robust Alliance and Greater Shared Responsibilities*. Washington, Tokyo: Joint Statement of the Security Consultative Committee.

<sup>131</sup> Werner, Debra. (18 April 2018). *International SSA Agreements Could Pave the Way for Further Space Cooperation, Panelists Said*. ref: SpaceNews: <https://spacenews.com>.

<sup>132</sup> Joint Space Component Command Public Affairs. (24 July 2018). *CSpOC Established at Vandenberg AFB*. ref: United States Air Force Website: [www.schriever.af.mil](http://www.schriever.af.mil).

<sup>133</sup> Cabinet Office. (2019). *Michibiki: Juntenchō Eisei Shisutemu (Quasi-Zenith Satellite System)*. ref: Government of Japan: <https://qzss.go.jp>.



the satellites are, therefore, more frequently directly overhead cities with many tall buildings (e.g. Tokyo).

The DoD saw an opportunity in the QZSS satellites, which fly in orbits not previously used by the U.S., and, after much bilateral coordination, is planning “for Japan to host a Space Situational Awareness sensor payload on their QZSS space vehicles.” Signing of a significant new agreement to place American sensors on Japanese satellites is, at the time of this writing, planned to be completed in 2019, and the first launch of a U.S. SSA payload on a Japanese QZSS satellite is scheduled for 2023.<sup>134</sup>

Another nascent area of cooperation is personnel development. The Japanese press reported in May 2019 that a new space unit will be operational by 2022 at Fuchu AB on the west side of Tokyo, with the MOD having slated 100 billets to launch operations.<sup>135136</sup> Going from effectively 0 to 100 space experts in three years is an almost impossible task. Easing Japan’s road to developing a space cadre are recent U.S. moves to open several training and exercise opportunities to international students and specifically inviting Japan to participate.

One example of this is the Schriever Wargame held at Maxwell AFB, Alabama in October 2018. In addition to the hundreds of Air Force, DoD, and other USG participants in a typical iteration, this one included not only the U.K., New Zealand, Australia, and Canada (all Five Eyes countries), but also Germany, France, and Japan. The wargame looked at technology that is anticipated to be fielded over the next 10 years and examined what a space engagement may look like, focusing on the U.S. Indo-Pacific Command area of responsibility.<sup>137</sup> This marked the first time Japan was invited to participate and, by all accounts,<sup>138</sup> it was an

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<sup>134</sup> McLeary, Paul; Hitchens, Theresa. (5 Aug 2019). US, Japan to Ink Hosted Payload Pact to Monitor Sats. ref: Breaking Defense: <https://breakingdefense.com>.

<sup>135</sup> Ibid.

<sup>136</sup> “launch operations” in this case is used to mean “stand up the organization,” not “dedicated to the spacelift mission.”

<sup>137</sup> Tadjeh, Yasmin. (26 November 2018). Training the Space Force: How the Military Will Prepare for Future Battles. ref: National Defense: [www.nationaldefensemagazine.org](http://www.nationaldefensemagazine.org).

<sup>138</sup> Japanese Government Officials from Multiple Agencies with Responsibilities for National Security Space Who Attended Schriever Wargame 2018. (October to November 2018). Discussions to Gather Feedback from Attendees and Assess the Percieved Value to Japan. (Dobberfuhl, Phillip M., Lt Col, USAF, Director of

eye-opening, incredibly useful event. It provided examples of how different agencies with a role in national security space can effectively work together, ideas that help focus future plans, and so forth.

In addition to exercises, in 2019 the Air Force established two new courses on national security space: a three-week, unclassified course on SSA and an unclassified version of the Space 100 course, which provides an overview of space operations, orbital mechanics, the launch process, satellite operations, and space weather. Additionally, the existing midlevel Space 200 class that focuses on space systems development and space power has been opened to include New Zealand, France, Germany, and Japan, in addition to the U.K., Australia, and Canada who already attended.<sup>139</sup> The Space 300 capstone class was also opened to Five Eyes countries in 2019, with other close allies possibly being added to the list in the coming years.

Military space leaders have extolled the value of exercising, training, and conducting war games with our allies like Japan. “It is very important today that we have -- and we are working very closely with our partners, specifically our Five Eyes partners, with France, Germany, and Japan...This is a big growth area for us and I think it’s going to provide our country a great advantage. We’re stronger together.”<sup>140</sup> Japan’s access to previously restricted and new training courses will help tremendously in the near term building of a space cadre.

