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The U.S. Space Force (USSF) faces a daunting challenge under its mandate to organize American military activity in space with a very small number of uniformed Guardians. Capped at only 8,600 military personnel in 2023 with slow growth projected in future years, the service must service established joint space requirements while supporting new missions, particularly in the Protect & Defend portfolio to blunt anti-satellite technologies and secure military effects in the space domain. The USSF has little force structure allocated to these missions and growing them at speed will require tough decisions about manpower use and risk across missions.

Internationaland U.S. law and DoD guidance provide an initial lens with which to examine operational missions to determine which functions currently performed by the USSF must be performed by uniformed military personnel, which should remain U.S. government activities, and which provide opportunity for leverage the explosive growth of the private American space sector through contracted services.

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JOINT FORCES STAFF COLLEGE

JOINT ADVANCED WARFIGHTING SCHOOL

Do The Right Thing:
Balancing Military, Civilian, and Commercial Space Capabilities

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The Right Stuff:
Balancing Military, Civilian, and Commercial Space Capabilities

by Alexander A. Courtney

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes (or appropriate statement per the Academic Integrity Policy).

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Abstract

The U.S. Space Force (USSF) faces a daunting challenge under its mandate to organize American military activity in space with a very small number of uniformed Guardians. Capped at only 8,600 military personnel in 2023 with slow growth projected in future years, the service must service a wide array of established missions while investing resources to support new and growing missions, particularly in the Protect & Defend portfolio of capabilities to blunt Russian and Chinese anti-satellite technologies and secure military effects in the space domain. The USSF has little history and force structure allocated to these new missions and growing them with appropriate speed will require tough decisions about manpower use and risk across missions. Failure to meet the growing threat to U.S. space assets could lead to the "Space Pearl Harbor" presaged in the Rumsfeld Report of 2001 and grave danger to the joint force.

International and U.S. law along with DoD guidance provide an initial lens with which to examine operational missions to determine which functions currently performed by the USSF must be performed by uniformed military personnel, which should remain U.S. government activities, and which provide opportunity for leverage the explosive growth of the private American space sector through contracted services. Intelligent differentiation of manpower uses will free military manpower for inherently military missions while providing the same space-based services the U.S. military depends on for modern operations in all domains. Additionally, focusing military research, development, and acquisition funds toward experimental capabilities which answer niche mission needs will provide a more effective stimulus for transformative technology development by subsidizing the risky initial phases of disruptive technology development.

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Dedication

For Claire and Hannah. Yours are the only opinions that really matter.

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"The essence of strategy is choosing what not to do." – Michael Porter[1]

Chapter 1: Introduction and Methodology

INTRODUCTION:

The United States Space Force faces significant challenges in meeting its growing mission requirements with the manpower authorized in the 2023 National Defense Authorization Act. Most leaders say that their most precious resources are the people assigned to the organization. For the U.S. Space Force (USSF) this is more than a platitude. Allowed just 8,600 active-duty personnel in the *2023 National Defense Authorization Act* (NDAA) – approximately one-sixtieth the size of the Army's active-duty force – to support the bulk of joint military space missions and much of the operation of the Intelligence Community's (IC) space equities, USSF senior leaders will face challenges meeting the growing needs of the joint force and new activities in the domain.[2] Emerging missions, particularly in the "Protect and Defend" portfolio of missions designed to enhance survivability of critical space architecture and secure space superiority in a high-end fight with a peer adversary, place new demands on manpower to stand up operational units along with training, test, and range bills to provide a ready force.

This paper attempts to identify the available trade space for manpower decisions by categorizing missions that, by law or policy, must be performed by military members and which could be performed by civilians (both DoD employees and those of other government agencies) or executed through contract with commercial entities. To make best use of its limited inventory of uniformed military personnel the USSF should cut deeply from missions that civilians can operate or can be performed by private industry under contract so that it can focus on those inherently military functions the joint force needs to compete, fight, and win in the modern

security environment. Doing so will introduce risk to operations, but other entities in government or the commercial sector can mitigate those challenges; only the military can engage in the application of violent force to achieve national objectives in and through space and thus should be prioritized by the USSF.

Fortunately, the commercial space industry has grown explosively over the past decade and seems to be accelerating its offerings while the cost of commercial space services drops because of huge reductions in the cost of launching satellites in to orbit, in turn allowing more entrants in the industry and driving price and capability competition. The USSF already partners with commercial vendors in several areas to great effect and has announced plans to expand contracts for space services to deal with growing demand for space effects across the DoD. Additionally, as other elements of the federal government derive increasing value from space-based capabilities opportunities exist for other agencies to assume missions that provide value to society outside the battlefield that are currently performed by USSF Guardians. This shift is more than a good idea; it is in fact directed by federal law and Department of Defense guidance on manpower usage.

We should note up front that all missions of the USSF are important and the elimination or underperformance of any would result in significant mission degradation across the joint force. There is a lengthy history of success demonstrating that space-based capabilities have been a critical enabler of the joint force for decades. The current force structure is also streamlined due to decades of fiscal and manpower choices, especially during times when space activities were seen as a supporting function for other domains instead of its own arena of conflict. One of the driving forces behind the creation of the USSF was that the services were underinvesting in their space capabilities and the country needed an institution that would keep advancing space

operations at front of mind. The missions performed by legacy space operations organizations (e.g. Air Force Space Command, NRO, NASA, NOAA) developed piecemeal over the course of decades to answer emerging organizational needs. It is unlikely that this approach generated the optimal mix of missions across government. Manpower and mission allotments aside, the creation of the USSF is cause enough to revisit which missions are core military activities to serve as a baseline of activity and identify for the new service.

This topic is of interest to the joint force because the U.S. military is incredibly reliant on space capabilities to conduct their operations. Dependence on rapid access to intelligence products derived from space-based collection platforms, command and control, communications, and situational awareness continue to grow in response to a more dynamic, interconnected battlefield. In operations far from the continental U.S., space provides a flexible means of collecting and transmitting information. America's post-Desert Storm approach to war demands timely communication up, down, and across the joint force. Our adversaries have studied America's combat operations and have identified U.S. space architecture as an important center of gravity vulnerable to attack. Other countries have concluded the same fact and are growing their investments in systems designed to deny America access to the benefits of space; the USSF must respond with aggressive force design to counter these developments. Finally, intelligent investment in commercial capabilities by the U.S. government by focusing military development spending on niche mission needs will support the growing American space industry and provide more effective advantage as it faces increasing competition from Chinese and European providers.

Methodology

This paper will review defined guidance for "inherently military" from law, specifically Article 44 of the Geneva Convention of 1949 which defines the qualifications of lawful combatants under international law and Title 10 U.S. Code §101 which describes the structure and composition of the American armed forces. These documents will identify the activities that can only be performed lawfully by uniformed military personnel if they are to be performed at all. DoD Instruction (DODI) 1100.22, DoD Directive (DODD) 1100.4 provide clear policy instruction that the highest priority for military manpower is the execution of military missions and that other activities will utilize the lowest cost manpower appropriate for the task.

The next test will identify missions that meet criteria as being "inherently governmental" activities as described by the Federal Activities Inventory Reform (FAIR) Act. Inherently governmental tasks cannot be outsourced to commercial vendors and, in the interest of confidence in the U.S. government, government employees must accomplish. The remaining activities constitute the space where senior leaders in the USSF, joint force, and congressional can make choices regarding resource allocation as new mission prospects emerge or for more effective use of manpower. The final element of analysis will examine if similar services offered by the commercial space sector could fulfill mission requirements; space activity cannot be outsourced to the commercial sector if no vendor offers that service.

Chapter 2: Background

From the earliest days of the Space Race the United States military has been a primary proponent for and recipient of space capabilities. Explorer-1 – America's first manmade satellite launched in 1958 – began as a joint effort by the U.S. Army and Navy to advance rocket

technology.[3] Throughout the Cold War the space programs of the U.S. and the U.S.S.R. tacitly supported ballistic missile development to enhance nuclear weapon delivery systems. Both countries launched their first generation of Earth-observation "spy" satellites to track missile development and other military activities in their rival's territory. Space tracking (the monitoring of satellites throughout their orbits), satellite communications (SATCOM) (to coordinate military forces around the world), navigation (to allow precise maneuver of disparate forces), as well as a network of antennas to control these new constellations (for more responsive upload of mission plans or downlink of collected data) added additional national capabilities as the domain matured. Even the first weather satellite, Vanguard-2, was a product of the Naval Research Lab designed to project weather conditions for American fleets operating across the globe. These missions are still core military space activities.

President Trump established the United States Space Force on December 20th, 2019, when he signed the *National Defense Authorization Act for Fiscal Year 2020*. The act converted Air Force Space Command into the Space Force and tasked the new service to "provide freedom of operation for the United States in, from, and to space; conduct space operations; and protect the interests of the United States in space."[4] This description of military space activities was not so different from the description of its predecessor, Air Force Space Command: "Provide resilient, defendable and affordable space capabilities for the Air Force, Joint Force and the Nation" according to an archived website, and the legacy missions transitioned with the command.[5] The strategic context and intent motivating the establishment of a new service, however, were entirely different from the historic environment.

The decision to create a military space branch was the culmination of decades of debate about how to organize military space efforts. During the Eisenhower administration each service

initiated their own space projects aligned with their individual operational needs with little coordination and much jockeying for influence and funding.[6] A consequential event in the history of DoD space was the creation of the Advanced Research Projects Agency ("Defense" was added later, modifying the name into the modern acronym "DARPA") which quickly appropriated all DoD space missions to elevate the priority of space technologies and constrain interservice rivalry.[7] Instead of becoming the skeleton of a new service, however, ARPA behaved like an acquisitions office for space systems. It prioritized and secured funding for various space-related efforts and then contracted with each service to provide acquisitions support to actualize development while retaining final technical and financial control (and significant portions of the "credit" for each system's operational accomplishments. Essentially, this led to the services building the systems they wanted but with ARPA pulling the strings. Despite the challenges inherent in the process, the services developed their own portfolios of space capabilities over time and the Air Force regained management of the bulk of the military space enterprise. ARPA's involvement in space programs did not go away; they morphed into a new organization discussed in detail later – the National Reconnaissance Office (NRO).

