Space Power and the Foundations of an Independent Space Force

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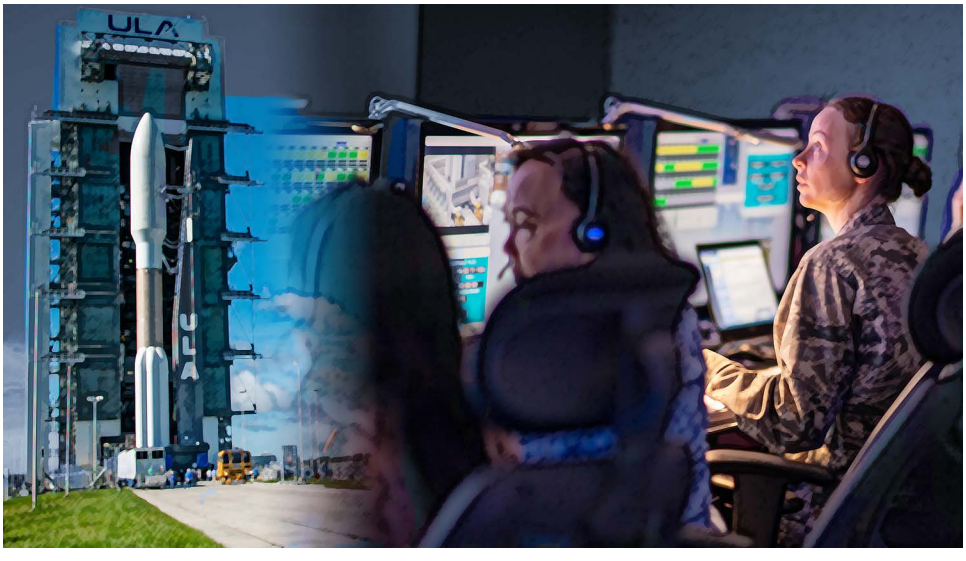

Even though the debate over whether to establish a Space Force has moved on to the specific form it will eventually take, the debate over its creation has highlighted important arguments that need to be addressed for the new service to fully mature. Failing to address these concerns will lead to lingering issues that will negatively impact the Space Force's future development and interactions with the other services, particularly the Air Force. In *Organizing Space Power: Conditions for Creating a US Space Force*, the now-retired Lt Col Michael Martindale and Lt Gen David A. Deptula made one of the most cogently argued cases for a conditions-based approach to identifying the need for a separate space service.[1] They identified five conditions that must be met before the creation of a separate Space Force is justified. Three of these conditions are fully or partially met—political will, a societal view of the US as a space power, and the demonstrated ability of space power to fulfill peacetime roles. However, the authors also identified two conditions that they argued remain unmet—the development of a general theory of space power and the demonstrated capability to produce direct

combat effects in and from space. This article will set a foundation to address the first concern by distilling three central space power principles from existing space power theories. It will also argue that the logic supporting the final condition is flawed and should not hinder the development of a space-focused service.

Fundamental Elements of Space Power

The outlines of a space power theory are necessary since at sea, in the air, and on land, there are theories of war that influence policy and form the paradigm for strategic thought in these domains. These theories influence national policy by generating a functional theory of war that allows for the accurate assessment of military strategies. The shape of that theory does not have to be consciously present in the mind of the policy maker or military strategist. However, without that paradigm, the coherent formulation of policy and strategy lacks structure and direction. A sound space power theory allows for the controlled development and application of military power in space. Absent a controlling theory, warfare in space is nothing more than a contest to see which side can destroy or disable more enemy space assets. While a straightforward military objective, it begs the question: to what end? The form and function of military forces are a means to achieve specific goals in support of political ends. Structuring military space doctrine and acquisition around simplistic poorly understood concepts of dominance or control is only the beginning of the evolution of understanding war in space.

Military theory is not static; it is continually evolving. A new theory, or a reinterpretation of an existing theory, arises whenever the strategies derived from accepted theory fail the test of war or are challenged by the development of new technology. These new or reinterpreted theories form the basis of military strategy that attempt to apply theory to reality. Often, a supposedly new theory is nothing more than an old theory applied to new circumstances and technologies. Whether a new theory suited specifically to space is eventually formulated or an older theory is adapted to fit the newest war-fighting domain is unimportant. A coherent national military space strategy cannot exist without a broadly accepted theory of space power upon which to build upon or at least a set of guiding principles.

Before addressing the existing theories of space power, it is instructive to attempt to define the term itself. What is *space power*? There is no accepted definition of the term. Looking to US military doctrine for a description of space power seems the easiest and most straightforward way to determine a definitive *space power* definition. However, current US military doctrine does not include an independent definition of *space power*. The 2018 version of Joint Publication (JP) 3-14, *Space Operations*, includes *space power* in its glossary but lists "none, approved for removal from the DOD dictionary," as the definition.[2] No specific explanation

is given for its removal, but in *US Air Force Doctrine Document 1* (AFDD-1) a possible explanation appears. In AFDD-1, the term *airpower* is not used separately from space power but instead used as a single term—*air and space power*—throughout the document.[3] The USAF controls the bulk of US military space assets, and at the time AFDD-1 was written, there were the beginnings of a significant movement to separate space functions from those assets. Therefore, this mashup of domains was probably a misguided attempt to conflate them for organizational reasons, further harming the development of an independent and useful space power theory.