## **V.B.2 Future National Security Space Activities: Cooperative with Japan: Mid**

Some ideas for mid-term future cooperation include a new twist on existing programs. Though nothing in national security space is easy, communications are one of the more straightforward areas of potential

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Foreign Military Sales, Mutual Defense Assistance Office, U.S. Embassy - Tokyo, interviewer)

<sup>139</sup> Insinna, Valerie. (18 April 2018). Air Force Looks to Ramp Up Space Training, Info Sharing with Allies. ref: Defense News: [www.defensenews.com](http://www.defensenews.com).

<sup>140</sup> General John Raymond, Commander, U.S. Space Command; Steve Kitay, Deputy Assistant Secretary Of Defense For Space Policy; Colonel David S. Westover Jr., Director Of Public Affairs, U.S. Space Command. (29 August 2019). Media Roundtable with U.S. Space Command Commander Gen. John Raymond. ref: U.S. Department of Defense Newsroom: [www.defense.gov](http://www.defense.gov).

cooperation. Japan's MOD launched their first satellite in 2017, one of three communications satellites in the Kirameki constellation.<sup>141</sup> As with the commercial sector, the military's desire for more communications bandwidth is insatiable. Bandwidth on this system could be leased or provided (gratis or as part of an exchange) to DoD users with an X-band requirement and a willingness to buy the ground terminals.

Along the same lines of communications satellites, WGS showed another possible cooperation methodology when Australia purchased one WGS spacecraft and the launch services to get it to orbit. With #6 out of the 11 satellite constellation being purchased by Australia, the Air Force reduced acquisition costs by about 9%. In return, Australia obtained access to a global communications network for the price of a single satellite and launch.<sup>142</sup> Japan could do the same with the WGS system or another DoD communications system that would welcome the investment. Besides the cost benefit for both sides, there is a deterrent effect as well. If a nefarious actor wanted to hurt the U.S. by targeting WGS, after Australia's participation their action would now also affect Australia. Involving another country in their action may not be in their interest or be counter to their objectives, causing them to not target the system in the first place.

GPS and QZSS are planned to continue operating for decades. All the GPS satellites orbit at approximately the same distance from Earth. GPS payloads on future QZSS satellites could provide resiliency for the GPS system and greater accuracy in the USINDOPACOM area of responsibility.

Returning to personnel, while the MOD is gaining operational capability in SSA, nearly all the other categories of national security space exist and are currently operated by other Government of Japan agencies. This provides ample opportunities for personnel exchange positions to be arranged in existing launch, ISR, weather, communications, and PNT systems. The exchanges could be in operational, acquisition, education/training, or policy type positions, depending on the program. Saying that all that's needed is a piece of paper (i.e. memorandum of

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<sup>141</sup> Tomkins, Richard. (25 January 2017). Japan Launches First Military Communications Satellite. ref: United Press International: [www.upi.com](http://www.upi.com).

<sup>142</sup> Klotz, Irene. (8 August 2013). U.S. Military Satellite, Paid for by Australia, Launched into Orbit. ref: Reuters: [www.reuters.com](http://www.reuters.com).

understanding or agreement) would be oversimplifying, but there are no technical problems to overcome. It's easy to imagine a mid-level officer from the Ministry of Education, Culture, Sport, Science and Technology (MEXT) sitting in Los Angeles AFB, California next to a NASA rocket expert, working with an Air Force captain to acquire the next batch of launch vehicles. From a whole-of-government perspective, both the U.S. and Japan would benefit from more exchange positions within our respective national security space organizations.

One final idea for space cooperation using current systems is to launch satellites on each other's rockets. Both the U.S. and Japan have existing national security space launch vehicles in the Delta IV/Atlas V EELV<sup>143</sup> and H-IIA/B<sup>144</sup> series that are extremely reliable. Both countries are developing lower cost successors. Insufficient attention or political battles that dramatically change the direction of long term programs can be crippling in national security space launch.

A worst-case-scenario example of what could happen can be found in the handling of the Space Shuttle retirement and subsequent loss of American capability to launch manned space missions into LEO and the Moon. In 2010 the Obama administration cancelled the Ares rocket and Orion spacecraft programs, which were intended to replace the space shuttles, and started a new program from scratch.<sup>145</sup> The move was widely condemned in congress and the space community, including by Neil Armstrong (first man on the moon), Gene Cernan (last man on the moon), Jim Lovell (hero of Apollo 13), and this author.<sup>146</sup>

It should go without saying that, in order to maintain the legally mandated "assured access to space" policy,<sup>147</sup> having the choice to use an allied alternative for launch is infinitely more desirable than allowing a

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<sup>143</sup> Vandenberg Air Force Base. (4 August 2017). Evolved Expendable Launch Vehicle (EELV). ref: United States Air Force: [www.vandenberg.af.mil](http://www.vandenberg.af.mil).