Despite its origins in military competition, the space age saw remarkably little weaponry in space. The only treaty limitations come from the Outer Space Treaty of 1967 which prohibits "any object carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station weapons in outer space."[8] Aside from that treaty there are no limitations on military operations in space. Policy considerations were mostly responsible for the lack of experimentation and development of orbital weapons.[9] Aside from experimentation with missiles designed to strike satellites in low orbits, no country has acknowledged placing offensive weapon systems in orbit.

The logic was both practical and aspirational. The U.S. was already locked in an arms race on multiple fronts with the U.S.S.R. Bombers, submarines, aircraft carriers, and nuclear weapons were all major fronts of the existing contest. From a practical standpoint, adding another arena of competition would be expensive and administratively taxing. President Eisenhower's budget statement heading into 1958 – just months after the launch of Sputnik when the U.S. government was still determining its approach to organizing space missions, both civilian and military – highlighted the fact that 63% of the government's budget went to defense (both domestic and capability building among allies).[10] He emphasized that, while necessary to guarantee security against Soviet aggression, "Future defense costs must be held to tolerable levels. Effective action must be taken to improve efficiency and to maintain a proper balance between expenditures for future military strength and expenditures for current readiness."[11] Additionally, the top defense priority for space was the development of reconnaissance satellites to monitor Soviet missile launches, troop movements, and infrastructure development to inform national leaders about Russian capabilities and intentions. Designing spacecraft "carriers" akin to aircraft carriers or missile launch sites on the moon threatened to explode the DoD's budget and put the more important reconnaissance missions at risk. In modern times, the U.S. military effectively integrated space technologies into its way of war and became the country with the most to lose if space were to become fair game in a future war and largely maintained the policy of no offensive action in space.

The more idealistic motivation for limiting offensive military space operations was a genuine desire to preserve space as a realm of peaceful exploration. The same Outer Space Treaty that restrained states from putting nuclear bombs on orbit also declared that "The exploration and use of outer space, including the Moon and other celestial bodies, shall be

carried out for the benefit and in the interests of all countries…and shall be the providence of all mankind" and referred to astronauts as "envoys of mankind."[12] Though years away from the stunning accomplishments of the Apollo space missions that took humanity to the moon, there was a real sense of opportunity for mankind to leave behind the ugly rivalries that had already shed so much blood in the 20th century. It is not exaggeration to compare the feeling of possibility to that felt at Charles Lindberg's crossing of the Atlantic, that technology could bring the world together instead of becoming yet another crass field on which men could kill one another.

The last decade has unfortunately proven that wherever humanity goes, conflict and political rivalry go with it. Following the stunning success of the of the U.S.-led coalition during Operation DESERT STORM the world took notice of the role that space played in establishing the winning combination of battlespace awareness from spy satellites, coordinated maneuver of a dispersed force through SATCOM, and precision fires assisted by GPS. The victory was the payoff of decades of work across the national security enterprise to develop, field, and integrate powerful new technologies. While few countries could match the spending that paid for these capabilities, America's rivals recognized that the new information-centric way of fighting also brought opportunities for asymmetric combat against America. Chinese military analyst Wang Hucheng published a paper in 2000 identifying space as "the U.S. military's 'soft ribs' and strategic weaknesses…For countries that can never win a war with the United States by using the method of tanks and planes, attacking the U.S. space system may be an irresistible and tempting choice."[13]

Russia and China have prioritized anti-satellite capabilities to threaten American assets. The growing arsenal of systems includes ground-based anti-satellite missiles, electronic warfare,

directed energy, and orbital warfare capabilities. In 2020 Russia launched a satellite with an orbit close to an American NRO asset. China demonstrated a new capability of its Shijian-21 satellite. Equipped with a robotic arm, the satellite seized a defunct Chinese communications satellite and dragged it into a graveyard orbit far away from Earth. The Russian and Chinese governments both claimed that their satellites were designed for inspection or debris removal missions, but others view their purpose differently. The USSF Chief of Space Operations, Gen Jay Raymond, highlighted the Russian system as a demonstration of an orbital weapon system: "The satellites exhibited characteristics of a weapon system when one of those satellites launched a high-speed projectile into space."[14] Debris in certain high-value orbits (e.g. geosynchronous) is a global concern, but one can also see how the Chinese robotic arm satellite could also grab a healthy adversary satellite and push it into an undesirable or unrecoverable orbit. It was time to revisit old policy assumptions.

More recent debates about the need for a military service for space focused more on whether that organization should focus on enforcing rules and norms as they develop for the environment and protect U.S. interests in space, akin to the Coast Guard, or if it should orient toward national security activities like the other Title 10 services. In a ceremony unveiling the Space Force's flag in the White House Rose Garden, President Trump made clear that the purpose of the Space Force was, like the other military services, both defensive and offensive in nature. In his idiosyncratic manner, the president declared that the occasion was "important from a defensive standpoint, from an offensive standpoint, from every standpoint there is."[15] That statement answered the "Force vs Guard" discussion, but it also laid the foundation for space missions previously shackled by policy considerations: not space-enabled combat but combat in space itself. Additional clarification came from one of the first official USSF publications. The

Space Capstone Publication, the foundation of service doctrine, states up front that space is a warfighting domain, joining air, land, sea, and cyberspace. Countries do not necessarily need a separate service to achieve superiority to a warfighting domain but they do require the means to secure access and action in that domain and the ability to deny that access and action to an adversary. In the same way that we would not say that a ship with thick armor is able to control the seas without knowing what kind of weapons it carries, the U.S. cannot enjoy advantage in space without both the ability to protect the assets it needs and the means of ensuring enemy spacecraft cannot perform their missions.

It is worth pausing to delineate the difference between the USSF and U.S. Space Command (USSPACECOM) as the two are frequently confused or conflated, even in military circles. The Space Force is a Title 10 military branch under the Department of the Air Force, coequal with the Army, Air Force, Navy, and Marine Corps tasked with the responsibility to "organize, train, and equip" ready forces for the joint force. USSPACECOM is a geographic combatant command as described in the Goldwater-Nichols Act of 1987 with an area of responsibility beginning 100 kilometers above the Earth's surface with (as of now) no defined outer limit. It is tasked with conducting military operations within its assigned AOR by employing forces from each of the military services to achieve national security objectives. While they are in many cases the operational customer of the USSF's capabilities they do not have a voice in determining manpower investments and can only shape requirements on the service through its integrated priority list based on OPLAN needs.

National Security Space

National Security Space is a term of art meaning those government space activities that support national security missions. In common usage it means both military space applications (primarily the USSF, but the Army, Navy, and Marines retain certain capabilities to support their domain-centric missions) and intelligence community space equities. The military and IC space communities share common interests and have important interdependencies. For example, NRO satellites provide invaluable data and intelligence on adversary activity to the joint force (among many other customers) including signals intelligence used by the USSF to characterize foreign space systems. In turn, the USSF is tasked with defending American space assets from attack; the IC's reconnaissance satellites are likely high on an adversary's list of targets early in a conflict to blind U.S. forces. "National security space" efficiently captures this relationship.

Space Operations Command

To accomplish the USSF's organize, train, and equip mission, the service divides itself into field commands: Space Operations Command (SpOC) conducting mission activity on behalf of combatant commanders; Space Training and Readiness Command (STARCOM) responsible for training, education, and doctrine; and Space Systems Command (SSC) which handles acquisition and sustainment. The acquisition of satellites, ground support equipment, sustainment of systems, and contracting of services is a critical element of the national security space enterprise but it does not fall within the scope of this effort. Additionally, training, range support, doctrine development, and professional education are invaluable force multipliers for space operations but likewise do not directly fulfill the requirements of joint force commanders. For these reasons we focus on SpOC and leave STARCOM and SSC manpower analysis to a future researcher.

The operational echelon below the field command and above the tactical squadrons is the Space Delta (DEL). Each DEL organizes tactical capabilities by their overarching function. The structure organizes the units performing electromagnetic warfare, for example, under DEL 3. Some of the missions are recognizable from the Space Race – missile warning, SATCOM, navigation, and space tracking, referred to here by the doctrinal term "Space Domain Awareness," and organized under separate DELs. A few activities, especially those supporting or integrating multiple missions stand separate from the others and are worthy of mention and explanation at this portion of the paper.

FIGURE 1: SPOC ORGANIZATION[16]

DEL 7 is an example of a mission delta that operates few systems but provides enhancement for the rest. DEL 7 provides intelligence support to operations to include detachments for each of the mission deltas along with higher-level space intelligence,

surveillance, and reconnaissance (ISR) exploitation and targeting. DEL 18, providing manpower for the National Space Intelligence Center, provides foundational intelligence exploitation, analysis, and reporting. Space Base Deltas One and Two organize the base support units (overwhelmingly provided by the Air Force) such as security, fitness and morale, finance, and civil engineering. DELs 5 and 15 provide command and control functions for coalition and interagency space activities for the USSF component to USSPACECOM at the Combined Space Operations Center and the National Space Defense Center, respectively.

The National Reconnaissance Office

As previously described, following ARPA's acquisition of all DoD space programs in the 1950s, most missions returned to the services for contract servicing or operational employment. The major exception was ISR from space. The DoD agency tasked with operating America's intelligence satellite program is the NRO, a DoD intelligence agency coequal with the National Security Agency, National Geospatial Intelligence Agency, and the Defense Intelligence Agency. Jointly stablished by Secretary of Defense Robert McNamara and CIA director Allen Dulles on 6 September 1961 the NRO collected the nascent space-based ISR efforts of the Navy and Air Force under one organizational umbrella.[17] It supervised a growing portfolio of intelligence collection programs that provided the intelligence community and national leadership with an expanding array of collection approaches along with the acquisition and launch programs to put the satellites into orbit. The very existence of a government agency called the "NRO" was a national secret until 1992.[18]

While the NRO remains separate from the military services, it still fills a significant portion of its manpower requirements with uniformed military. 35% of the approximately 3,000

NRO employees are military. Of that, the largest contingent comes from the USSF – 836 in total – over a quarter of the people working for the agency.[19,20] Constituting nearly 10% of the service's total personnel, the scale of this institutional requirement is notable in its scale; one in ten Guardians works directly on NRO spacecraft and missions.