<sup>144</sup> Kyle, Ed. (Last Update 28 October 2018). Hi-IIA/B Data Sheet. ref: Space Launch Report: [www.spacelaunchreport.com](http://www.spacelaunchreport.com).

<sup>145</sup> Malik, Tariq. (2 February 2010). NASA Grieves over Cancelled Program. ref: NBC News: [www.nbcnews.com](http://www.nbcnews.com).

<sup>146</sup> An example opinion piece that expresses the essence of this commonly held sentiment can be found at: Whittington, Mark R. (8 March 2017). How Barack Obama Ruined NASA Space Exploration. ref: The Hill: <https://thehill.com>.

<sup>147</sup> Policy Regarding Assured Access to Space: National Security Payloads, 10 U.S.C. §2273 (2018)

capability gap to form when a primary launch mechanism is not available for any reason.

All of the programs listed in this section currently exist or are in the operational phase. The barriers to bilateral cooperation are fairly low from both a technical and a policy perspective. There are medium to high potential benefits to gain by these mid-term future possibilities.

### **V.B.3 Future National Security Space Activities: Cooperative with Japan: Long**

This section will explore a few ideas for bilateral national security space cooperation in a long term timeline, ending with a couple that are unfeasible at the current time for one reason or another.

As discussed in section IV.C.3.b. Why a Space Force: National Interests: Strategic Considerations: Rare Earth Elements, asteroid sample return missions have been and are in the process of being conducted by Japanese and U.S. government space agencies. As commercial versions of these ventures start emerging, a framework for protecting the rights and physical assets (e.g. mining craft) from harassment, pirate-like stealing, and outright land grabs (regardless of knowledge that they're not allowed under the Outer Space Treaty, some countries will continue to abide by the "if no one stops me, it's allowed" might-makes-right-type principle). We have seen these actions on the seas (e.g. South China Sea) and in our current activities in space (see section IV.C.4. Why a Space Force: National Interests: Threat of this paper). To suggest that something as potentially valuable and strategically important as the products from resource harvesting would go unbothered is not reasonable.

Add to that the Moon missions, which enable the further utilization of space, as well as the burgeoning space tourism sector, and the need to protect and defend national interests is clear, if not immediate. Starting to think about the who, what, where, and how of this cannot start after the activities have started. The roles and responsibilities, policies and doctrines, and laws and regulations should be developed early and should be in place prior to and in order for those activities to occur in a stable, peaceful environment understood by all players, including adversaries.

This will foster development, deter aggressors, and provide ample opportunity to divide responsibilities among allies - maybe agreements along the lines of “you’ve got the Moon, we’ll take asteroids” or “you’ve got LEO, we’ve got MEO and beyond” or “you’ve got Coast Guard-like rescue and life support missions, we’ll take Navy-like deterrence and defense missions” could be developed to benefit both the U.S. and Japan (as well as European and other spacefaring nations).

In following another parallel between maritime and space domains, the U.S. and Japan’s jointly developed SM-3 Block 2A missile defense interceptor can be an example for technology sharing or coproduction efforts possible in the space sector.<sup>148</sup> While many international supply chains develop naturally in a market, the space sector is big enough and hard enough that government directed, arranged, or incentivized international cooperation in the areas of R&D, development, production, and operation could be a welcome force for good in advancing the private sector capabilities that further both countries’ national interests.

One possibility that is currently technically feasible, but unrealistic for policy reasons, is Japan providing the U.S. with next generation ICBMs. The Minuteman III missile was designed in the 1960s and, despite reaching the end of its originally planned lifespan, the current missile’s retirement has been extended over and over again<sup>149</sup> due to the replacement ICBM programs being repeatedly delayed or deferred.<sup>150</sup> In 2013, Japan’s Epsilon rocket successfully launched its first payload into space. It cost \$38.5M (a bargain price, partially owing to the fact that it is based on the boosters used in the H-IIA launch vehicle), and has advanced, modern avionics that allow automation for much of the launch process.<sup>151</sup> It is the size of an ICBM and could be fairly easily used as a very low cost,

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<sup>148</sup> Gruss, Mike. (31 October 2013). Military Quarterly | SM-3 Block 2A Passes Critical Design Review, Set for Flight Testing in 2015. ref: Space News: <https://spacenews.com>.

<sup>149</sup> Brissett, Wilson. (February 2018). Replacing Minuteman. ref: Air Force Magazine: [www.airforcemag.com](http://www.airforcemag.com).

<sup>150</sup> Harper, Jon. (16 April 2019). Minuteman III Replacement Could Fall under Budget Ax. ref: National Defense Magazine: [www.nationaldefensemagazine.org](http://www.nationaldefensemagazine.org).