The military members who work in the NRO perform an array of functions. For the Army, Navy, Air Force, and Marine Corps the footprint is almost entirely in intelligence collection requirements management. The Space Force also provides personnel for these functions but also for the development and acquisition of new systems, launch operations, and the daily command and control of the NRO's fleet of spacecraft. During their assignment to the NRO, however, these Guardians operate under the direction of the director of the NRO, not a combatant commander or the chief of space operations, with important implications for how these constellations operate in a contested environment. For example, under normal conditions the commander of USSPACECOM cannot order an NRO satellite to relocate or change its behavior as part of his campaign plan. Both leaders agree on a framework for determining authorities in competition and in conflict, that concept remains untested in a crisis.[21]

International Law:

The question of who, if anyone, can employ just or lawful violence has a long history. Without diving into the philosophy of the concept, current guidance for the U.S. comes from two main sources, the Geneva Convention III of 1949 with subsequent updates and U.S. Code Title 10, *Armed Forces*.

Article III of the Geneva Convention broadly deals with the treatment of prisoners of war, a term that does not include all parties engaged in fighting. It divides fighting personnel into

two categories: lawful combatants and unlawful combatants. Lawful combatants are armed forces that are separate from the civilian population by the nature of their overt involvement with combat operations (directly or indirectly) and their adherence to international norms of behavior in their conduct of operations. Specifically, they must be commanded by a person responsible for the behavior of his or her subordinates, wear a sign or insignia recognizable at a distance, carry their arms openly, and obey the laws and customs of war.[22] Persons who do not meet these criteria can fall under a few other unsavory titles (e.g. brigands, terrorists, murderers) but they can generally be recognized as unlawful combatants. As a signatory of the four Geneva Conventions, the U.S. is committed to adherence to treaty norms of behavior to include the proper designation of combat forces.

Title 10 of U.S. code addresses the armed forces. The legal mechanics of the 2020 NDAA effected changes to portions of Title 10 subtitle D, adding the USSF to the list of covered agencies and naming it as a member of the armed forces and the eight uniformed services (which includes the National Oceanographic and Atmospheric Administration and the National Health Service). As a component of the armed forces the requirements of the Uniform Code of Military Justice (UCMJ). The operational practices that ensure compliance with international law are captured in the punitive articles of the UCMJ.

Of particular interest for this study, mercenaries are not considered lawful combatants. Additional Protocol I of the Geneva Conventions addresses the status and definition of mercenaries with a six-part test. The key elements are that a mercenary is one who engages in hostilities in a conflict without being a member of any belligerent state's armed forces with the primary interest of private financial gain.[23] If the U.S. were to attempt to outsource offensive combat operations to a private security firm those individuals would be unlawful combatants

under international law. The status of similar firms providing defensive security at U.S. installations overseas or for protection of American personnel is permissible (the U.S. State Department Diplomatic Security Service contracted with Blackwater USA to supplement security details for diplomats working in Iraq and Afghanistan) but notionally defensive operations can quickly become murkier. A 2007 report to Congress indicated that shooting in 84% of use-of-force incidents involving Blackwater security personnel were initiated by Blackwater personnel.[24] No charges were filed against the contractors, but the report raised concern about American commitment to international law and led to subsequent changes to policy within the DoD, Department of State, and the Department of Justice. This history suggests that the U.S. military will face stiff opposition to any plan to rely on private actors to conduct offensive space operations.

Manpower Guidance:

The Federal Activities Inventory Reform Act (FAIR) of 1998 requires that executive branch agencies submit to the director of the Office of Management of Budget an accounting of all activities accomplished by that organization that, in the best judgement of the agency head, are not inherently governmental functions. The law provides a definition of "inherently governmental function" but, as other analysts have noted, the description does not provide much in the way of objective criteria: "The term 'inherently governmental' means a function that is so intimately related to the public interest as to require performance by Federal Government employees."[25] A cursory review of cable news commentary shows indicates that there are numerous opinions of what activities the government should undertake, leaving this definition with significant room for interpretation.

Derived from this law and other related direction are DoD Directive 1100.4 *Guidance for Manpower Management* and DoD Instruction 1100.22 *Policies and Procedure for Determining Workforce Mix*. These documents establish the policy of the U.S. government that "assigned missions shall be accomplished using the least costly mix of personnel (military, civilian and contract) consistent with military requirements and other needs of the Department."[26]

The most significant for this analysis, however, is the directive found in paragraph 3.2.3 od DODD 1100.4: "Manpower shall be designated as civilian except when military incumbency is required for reasons of law, command and control of crisis situations, combat operations, or esprit-de-corps; when unusual working conditions are not conducive to civilian employment; or when military-unique knowledge and skills are required for successful accomplishment of the duties."[27] This line offers a lot of guidance to unpack, but the element directing that DoD positions are to be coded as civilian billets and only coded for uniformed military personnel under certain exceptions is especial worthy of exploration. The policy addresses two reasonable concerns.

First, America's military service members are expensive. One quarter of the DoD's budget goes toward personnel costs. A Center for Strategic and International Studies report concluded that the average active duty member costs $136,000 per year in pay, bonuses and special allotments (e.g. sea pay, flight pay, college tuition assistance), housing stipends, medical benefits, and future retirement obligations.[28] Figure 2 shows that there is about a $20,000 difference annually between the cost of civilian and military labor. It is important to note that this reflects the *average* cost; considering that the joint force is overwhelmingly young, enlisted, and of junior rank, the $134,000 sum is especially significant compared to civilian employment in other industries. With these considerations in mind, it is understandable from a fiscal

standpoint why the DoD would want to maximize civilian billeting.

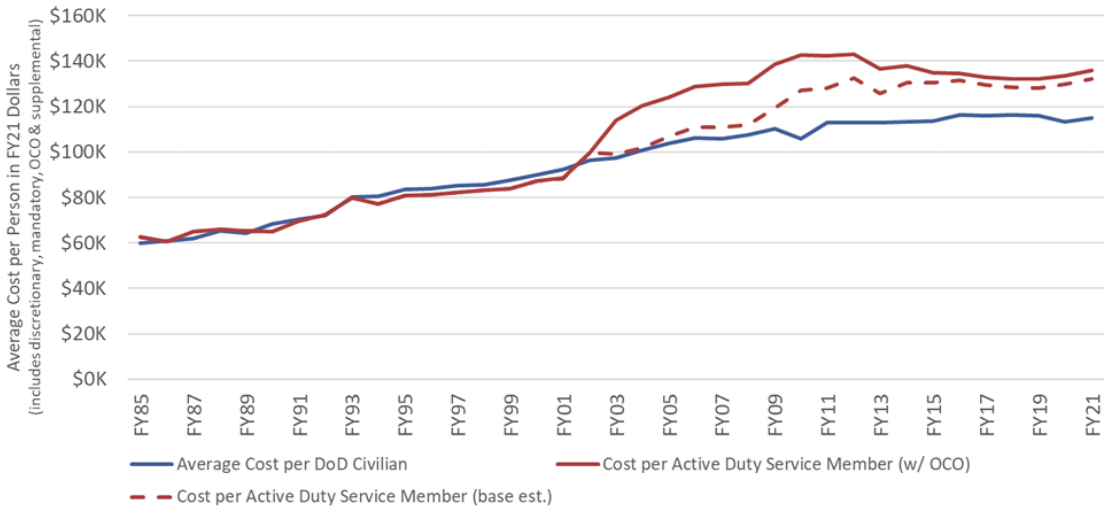

FIGURE 3: Cost of DoD Civilian vs. Active Duty Service Member[29]

The second reason for preferencing civilian positions is to concentrate the work of military personnel on military missions. From DODD 1100.4: "National military objectives shall be accomplished with a minimum of manpower that is organized and employed to provide *maximum effectiveness and combat power*" (emphasis mine). The central role of military forces is the lawful employment of violence in advancement of national objectives. The Geneva Conventions dictate that only combatants organized under a coherent chain of command and openly designated as armed forces can engage in lawful combat operations.[30] Even if military personnel are more expensive you cannot hire civilians to pilot fighter jets on strike missions or execute artillery barrages under international law. Combat power can only come from uniformed military members and so the DoD understandably wants to generate the most capability from the servicemembers it has. Personnel allocated to positions that could be filled by civilians diminishes potential combat strength while increasing overall cost.

DODI 1100.22 outlines criteria for identifying the activities that must or should be performed by military personnel. These criteria are listed in priority order with work falling into

multiple categories judged by the highest applicable category. Direction and control of military forces predictably lands at the top: "Manpower shall be designated military…if the planned use of destructive combat capabilities is part of the mission assigned to the position."[31] As one works down the list, however, more ambiguity creeps in and the increasing "gray zones" on the chart reflect this feature. For example, Criterion B as described in DODI 1100.22 – "Exception of Combat Support and Combat Service Support due to Operational Risk" – instructs that "if, in the commander's judgement, performance of the function by DoD civilians or contractors or total reliance on DoD civilians or contractors would constitute unacceptable risk."[32]

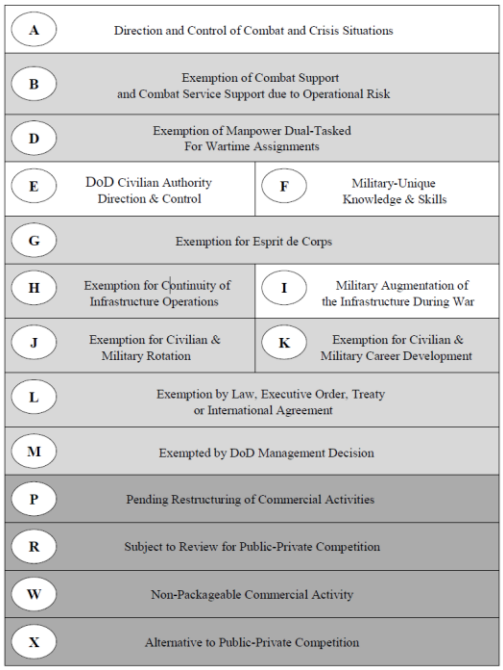

FIGURE 3: Manpower Mix Criteria

There is a great deal of subjectivity built into that determination. One of the critiques of the DoD's guidance in this area is that vague characterizations and the difficulty in characterizing all the possible activities a particular position might hypothetically require in a future conflict led to an overly cumbersome process that is infrequently followed or used as a *post hoc* justification once a determination is made for other reasons.[33] There are also significant

differences in how each service implements the guidance resulting in interesting inconsistencies. For example, the Air Force rates 95% of their "Surgical Care" billets as military essential jobs while the Army only classifies a little over half of their surgery staff as military essential.[34] Without delving into a line-by-line comparison of how each service allots military members to combat support activities we can generalize that there is no general agreement on which support activities are inherently military in nature.