<sup>151</sup> Malik, Tariq. (14 September 2013). Japan’s 1st Epsilon Rocket Launches into Space on Maiden Voyage. ref: Space.com: [www.space.com](http://www.space.com).

technologically mature (i.e. good cost, schedule, and performance) replacement for the Minuteman III.

Of course, the U.S. would not want to let part of the nuclear triad be reliant on a foreign country, no matter how close an ally, and the U.S. industrial base cannot lose the capability to manufacture solid rocket motors (i.e. strategically infeasible). From Japan's perspective, although the so-called "3 Ps" restricting defense exports have been relaxed,<sup>152</sup> they have not been rescinded, and there is little likelihood in the near term for the political acceptability of such a program to materialize.

There has ever been a competition between the hunter and the hunted to obtain better means of detection and, conversely, evasion to gain an advantage over each other. We have seen this principle play out in every physical domain. For example, sonar was developed to detect previously invisible submarines, so submarines developed quiet propulsion methods.<sup>153</sup> On land, camouflage clothing was created to hide personnel. Because subsequent thermal imaging enabled users to "see" body heat, new development is aimed at uniforms that block heat signatures.<sup>154</sup> Early airplanes were invisible outside of visual or audible range, so radar was developed for detection at greater ranges.<sup>155</sup> Subsequent stealth technologies were invented to reduce detection ranges. In space, too, current and upcoming SSA capabilities provide the ability to detect and track spacecraft and other objects.<sup>156</sup>

The final future idea this paper offers up is the bilateral development of materials, TTPs (tactics, techniques, and procedures), physical shapes, sizes, and so forth that make allied satellites invisible to adversaries, or at

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<sup>152</sup> Takenaka, Kiyoshi; Kubo, Nobuhiro. (1 April 2014). Japan Relaxes Arms Export Regime to Fortify Defense. ref: Reuters: [www.reuters.com](http://www.reuters.com).

<sup>153</sup> Hambling, David. (11 January 2012). The Next Generation of Silent Submarines Could Defeat Radar and Sonar Sensing. ref: Popular Science: [www.popsci.com](http://www.popsci.com).

<sup>154</sup> Mizokami, Kyle. (11 April 2019). The U.S. Army Wants to Block Heat Signatures of Soldiers and Tanks. ref: Popular Mechanics: [www.popularmechanics.com](http://www.popularmechanics.com).

<sup>155</sup> Whitmore, Mark. (24 May 2018). How Radar Changed the Second World War. ref: Imperial War Museums: [www.iwm.org.uk](http://www.iwm.org.uk).

<sup>156</sup> Holzinger, Marcus J. (accessed 10 September 2019). Space Situational Awareness. ref: The Daniel Guggenheim School of Aerospace Engineering, Georgia Institute of Technology: <http://holzinger.gatech.edu>.

least harder to detect, characterize, analyze, and/or reliably track. One could imagine, for example, the miniaturization capability of Japan coupled with the sensor capability of the U.S. to co-develop satellites that are too small to detect reliably from earth but can still perform typical GEO-type satellite functions.

Regardless of the current feasibility of the long term bilateral space cooperation ideas listed above, earlier thought into potential bilateral and multilateral efforts at space governance, commercialization, technology development, and so forth is critical to ensuring the maintenance of mutual national interests in a stable and peaceful space domain in the future.

## **VI. Conclusion**

Understanding the lens through which the U.S. views space - the final frontier - enables understanding of U.S. thoughts, words, and deeds in space. Recognizing that nearly all historical major U.S. space developments originated in the realm of national security space will help understand the current issues under debate.

It is the view of this writer that there are undeniable benefits in creating a Space Force. Those tremendous benefits include the efficiencies and clear direction enabled by consolidation of authorities under one boss, the potentially huge acquisition (cost, schedule, performance) improvements, the expertise and depth of knowledge that appropriately trained and intentionally developed personnel can offer, and the protection of national interests - money, people, strategic - from threats.

In addition to a robust and growing commercial space sector, the DoD has plans for near, mid, and long term future activities, and there are several areas with potential for bilateral cooperation with Japan. There is no question it is to our mutual advantage to work together to overcome obstacles and realize the promise of the final frontier, as we figuratively and literally boldly go where no man has gone before.<sup>157</sup>

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<sup>157</sup> Eidenmuller, Michael E. (accessed 22 August 2019). Captain James Tiberius Kirk: Opening Narrative on the Voyage of the Starship, Enterprise. ref: American Rhetoric: Star Trek: <https://americanrhetoric.com>.



There it is, ladies and gentlemen. Second start to the right, and straight on 'till morning.<sup>158</sup>

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<sup>158</sup> Geronimi, Clyde; Jackson, Wilfred; Luske, Hamilton (directors). (1953). RKO Radio Pictures. Peter Pan [film].