The interpretation of these instructions has also changed over time. Two decades ago, it was common to see uniformed service members working at the front desk at temporary lodging facilities on military bases whereas that function is almost universally performed by civilian employees today. The same is true for cooks in stateside dining facilities and administrative functions in the headquarters and unit levels. Recent changes have been even more dramatic and demonstrate that even deployment to combat zones is not, on its own, an inherent military activity. An Institute for Defense Analyses study found that the wars in Iraq and Afghanistan triggered a shift in defining which jobs in conflict zones were considered appropriate for civilian or contract workers. In a glaring example, 50% of the DoD workers in Iraq and 59% in Afghanistan were contractors.[35] These jobs included construction, maintenance, and security work on austere bases subject to periodic attack or highly dangerous jobs outside the wire transporting supplies to forward operating bases. Civilian employees and contractors demonstrated themselves to be capable of performing tasks in highly dangerous environments where military members receive special pay and tax benefits to compensate for the heightened risk.

Manpower Data

The main source of data on personnel investments comes from the 2023 SpOC Chartbook for Fiscal Quarter 4 of 2023, developed and maintained by the SpOC Manpower, Organization, and Manpower Office. It combines the data from the unit manning documents (UMD) of every organization within SpOC, it captures the size of all USSF tactical units by authorized billet, a steadier and clearer guide to the choices the USSF makes about human capital. Actual manning of SpOC units, like all large organizations, varies by the day as members move to new units, new Guardians join, others retire or separate, or personnel move to or from assignments outside of SpOC.

At the end of fiscal year 2023, SpOC had 3,660 uniformed members assigned to 9 operational DELs constituting 42% of the total service's inventory. The largest, DEL 8, had 708 members conducting SATCOM and navigational warfare (i.e. GPS). The smallest, DEL 2, was staffed by 215 members for tracking the orbits of satellites and debris and maintaining the world's authoritative catalog of space objects.

The mission areas with the largest personnel investments carry significant overlap with the most prolific commercial offerings. The three largest personnel investments are in remote sensing (civilian equivalents of many NRO capabilities), SATCOM and NAVWAR, and missile warning (substantially, but certainly not exclusively, space tracking).

Chapter 3: Analysis

As identified in the methodology, we will examine each major mission area by considering three questions: 1) Is it inherently military? 2) Is it inherently governmental? 3) Is it offered by commercial vendors? For reasons identified earlier, this paper will not test the

missions of DELs 5 (C2), 7 (ISR), 15 (C2), or 18 (ISR) due to their lack of weapon systems as commonly understood, or the Space Base Deltas for the same reason.

To avoid repetition, the first question about a mission's military inherency can be analyzed collectively. While limited by classification, this study presumes based on mission descriptions and publicly available mission descriptions that the only DELs sponsoring any kind of offensive space capabilities are any classified offensive orbital capabilities in DEL 9 and DEL 3's offensive SATCOM jamming capability. Based on the description of inherently military operations in the previous chapter we can provide a general statement that only those activities qualify as inherently military in nature under international and U.S. law and policy. Based on the criteria listed in DODD 1100.2I (referenced in Figure 4) there is no criteria that clearly triggers its designation as requiring military personnel.

Avoiding a monotonous analysis through each of the 16 criteria, we examine some of the best contenders for consideration. The top criterion, "Direction and Control of Combat and Crisis Situations," does not apply. GPS is an indispensable force multiplier and certain missions are significantly degraded without its assistance, but on its own it does not an application of force or a provide command and control to military forces. A better fit may be found in criterion B – "Combat Support or Combat Service Support for Operational Risk." The text of DODI 1100.22 explains this exemption is for circumstances where the commander determines that the performance of this activity by DoD civilian (or contractor) would be unacceptably dangerous to operations.[36] This is a high bar to meet. Civilians perform many critical functions within our society and our military relies on the successful accomplishment of those activities to accomplish their missions. For example, Al Udeid Air Base in Qatar is host to a large contingent of refueling aircraft that provided vital support to strike and air support missions throughout USCENTCOM,

especially during the wars in Iraq and Afghanistan. During that time the Air Force outsourced the installation, operation, and maintenance of the base power plants and electrical distribution system to logistics company KBR.[37] Of additional note, Executive Order 12744 included Al Udeid in a list of combat zones subject to special tax benefits for military members assigned there.[38] If contractors serving in a designated combat zone can be trusted to provide all electricity for an important overseas installation, it stands to reason that a satellite constellation operated from a secure facility in Colorado could be similarly operated by civilians without undue risk to the joint force.

DEL 2 – Space Situational Awareness

A foundational component of control of a domain is the ability to detect and characterize activity within it. Tracking objects in space falls to DEL 2 which gathers data from diverse military, government, commercial and academic institutions to determine orbital trajectories of the over 44,000 observable objects in space.[39] These objects range from active satellites to debris from launch vehicles, defunct spacecraft, and the International Space Station. With this data they are able to provide prediction and warning about potential collisions (reference the 2013 Sandra Bullock movie *Gravity* for the significance of this mission) as well as maintain awareness of suspicious activity by foreign satellites with announced or suspected offensive or ISR collection capabilities. DEL 2 shares this data free to the international public through its website www.Space-Track.org. As will be discussed later for GPS, this is an invaluable service to the global community to avoid harm to manned spaceflight missions like the International Space Station, unnecessary destruction of space assets through collisions, and a preservation of the space environment from dangerous contamination with unmonitored space junk. The current model, however, is akin to the Federal Aviation Administration (FAA) provided air traffic

control for the entire planet, not just American airspace. The military is performing a function where an increasingly large portion of the benefit is enjoyed by civilian users.

Space Policy Directive-3 identified the Department of Commerce (DOC) as the lead agency for providing space traffic management data to space operators around the world.[40] The civilian agency brings with it the legal authority to direct American spacecraft to certain standards of behavior or to take involuntary actions for the safety of the overall environment, much like the FAA's authority for aircraft. President Trump signed that policy in 2018 and the transfer and still faces significant hurdles before fully accepting the mission from the USSF. As more civilian spacecraft enter the space domain it will become increasingly difficult to manage the orbital picture. The military mission of interest to the joint community is the careful tracking of potentially threatening foreign satellites that could degrade U.S. space assets or enhance adversary ISR networks to endanger American forces in other domains. The transfer of overall awareness to the DOC will facilitate a consolidation of effort within the USSF on its specific interests.

DEL 3 – Electromagnetic Warfare

Satellites are commanded and their collected data is transmitted back to Earth by signals operating in the electromagnetic spectrum (EMS). In the early days of space-based ISR optical satellites would drop canisters of film back into the atmosphere for development and exploitation, resulting in a significant delay between the collection of intelligence and its readiness to inform national policy or military planning. The EMS is a hotly contested arena with China and Russia both making significant investments in electronic warfare (EW) capabilities. China conducted a significant reorganization of their combat forces to unify their space, cyber, EW, and information operations under their newly created Strategic Support Forces. Other

doctrinal statements indicate that they see a close relationship between dominance in space and the EMS and success in large-scale combat operations.

DEL 3 is adding new classified capabilities but the core of its mission has historically been defensive and offensive SATCOM EW capabilities. The 4th Electromagnetic Squadron (EWS) operates the Counter Communication System and can provide reversable SATCOM denial against adversary signals.[41] This capability is one of the few acknowledged systems capable of securing advantage in space through offensive action. The 16th EWS provides a complimentary service to the joint force – the geolocation of signal interference on friendly SATCOM. Whether the source is hostile jamming activity or inadvertent misdirection of blue force signals, these defensive systems allow SATCOM owners and users to characterize the nature of the interference and employ countermeasures or deconfliction actions as needed.

Offensive activity, even in the EMS, is an inherently military activity due to the employment of force (in this case virtual) against a foreign actor as part of a military operation. There is no lawful use for such a capability in the commercial sector (the FCC in fact actively pursues and files criminal complaints against those who do). As such it must remain a USSF mission.

Defensive EW offers other manpower options. All SATCOM operators worry about interference with their signals. In a famous example, an American electrical engineer operating under the pseudonym “Captain Midnight” hijacked a signal belonging to the cable network HBO for nearly five minutes in a protest against a recent price increase for the channel.[42] He was arrested after an investigation by the FCC and FBI and received fines and probation for the incident. Commercial broadcasters and satellite operators are willing to pay for services to identify and mitigate interference quickly and so several services exist and compete in this field.

One example, Kratos Defense, brags about their one-of-a-kind global EMS monitoring capability in its offerings to promote signal reliability.[43] The defensive nature of interference resolution and the availability of numerous commercial offerings indicate that not only is this not an inherently military field, but it is an activity that private firms could perform as a contracted service for the USSF, allowing DEL 3 to reinvest these military billets in other activities or to refine their focus on support to technically or operationally sensitive missions the DoD would prefer be kept out of the public eye.

DEL 4 – Missile Warning

America's missile warning sensor architecture consists of ground, sea, air, and space-based systems integrated into a common warning network for accurate, reliable threat warning and characterization. The USSF owns a significant portion of this network in the form of ground-based radar systems covering nearly all potential angles of attack along with a constellation of satellites equipped with delicate infrared sensors to spot missile heat signatures from the moment of ignition anywhere in the world. Originally developed with the Soviet Union in mind, the DoD performed decades of upgrades to the sensitivity and accuracy of this global sensor network so that it now provides not only warning of strategic nuclear attack against the homeland, but critical technical intelligence about foreign missile system performance and geospatial intelligence about operating and test locations. During the conflicts in Syria and Ukraine it has also provided important theater missile warning to enhance survivability of U.S. and friendly forces in the region. Following the American air strike against Iranian General Qassem Soleimani, Iran retaliated with multiple rocket launches against U.S. forces in Iraq. The Space Based Infrared System identified those launches from space and DEL 4 operators sent early warning messages allowing coalition forces to take cover and limit casualties.[44]

The ground-based elements of this network also form the collection backbone of DEL 2's space awareness capability. These powerful phased array radars were designed to identify Russian warheads crossing the horizon to attack the continental U.S. but operators quickly learned that the beams often picked up "stray" returns that crossed the system's field of view regularly. Those returns were space objects and as the U.S. and other countries added more satellites to the environment and the threat of Soviet nuclear attack diminished the radar crews added space tracking to its list of assigned missions.

While missile warning assets contribute to America's ongoing development of missile defense systems, none of them project any force against foreign systems. Referencing the Manpower Mix Criteria from DODI 1100.22 (Figure 4) however, there is a strong case that Code B, "Exemption for Combat Support and Combat Service Support due to Operational Risk" applies. The threat of ballistic missile attack on the U.S., its allies, or fielded forces around the world is a vital national concern. Even if it were possible to outsource this mission to a private provider (none exist) no commander would be comfortable trusting that a contract with the lowest acceptable bidder was sufficient reassurance that he would receive warning of inbound attack. Fitting the criteria of this exception means that missile warning is a vital military activity that can and should be performed by uniformed members as a force protection activity.

DEL 6 – Cyber

As discussed in the section on DEL 3, the ability to communicate with our satellites is reliant on access to them through the EMS. Just as important as the ability to operate in and through the EMS is the ability to physically access spacecraft with antennas in advantageous locations. 21 and 23 SOPS provides this access through the Satellite Control Network (SCN), a system of general purpose antennas that government spacecraft owners can schedule for use

uplinking commands to a satellite or downlinking collected mission data from them for processing. Commercial satellites face the same considerations but do not have access to the SCN. While operators will often have access to a dedicated ground station, some operators (especially those with satellites in low-Earth orbits without a fixed location relative to a position on the ground) elect to utilize private networks of antennas for the control of their space assets under model known as ground station as a service (GSaaS). U.S. government space systems outside of the DoD already utilize these offerings for other missions and the DoD even uses them in limited circumstances for unclassified commanding. As more entrants establish a presence in space GSaaS will likely offer more robust offerings that could align with USSF mission needs.

DEL 8 – SATCOM and NAVWAR

GPS – For the countless civilian users around the world and the growing economic impact of the system, GPS remains a U.S. military program operated largely by uniformed military personnel at Schriever Space Force Base, Colorado. There is no denying the impact that precision navigation and targeting support have had on U.S. military operations and doctrine, but as more civilian endeavors find vital utility in the same capability it invites a question of who should be responsible for ensuring that GPS continues operating without interruption.

The Navstar Global Positioning System was not the first space-based navigation aid, but it certainly represented a leap in capability over previous systems due to its coverage and three-dimensional location data. Operated by the 2d Space Operations Squadron (SOPS) and owned by the USSF, GPS has provided free navigational support since 1983 when President Reagan ordered the signal be transmitted unencrypted for public use; President Clinton later signed an executive order making it American policy to keep the signal unencrypted for users worldwide

and modern GPS satellites do not have the ability to selectively degrade the accuracy of its signals.[45]

These decisions were transformative for many segments of the world economy. In the years since GPS became available to the public a study commissioned by the National Institute of Standards and Technology estimates that GPS has enabled $1.4 trillion of business activity that otherwise would not have occurred without the capability.[46] Additionally, the report highlights the fact that 90% of the estimated economic impact accrued since 2010, indicating that we may only be at the beginning of a long growth cycle as enterprising businesses find new use cases for precision navigation that make novel business models practical.[47]

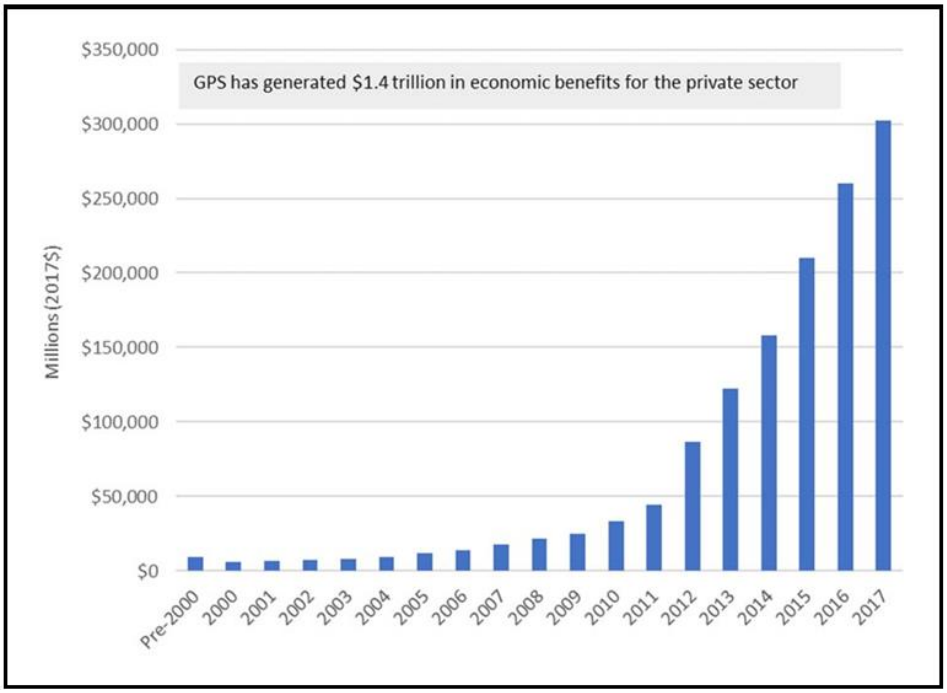

FIGURE 4: GPS Economic Benefit[48]

Revisiting the FAIR Act's definition of an "inherently governmental" activity as "a function that is so intimately related to the public interest as to require performance by Federal Government employees," it seems apparent that GPS's widespread use and America's

dependence on the availability and accuracy of the system's timing data are so acute that GPS easily meets these criteria. Many government agencies exist because the government deems their existence important for the safety and welfare of the American people. The Food and Drug Administration provides regulation and oversight of food safety, medication efficacy, and household products like cosmetics to reduce the possibility that harmful or fraudulent products could harm consumers. While private services like Consumer Reports or any number of the product review websites that populate the internet perform similar functions, but it is hard to think that the country would be so confident in a company, no matter how impartial, that lacked a means of public accountability for integrity and performance. In the same vein, would the American public enjoy the same confidence that the pilot of their commercial flight relied on a private navigation standard that relied on a private, proprietary model that perhaps competed with other similarly opaque models? It is noteworthy that there are other positioning systems aside from GPS. Several states or international entities operate either global (Russia, China, and the European Union) or regional (Japan and India) space-based navigation systems; none of them rely on private providers to operate these systems. For the sake of public confidence in a fundamental standard GPS meets the mark established by the FAIR Act.

SATCOM – As discussed in the manpower section, SATCOM remains a core military space mission. Connectivity with fielded forces as well as the need for resilient command and control and data exchange facilitate the modern sensor-shooter complex that make long-range fires possible. The USSF operates several constellations of SATCOM capabilities to provide specialized services across the electromagnetic spectrum to users in all domains. Included in these capabilities are bespoke systems designed to meet special requirements. 4 SOPS under DEL 8 is responsible for providing protected and wideband communications for the joint force

and national leadership. Among the data their satellites handle are nuclear command and control communications synchronizing America's most powerful weapons. For understandable deterrence reasons it is imperative that the president be able to reach alert forces to modify posture or to transmit launch orders.

One of the most extreme scenarios these systems must handle is retaining the ability to get message data to elements of the nuclear command and control system even with the atmospheric distortions caused by recent nuclear detonations. Their signals must also be hardened against intense jamming efforts because of the role of the payload communications. The satellites can "crosslink" through space if ground stations in one part of the world are destroyed. They are even able to shape the transmission zone of their signals so they are less likely to be detected or collected against by adversary ISR.

The USSF's SATCOM capacity is growing, but not at a speed sufficient to meet the exploding requirements of an interconnected joint force. The USSF and other services augment these systems with commercial bandwidth. The DoD already contracts for nearly half of its SATCOM requirements, paying about $1B for the extra capacity. If trends continue the portion of military comms travelling through commercial providers will grow and military SATCOM will specialize for niche missions only encountered by military communications.

From a policy standpoint there are a few cases where military ownership of SATCOM likely meet criteria for one of the exemptions in DODI 1100.22. The most likely candidate is nuclear command and control. The specialized technical criteria to function in a post-attack nuclear environment is unlikely to be a service any commercial enterprise will find profitable. Additionally, the inflexible reliability standards mean that U.S. Strategic Command would not be comfortable using commercial assets for such a vital activity. Many other forms of data

communication could be outsourced. Remotely-piloted aircraft (i.e. "drones") already operate with a high level of dependence on commercial SATCOM bandwidth. RPA operators can even work through intentional interference by adversaries through mitigation and response techniques that are now part of operational practice.[49] These facts, along with SpOC's existing manpower investment in SATCOM, means that the USSF should consider carefully which missions require uniformed Guardians and which ones appropriately-cleared commercial partners can execute effectively.

Orbital Warfare – With so much about DEL 9's operations trapped behind SCIF doors it is difficult to determine to what extent orbital warfare missions meet the guidance found in the FAIR Act and DODI 1100.22, however available statements about their activities can shed some light. Dr. John Plumb addressed Congress in September of 2023 to provide testimony of his office's report, "Space Policy Review and Strategy on Protection of Satellites." In that testimony he highlighted the work of the DoD to harden its space systems through greater threat awareness and resilient architectures, but also hinted at the need for activity beyond dodging anti-satellite missiles. "We will protect and defend our men and women from space-enabled threats. In conflict, this may necessitate ensuring that our adversaries are unable to rely on their space based services to find and strike our forces."[50]

Remote Sensing (NRO) – The USSF does not set requirements for the remote sensing missions of the NRO, but its manpower footprint in that organization mean that a discussion about alternatives to government owned and operated ISR spacecraft should be a regular topic of conversation between leaders in the two organizations.

There are plenty of interesting things to look at from space other than Soviet missile fields. The ability to survey large swaths of terrain and catalog natural and manmade features has

obvious benefits to several fields. Multispectral sensors, synthetic aperture radar, and even radio frequency collectors have applications that business entities are willing to pay for. Widely popular navigation apps combine data derived from GPS signal and overlays the derived data onto maps developed from overhead imagery to give users greater special understanding of the driving directions they follow. The first civilian observation satellite was Landsat-1 launched by NASA in 1972 (originally the Earth Resources Technology Satellite).[51] Its successes spawned eight more iterations with more iterations planned. It also spurred congress to pass the 1992 Land Remote Sensing Policy Act to provide a framework and ground rules for the development of a new commercial enterprise.[52] The remote sensing market segment is another area of explosive growth, fueled largely by the miniaturization of satellites, leaps in on-board processing to reduce data transmission requirements, and enhancements in automated tasking algorithms. The increase in cost performance compared to capability is astonishing. Landsat-8 cost $1 billion to design, build and launch in 2013; an equivalent-resolution (3-meter accuracy) satellite launched in 2022, Planet SuperDove, costs less than $300,000 per vehicle. The company operates fleets (or "flocks" in their terminology) that they claim can survey the entire planet every day.

The amount of high-resolution imagery data collected in 2022 is six times higher than it was ten years ago.[53] Direct comparisons to the classified NRO inventory and their capabilities are impossible in an unclassified paper, but the fact that daily surveillance by hundreds of satellites from just one company means that there are prodigious options for the government to purchase timely pictures of virtually any part of the globe that would suit the needs of most users. The NRO has already taken on a leadership role in doing precisely that. In 2017 the agency accepted responsibility to serve as lead agent purchasing commercial earth-sensing data for the DoD and intelligence community.[54]

Chapter 4 - Discussion

Innovation

The seminal work describing the rise of transformative new technologies into a marketplace is Dr. Clayton Christensen's *The Innovator's Dilemma*. In it he describes the process by which large companies like Kodak, IBM, Digital Equipment Company, or Sears miss out on innovations that eventually transform their markets despite having advantages the startups could only dream of – vast research and marketing budgets, existing customers and brand recognition, and some of the most capable managers money can buy. Dr. Christensen's answer comes down to a few factors that lead large companies to ignore disruptive innovations that reshape the overall market because of the incentives that drive investment in large organizations.

New technologies or novel business models begin as less effective alternatives for most existing customers. In the case of digital photography, the first cameras were large, expensive, and less functional – black and white images were stored on cassettes of magnetic tape. But with all of the limitations, the ability to take pictures without the need for expendable materials and chemical developing agents met the specific needs of niche users who were willing to pay a premium to meet those needs. That revenue supported further technology development by smaller companies and progressively made digital photography better and cheaper until it could compete directly with Kodak's traditional offerings.

Sometimes, instead of replacing an older paradigm, this process can generate entirely new lines of technology. In the same way that the space race of the 1960s spawned dozens of consumer products from tang to modern water filtration systems, the niche requirements of a military space program could provide another source of funding for breakthrough innovation. When the U.S. government purchases COTS systems for activities that have analogues in the

civilian sector like SATCOM, that money certainly helps underwrite the American aerospace industry and makes it more competitive in civilian markets. What it does not do is fund research into the technologies of tomorrow that would lock in years of American advantage in space, both on the battlefield and in the marketplace. The nature of military operations generates several niche requirements that no commercial entity would likely encounter (reference above the requirement for SATCOM that works in a post-nuclear environment). USSF acquisition dollars can have more than just a capability generation effect but could provide a boost to the American industrial base.

Identity and Retention

Military service is a uniqe profession with specific strengths, weaknesses, and special authorities. Young men and women join the military with certain desires and expectations in mind. We see some of these expectations in recruiting commercials. Finance and contracting are vital activities needed by every military branch. This kind of important work does not make it into the flashy advertising; fighter jets, ships at sea, or a Marine fighting a lava monster with a sword catch the attention of potential recruits.[55] Fantasy hyperble aside, combat weapon systems are also what the American public thinks of when they think about the DoD. The services have moved away from military personnel performing many support tasks like managing dining facilities or fitness centers to invest in combat power, but also because the jobs that recruits want when they join are those tied most directly to the mission.

Space missions that have direct corrilaries to civilian fields face constant compeition for personnel. The growing aerospace industry can afford to pay premium wages to first-term recruits who arrive with training in orbital mechanics, electromagnetic spectrum operations, and

space and/or ground system operations as well as a Top Secret clearance. For the Guardian working in SATCOM it could be almost exactly the same job but for more pay. An airman who performs maintenance on heavy transport aircraft can find similar employment working for passenger and cargo airlines; the only way to work on the F-22 fighter jet is to join the Air Force. Similarly, while dozens of companies operate SATCOM networks, only the USSF offers the opportunity to conduct or support combat operations outside of Earth's atmosphere.

Too much overlap also hurts the establishment of a unique space warfighting culture. Opinion pieces still question the need for a space service or whether it even meets the author's definition of warfighting. One essay by a Dr. Paula Thornhill, a retired Air Force brigadier general and current associate professor at the Johns Hopkins University School of Advanced International Studies, argues that the USSF is not a military service because its potential targets are satellites, not people. "Whatever the law may call it, it is not a military service. What it does is absolutely vital to America's national security, but it lacks the core relationship to organized violence that defines the other services."[56] While her argument is built on a fairly narrow definition of who counts as a warfighter, her sentiment expresses what others also observe, that the USSF is more of a service provider than a combat force. Part of the challenge the USSF faces is that the best understood (i.e. least classified) capabilities have no direct offensive or defensive capabilities. A Pew Research Center study found that Americans find it more likely that space tourism will become routine than that the U.S. military will fight another country in space (55% finding tourism likely versus 44% thinking war was probable).[57] The USSF has a serious legitimacy problem with the public and elements of the joint force that cannot be explained away with descriptions of the importance of GPS and SATCOM to the American way of life; it needs

to communicate its role in the defense of critical space capabilities and infrastructure and, even if notionally, its commitment to denying adversaries the advantages of space-based systems.

Chapter 5: Conclusion and Recommendations

Conclusion

In 1959 address, President (then Senator) Kennedy employed a popular linguistic anecdote about his assessment of the contemporary geopolitical environment. "When written in Chinese, the word 'crisis' is composed of two characters – one represents danger and one represents opportunity."[58] His Mandarin was a bit off, but the meaning is significant for the USSF to consider today. At the dawn of airpower, civilian and military leaders had to decide on which missions the military services would perform and which would be the domain of civilian endeavor. Some choices were easy – there is no commercial market for private bombers – while others – who should move people and cargo by air – were harder to discern. The risk to innovation was also high. Without market pressure to drive companies to seek advantage through technology or new business models the American aircraft industry likely would have lagged behind global competitors and left the Air Force with an underdeveloped industrial base when it faced conflict. So too does the USSF face a series of delicate decisions to identify what missions it should accomplish.

The analysis in this paper shows that the USSF owes itself and the joint force some deep consideration and subsequent communication about what are the characteristics of military space missions. Even if the USSF has work to do convincing the American people that the outcome of America's next major conflict could hinge on the advantages provided by space systems, hostile militaries are already well aware of that fact. China in particular has deeply considered how to

leverage national scientific and industrial capacity to pursue military advantage by blurring the lines between the role of industry and the military. America's aerospace industry is in a renaissance period of explosive growth to the benefit of Americans and the global economy. The USSF can itself lead a rebirth of strategic and operational advantage by examining its missions and structure through the lenses of the needs of the joint force and current security environment and the power of the American industrial base.

Recommendations

1) **The USSF should conduct a "clean slate" review of its missions and manpower allocations.** Organizations that develop over the course of decades tend to retain structures and processes that, while needed at some time in the past, hang on through tradition and expired justifications. As a new service, the USSF has a mandate from Congress to provide certain effects for the country and the joint force. If the previous construct and weight of effort were sufficient to meet America's changing national security needs, there would not be a new service.

    The USSF posted some admirable progress on implementing new organizational structures that acknowledge the limited inventory of personnel and empower subordinate leaders to make decisions that enhance institutional agility, demonstrating a recognition of the opportunity and the requirement to operate differently than other branches. Examining its investments in missions could be a harder, more personal exercise for the service. To a certain extent, all large organizations carry inertia that seeks to perpetuate existing values and resist change. Individuals in the tight-knit space operations

community have performed some of these missions and made careers out of their expertise, including senior officers.

A blank slate approach forces discussion about the vision for the service and forces hard choices, but it need not be a zero-sum activity. From a manpower perspective it is true that there will still be a fixed number of Guardians to support operations. But those missions that end up with fewer personnel can turn that challenge into a drive to reimagine the legacy mission with contemporary realities. In some cases these choices might lead to greater automation, in others deeper integration with allies, and only in a few areas complete divestment.

Part of this discussion should be the relationship between the USSF and the NRO. With one in ten Guardians assigned to the NRO, it is the service's single largest mission investment and the current status should make sense with the direction of the service. Without doubt, the NRO makes invaluable contributions to national security and Guardians supporting those missions benefit from close interaction with the intelligence community. What that support looks like and how it compares to other requirements with less flexibility in manpower type deserves consideration.

2) **The USSF should continue and expand efforts to augment its capabilities with commercially-sourced capacity**. Much time has passed between the dawn of the Space Age where governments were the only entities endowed with the needs and resources to invest in space capabilities. Greater competition in the marketplace means that there are more options than ever to answer any organization's needs and those options are growing in scope, capability, and cost effectiveness at an accelerating rate. In this environment of opportunity those arguing for an approach that modifies existing structures instead of

large-scale reimagination should bear the burden of proof that long-standing missions cannot be entrusted or supplimented by the commercial sector.

Fortunately, there are a number of efforts afoot to expand these relationships. The establishment of integrated mission deltas which combine operational and acquisition elements of the USSF under one mid-level commander tightens the connection between users and the acquisition professionals who interact with vendors on a daily basis bring more voices to the table. Additionally, the proposed development of a commercial space reserve to augment military capabilities during a crisis, akin to similar programs in the Navy and Air Force, formalizes the relationship between military and commerical space providers that could open the door to exploring new means of effectively providing space capabilities to the joint force.

Vita

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[1] Michael E. Porter, "What Is Strategy?," *Harvard Business Review*, November 1, 1996, https://hbr.org/1996/11/what-is-strategy.
[2] Mark F. Cancian, "U.S. Military Forces in FY 2022 - Army" (Center for Strategic and International Studies, October 2021), 2, https://defense360.csis.org/u-s-military-forces-in-fy-2022-army/.
[3] "A Short History of Military Space," Air & Space Forces Magazine, accessed November 16, 2023, https://www.airandspaceforces.com/article/1204space/.
[4] "10 USC Ch. 908: THE SPACE FORCE," accessed November 14, 2023, https://uscode.house.gov/view.xhtml?path=/prelim@title10/subtitleD/part1/chapter908&edition=prelim.
[5] "AFSPC Mission," accessed November 16, 2023, https://www.afspc.af.mil/Home/AFSPC-Mission/.
[6] David N. Spires et al., *Beyond Horizons: A Half Century of Air Force Leadership In Space*, Revised (Montgomery AL: Air University Press, 1998), 58.
[7] David N. Spires et al., 58.
[8] United Nations General Assembly, "Resolution 2222: Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies" (United Nations Office of Outer Space Affairs, December 19, 1966), 13, https://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf.
[9] David N. Spires et al., *Beyond Horizons: A Half Century of Air Force Leadership In Space*, 55.
[10] "Annual Budget Message to the Congress for Fiscal Year 1958. | The American Presidency Project," accessed November 29, 2023, https://www.presidency.ucsb.edu/documents/annual-budget-message-the-congress-for-fiscal-year-1958.
[11] "Annual Budget Message to the Congress for Fiscal Year 1958. | The American Presidency Project."
[12] United Nations General Assembly, "Resolution 2222: Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies," 14.
[13] Ashley J. Tellis, "China's Military Space Strategy," *Survival* 49, no. 3 (October 2007): 49, https://doi.org/10.1080/00396330701564752.
[14] "Exclusive: Russian Craft Shadowing U.S. Spy Satellite, Space Force Commander Says," Time, February 10, 2020, https://time.com/5779315/russian-spacecraft-spy-satellite-space-force/.
[15] "Remarks by President Trump at Presentation of the United States Space Force Flag and Signing of an Armed Forces Day Proclamation – The White House," accessed November 12, 2023, https://trumpwhitehouse.archives.gov/briefings-statements/remarks-president-trump-presentation-united-states-space-force-flag-signing-armed-forces-day-proclamation/.
[16] "Space Operations Command," Space Operations Command (SpOC), accessed December 4, 2023, https://www.spoc.spaceforce.mil/About-Us/Fact-Sheets/Display/Article/2550627/https%3A%2F%2Fwww.spoc.spaceforce.mil%2FAbout-Us%2FFact-Sheets%2FDisplay%2FArticle%2F2550627%2Fspace-operations-command.
[17] Bruce Berkowitz, *The National Reconnaissance Office at 50 Years: A Brief History* (Chantilly, Virginia: National Reconnaissance Office, Center for the Study of National Reconnaissance, 2011), 12.
[18] Berkowitz, 24.
[19] "> About NRO," accessed December 2, 2023, https://www.nro.gov/About-NRO/.
[20] USSF Enterprise Talent Management Office, "Email Exchange Between Author and USSF Enterprise Talent Management Office," November 7, 2023.
[21] Colin Clark, "NRO, NGA, SPACECOM, Space Force Hammer Out Boundaries," *Breaking Defense* (blog), August 24, 2021, https://breakingdefense.com/2021/08/nro-nga-spacecom-space-force-hammer-out-boundaries/.
[22] "Combatants and POWs | How Does Law Protect in War? - Online Casebook," accessed February 2, 2024, https://casebook.icrc.org/law/combatants-and-pows#footnote3_mxpzzz9.
[23] "Mercenaries," accessed February 5, 2024, https://ihl-databases.icrc.org/en/customary-ihl/v1/rule108.
[24] Majority Staff, "Memorandum Re: Additional Information about Blackwater USA" (House of Representatives Committee on Oversight and Government Reform, October 1, 2007), 6, https://web.archive.org/web/20080131113042/http://oversight.house.gov/documents/20071001121609.pdf.
[25] 105th Congress, "Public Law 105-270--Oct.19, 1998: Federal Activites Inventory Reform Act of 1998" (U.S. Congress, October 19, 1998), Sec 5(2), https://www.congress.gov/105/plaws/publ270/PLAW-105publ270.pdf.
[26] USD (P&R), "Department of Defense Directive 1100.4: Guidance for Manpower Management" (Department of Defense, February 12, 2005), 3.1, https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/110004p.pdf.
[27] USD (P&R), 3.2.3.

[28] Leo Shane III, "Drastic Changes to Military Pay, Benefits Needed to Meet Rising Personnel Costs: Report," Military Times, September 10, 2021, https://www.militarytimes.com/pay-benefits/mil-money/2021/09/10/drastic-changes-to-military-pay-benefits-needed-to-meet-rising-personnel-costs-report/.
[29] Seamus P. Daniels, "Assessing Trends in Military Personnel Costs" (Center for Strategic and International Studies, September 2021), 36, https://www.csis.org/analysis/assessing-trends-military-personnel-costs.
[30] "Combatants and POWs | How Does Law Protect in War? - Online Casebook."
[31] Undersecretary of Defense for Personnel and Readiness, "Department of Defense Instruction 1100.22, Change 1 -- Policy and Procedures for Determining Workforce Mix," December 1, 2017, 19.
[32] Undersecretary of Defense for Personnel and Readiness, 24.
[33] Thomas C. Greenwood, USMC (Ret) et al., "Revisiting the Criteria for Military Essentiality in Total Force Manpower Management" (Institute for Defense Analyses, April 2019), 71.
[34] Thomas C. Greenwood, USMC (Ret) et al., 39.
[35] Thomas C. Greenwood, USMC (Ret) et al., 17.
[36] Undersecretary of Defense for Personnel and Readiness, "DODI 1100.22," 24.
[37] Power Engineering International, "KBR Wins USAF On-Site Power Contract in Qatar," Power Engineering International, May 29, 2013, https://www.powerengineeringint.com/decentralized-energy/on-site-power/kbr-wins-usaf-on-site-power-contract-in-qatar/.
[38] "Combat Zones | Internal Revenue Service," accessed December 4, 2023, https://www.irs.gov/individuals/military/combat-zones.
[39] "Space-Track.Org," accessed February 5, 2024, https://www.space-track.org/auth/login.
[40] "SSA/STC – Office of Space Commerce," January 31, 2024, https://www.space.commerce.gov/category/ssa-stm/.
[41] "Counter Communications System Block 10.2 Achieves IOC, Ready for the Warfighter," United States Space Force, March 13, 2020, https://www.spaceforce.mil/News/Article/2113447/counter-communications-system-block-102-achieves-ioc-ready-for-the-warfighter/http%3A%2F%2Fwww.spaceforce.mil%2FNews%2FArticle-Display%2FArticle%2F2113447%2Fcounter-communications-system-block-102-achieves-ioc-ready-for-the-warfighter%2F.
[42] David M. Ewalt, "The Tale of Captain Midnight, TV Hacker And Folk Hero," Forbes, accessed February 5, 2024, https://www.forbes.com/sites/davidewalt/2013/03/18/the-tale-of-captain-midnight-tv-hacker-and-folk-hero/.
[43] Kratos Defense & Security Solutions, "Military & Government | Kratos," accessed February 5, 2024, https://www.kratosdefense.com/systems-and-platforms/space-systems/military-and-government.
[44] Nathan Strout, "Exclusive: How the Space Force Foiled an Iranian Missile Attack with a Critical Early Warning," C4ISRNet, January 13, 2021, https://www.c4isrnet.com/battlefield-tech/space/2021/01/07/exclusive-how-the-space-force-foiled-an-iranian-missile-attack-with-a-critical-early-warning/.
[45] "Selective Availability Feature Eliminated from GPS III Satellites – Office of Space Commerce," September 18, 2007, https://www.space.commerce.gov/selective-availability-feature-eliminated-from-gps-iii-satellites/.
[46] Alan C. O'Connor et al., "Economic Benefits of the Global Positioning System (GPS)" (RTI International, June 2019), xiii, https://www.rti.org/sites/default/files/gps_finalreport618.pdf?utm_campaign=SSES_SSES_ALL_Aware2019&utm_source=Press%20Release&utm_medium=Website&utm_content=GPSreport.
[47] Alan C. O'Connor et al., ES-3.
[48] Alan C. O'Connor et al., ES-3.
[49] "Accelerating Change: Addressing Space Threats to RPA Operations > Creech Air Force Base > Article Display," accessed February 5, 2024, https://www.creech.af.mil/News/Article-Display/Article/2698095/accelerating-change-addressing-space-threats-to-rpa-operations/.
[50] Sandra Erwin, "DoD Submits Congressionally Mandated Space Policy Report," *SpaceNews* (blog), September 14, 2023, https://spacenews.com/dod-submits-congressionally-mandated-space-policy-report/.
[51] "Landsat 1 | Landsat Science," November 30, 2021, https://landsat.gsfc.nasa.gov/satellites/landsat-1/.
[52] Emmi Yonekura, *Commercial Space Capabilities and Market Overview: The Relationship Between Commercial Space Developments and the U.S. Department of Defense*, Research Report (Santa Monica, Calif: RAND, 2022), 30, https://doi.org/10.7249/RRA578-2.
[53] McKinsey & Company, "The Role of Space in Driving Sustainability, Security, and Development on Earth" (McKinsey & Company, 2022), 12.
[54] Yonekura, *Commercial Space Capabilities and Market Overview*, 28.
[55] *THE BEST - US Marines TV Recruitment Spot - Ever Produced*, YouTube Video (GoldenLionFilms, 2006), https://www.youtube.com/watch?v=62tnJtLBQzQ.

[56] "The Space Force Isn't a Military Service," Defense One, February 18, 2022, https://www.defenseone.com/ideas/2022/02/space-force-isnt-military-service/362108/.
[57] Brian Kennedy and Alec Tyson, "Americans' Views of Space: U.S. Role, NASA Priorities and Impact of Private Companies," *Pew Research Center Science & Society* (blog), July 20, 2023, https://www.pewresearch.org/science/2023/07/20/americans-views-of-space-u-s-role-nasa-priorities-and-impact-of-private-companies/.
[58]

Bibliography

"> About NRO." Accessed December 2, 2023. https://www.nro.gov/About-NRO/.

"10 USC Ch. 908: THE SPACE FORCE." Accessed November 14, 2023. https://uscode.house.gov/view.xhtml?path=/prelim@title10/subtitleD/part1/chapter908&edition=prelim.

105th Congress. "Public Law 105-270--Oct.19, 1998: Federal Activites Inventory Reform Act of 1998." U.S. Congress, October 19, 1998. https://www.congress.gov/105/plaws/publ270/PLAW-105publ270.pdf.

"Accelerating Change: Addressing Space Threats to RPA Operations > Creech Air Force Base > Article Display." Accessed February 5, 2024. https://www.creech.af.mil/News/Article-Display/Article/2698095/accelerating-change-addressing-space-threats-to-rpa-operations/.

"AFSPC Mission." Accessed November 16, 2023. https://www.afspc.af.mil/Home/AFSPC-Mission/.

Air & Space Forces Magazine. "A Short History of Military Space." Accessed November 16, 2023. https://www.airandspaceforces.com/article/1204space/.

Alan C. O'Connor, Michael P. Gallaher, Kyle Clark-Sutton, Daniel Lapidus, Zack T. Oliver, Troy J. Scott, Dallas W. Wood, Manuel A. Gonzalez, Elizabeth G. Brown, and Joshua Fletcher. "Economic Benefits of the Global Positioning System (GPS)." RTI International, June 2019. https://www.rti.org/sites/default/files/gps_finalreport618.pdf?utm_campaign=SSES_SSES_ALL_Aware2019&utm_source=Press%20Release&utm_medium=Website&utm_content=GPSreport.

"Annual Budget Message to the Congress for Fiscal Year 1958. | The American Presidency Project." Accessed November 29, 2023. https://www.presidency.ucsb.edu/documents/annual-budget-message-the-congress-for-fiscal-year-1958.

Berkowitz, Bruce. *The National Reconnaissance Office at 50 Years: A Brief History*. Chantilly, Virginia: National Reconnaissance Office, Center for the Study of National Reconnaissance, 2011.

Clark, Colin. "NRO, NGA, SPACECOM, Space Force Hammer Out Boundaries." *Breaking Defense* (blog), August 24, 2021. https://breakingdefense.com/2021/08/nro-nga-spacecom-space-force-hammer-out-boundaries/.

"Combat Zones | Internal Revenue Service." Accessed December 4, 2023. https://www.irs.gov/individuals/military/combat-zones.

"Combatants and POWs | How Does Law Protect in War? - Online Casebook." Accessed February 2, 2024. https://casebook.icrc.org/law/combatants-and-pows#footnote3_mxpzzz9.

David N. Spires, George W. Bradley III, Rick W. Sturdevant, and Richard S. Eckert. *Beyond Horizons: A Half Century of Air Force Leadership In Space*. Revised. Montgomery AL: Air University Press, 1998.

Defense One. "The Space Force Isn't a Military Service," February 18, 2022. https://www.defenseone.com/ideas/2022/02/space-force-isnt-military-service/362108/.

Erwin, Sandra. "DoD Submits Congressionally Mandated Space Policy Report." *SpaceNews* (blog), September 14, 2023. https://spacenews.com/dod-submits-congressionally-mandated-space-policy-report/.

Ewalt, David M. "The Tale of Captain Midnight, TV Hacker And Folk Hero." Forbes. Accessed February 5, 2024. https://www.forbes.com/sites/davidewalt/2013/03/18/the-tale-of-captain-midnight-tv-hacker-and-folk-hero/.

III, Leo Shane. "Drastic Changes to Military Pay, Benefits Needed to Meet Rising Personnel Costs: Report." Military Times, September 10, 2021. https://www.militarytimes.com/pay-benefits/mil-money/2021/09/10/drastic-changes-to-military-pay-benefits-needed-to-meet-rising-personnel-costs-report/.

International, Power Engineering. “KBR Wins USAF On-Site Power Contract in Qatar.” Power Engineering International, May 29, 2013. https://www.powerengineeringint.com/decentralized-energy/on-site-power/kbr-wins-usaf-on-site-power-contract-in-qatar/.

“Landsat 1 | Landsat Science,” November 30, 2021. https://landsat.gsfc.nasa.gov/satellites/landsat-1/.

Majority Staff. “Memorandum Re: Additional Information about Blackwater USA.” House of Representatives Committee on Oversight and Government Reform, October 1, 2007. https://web.archive.org/web/20080131113042/http://oversight.house.gov/documents/20071001121609.pdf.

Mark F. Cancian. “U.S. Military Forces in FY 2022 - Army.” Center for Strategic and International Studies, October 2021. https://defense360.csis.org/u-s-military-forces-in-fy-2022-army/.

McKinsey & Company. “The Role of Space in Driving Sustainability, Security, and Development on Earth.” McKinsey & Company, 2022.

“Mercenaries.” Accessed February 5, 2024. https://ihl-databases.icrc.org/en/customary-ihl/v1/rule108.

Porter, Michael E. “What Is Strategy?” *Harvard Business Review*, November 1, 1996. https://hbr.org/1996/11/what-is-strategy.

“Remarks by President Trump at Presentation of the United States Space Force Flag and Signing of an Armed Forces Day Proclamation – The White House.” Accessed November 12, 2023. https://trumpwhitehouse.archives.gov/briefings-statements/remarks-president-trump-presentation-united-states-space-force-flag-signing-armed-forces-day-proclamation/.

Seamus P. Daniels. “Assessing Trends in Military Personnel Costs.” Center for Strategic and International Studies, September 2021. https://www.csis.org/analysis/assessing-trends-military-personnel-costs.

“Selective Availability Feature Eliminated from GPS III Satellites – Office of Space Commerce,” September 18, 2007. https://www.space.commerce.gov/selective-availability-feature-eliminated-from-gps-iii-satellites/.

Solutions, Kratos Defense & Security. “Military & Government | Kratos.” Accessed February 5, 2024. https://www.kratosdefense.com/systems-and-platforms/space-systems/military-and-government.

Space Operations Command (SpOC). “Space Operations Command.” Accessed December 4, 2023. https://www.spoc.spaceforce.mil/About-Us/Fact-Sheets/Display/Article/2550627/https%3A%2F%2Fwww.spoc.spaceforce.mil%2FAbout-Us%2FFact-Sheets%2FDisplay%2FArticle%2F2550627%2Fspace-operations-command.

“Space-Track.Org.” Accessed February 5, 2024. https://www.space-track.org/auth/login.

“SSA/STC – Office of Space Commerce,” January 31, 2024. https://www.space.commerce.gov/category/ssa-stm/.

Strout, Nathan. “Exclusive: How the Space Force Foiled an Iranian Missile Attack with a Critical Early Warning.” C4ISRNet, January 13, 2021. https://www.c4isrnet.com/battlefield-tech/space/2021/01/07/exclusive-how-the-space-force-foiled-an-iranian-missile-attack-with-a-critical-early-warning/.

Tellis, Ashley J. “China’s Military Space Strategy.” *Survival* 49, no. 3 (October 2007): 41–72. https://doi.org/10.1080/00396330701564752.

THE BEST - US Marines TV Recruitment Spot - Ever Produced. YouTube Video. GoldenLionFilms, 2006. https://www.youtube.com/watch?v=62tnJtLBQzQ.

Thomas C. Greenwood, USMC (Ret), Allison Abbe, Clark Frye, Anthony L. Johnson, and Ani K. Khachatryan. “Revisiting the Criteria for Military Essentiality in Total Force Manpower Management.” Institute for Defense Analyses, April 2019.

Time. “Exclusive: Russian Craft Shadowing U.S. Spy Satellite, Space Force Commander Says,” February 10, 2020. https://time.com/5779315/russian-spacecraft-spy-satellite-space-force/.

Tyson, Brian Kennedy and Alec. “Americans’ Views of Space: U.S. Role, NASA Priorities and Impact of Private Companies.” *Pew Research Center Science & Society* (blog), July 20, 2023. https://www.pewresearch.org/science/2023/07/20/americans-views-of-space-u-s-role-nasa-priorities-and-impact-of-private-companies/.

Undersecretary of Defense for Personnel and Readiness. “Department of Defense Instruction 1100.22, Change 1 -- Policy and Procedures for Determining Workforce Mix,” December 1, 2017.

United Nations General Assembly. “Resolution 2222: Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies.” United Nations Office of Outer Space Affairs, December 19, 1966. https://www.unoosa.org/pdf/gares/ARES_21_2222E.pdf.

United States Space Force. “Counter Communications System Block 10.2 Achieves IOC, Ready for the Warfighter,” March 13, 2020. https://www.spaceforce.mil/News/Article/2113447/counter-communications-system-block-102-achieves-ioc-ready-for-the-warfighter/http%3A%2F%2Fwww.spaceforce.mil%2FNews%2FArticle-Display%2FArticle%2F2113447%2Fcounter-communications-system-block-102-achieves-ioc-ready-for-the-warfighter%2F.

USD (P&R). “Department of Defense Directive 1100.4: Guidance for Manpower Management.” Department of Defense, February 12, 2005. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/110004p.pdf.

USSF Enterprise Talent Management Office. “Email Exchange Between Author and USSF Enterprise Talent Management Office,” November 7, 2023.

Yonekura, Emmi. *Commercial Space Capabilities and Market Overview: The Relationship Between Commercial Space Developments and the U.S. Department of Defense*. Research Report. Santa Monica, Calif: RAND, 2022. https://doi.org/10.7249/RRA578-2.