It is possible to find a definition of *space power* in earlier official documents. The 2009 version of JP 3-14 defines *space power* as "the total strength of a nation's capabilities to conduct and influence activities to, in, through, and from space to achieve its objectives."[4] This definition seems to be broad enough to capture all elements of space power—military and civilian— and is similar to other earlier definitions *of space power*. Writing in 1988, David Lupton developed one of the earliest theories of space power. He advocated a policy of space control through force and described *space power* as "the ability of a nation to exploit the space environment in pursuit of national goals and purposes and includes the entire astronautical capabilities of the nation."[5] This definition is broadly echoed by a later RAND study that defined *space power* as "the pursuit of national objectives through the medium of space and the use of space capabilities."[6] These definitions also support the concept that *space power* is more than just the military aspects of the domain; it also includes the commercial and political aspects of space working in concert to achieve some national goal.

These definitions seem almost too broad to serve as a basis for a working theory of *space power*. Rather than focusing on several quantifiable aspects of *space power* as the basis upon which to build a useful theory, they attempt to capture all aspects of power in space. Despite this, some theorists would still call these definitions too specific. In *Developing National Power in Space,* Brent D. Ziarnick criticizes definitions such as the one in JP 3-14 as "descriptions of unique cases of applied space power."[7] He argues instead for the broadest possible definition derived from Brig Gen William Mitchell's description of *airpower* as "the ability to do something in the air." It becomes a definition of *space power* that simply replaces *air* with *space*.[8] In so doing, Ziarnick establishes the broadest possible definition and one that is elegant in its simplicity. What it lacks is a tie back to why space is relevant to military forces that allows for the construction of a useful contemporary military theory. The ability to accomplish things in space has little relevance unless those things support national objectives. Moreover, because national objectives are so

often tied to where people live—on land, or at least on Earth—that is where the impact of space power must be measured to gain traction with a larger audience.

Alfred Thayer Mahan is an example of a military theorist who made a previously difficult to quantify military domain suddenly relevant. In his book, *The Influence of Sea Power upon History,* Mahan argued that the contribution of mastery of the sea to victory in warfare was severely underappreciated. He cleverly used a quote from George Washington to make his central point, "no land force can act decisively unless accompanied by a maritime superiority."[9] By demonstrating how actions at sea lead to success on land, Mahan allowed his readers to grasp the fundamental importance of sea power to nations. This seemingly simple realization, not entirely novel, as demonstrated by Washington's quote from a century earlier, forms the core of Mahan's theory. When supported by historical examples and fleshed out into a more comprehensive analysis, its impact was enormous.

While Mahan's target audience was American, he had a global impact that shaped history. German Kaiser Wilhelm stated that "I am… not reading but devouring Captain Mahan's book... it is on board all of my ships and constantly quoted by all of my captains and officers."[10] Germany and the other great nations latched onto Mahan's theory of sea power, and a naval arms race commenced between Britain and Germany in the years leading up to World War I. The suboptimal naval arms race that ensued and the larger build-up leading to World War I has become the subject of international relations research ever since.[11] The outsize influence that Mahan's book had demonstrates the impact that a military theory can have as a paradigm upon which nations build strategy and policy.

Developing a theory of space power is made doubly difficult because, unlike the sea, space is an untested domain. Humanity lacks any empirical evidence on the nature of conflict within it. Of course, this is a condition worth preserving, but it does prevent any space power theory from gaining traction from historical examples as Mahan's did. This lack of domain-specific evidence leads would-be-Mahans to attempt to adapt existing theories of war to space. The most popular domains from which to adopt theories are the existing fluid domains, sea and air. Theories of sea power are particularly attractive as they revolve around actions in one domain indirectly influencing action in another. This interaction contrasts with most airpower theories as they focus on the benefits of direct application of kinetic effects from the air to contribute decisively to victory on the land or at sea. One of the more successful applications of an existing theory was John Klein's effort to adapt sea power theorist Julian Corbett's work to space.

Corbett was a near contemporary with Mahan, and his principal work of military theory, *Some Principles of Maritime Strategy*, was published just 20 years after Mahan's in 1911. While Mahan's thinking was an adaption of earlier work by one

of Napoleon's generals, Antoine-Henri Jomini, Corbett's treatise on sea power was an adaption of the more nuanced work of the Prussian Gen Carl von Clausewitz to the sea. The central point of Corbett's theory of sea power argued that the "object of naval warfare is to control maritime communications."[12] This theory contrasted with Mahan's theory of sea power in that it strongly supported the construction of vessels adapted for the pursuit of commerce such as cruisers as well as a battlefleet, whereas Mahan argued that attempts to disrupt commerce were at best secondary to the construction of a battle fleet.[13] Klein adapted Corbett's central theory of sea power to space by modifying it to argue that "command of space entails the ability to ensure access and use of celestial lines of communications when needed to support the instruments of national power—diplomatic, economic, information, and military."[14]

Klein's theory argues for more than the control of space, rather he argues for the subtler concept, "command of space."[15] The command of space is achieved through presence, coercion, and force. The concept of presence highlights the fact that nations that have few or no assets in space have little influence on the domain. The degree of a nation's space presence allows it to shape international treaties, regulations, and customary practice. Today, the US has by far the largest space presence. Therefore, its actions and behavior set the baseline for other nations for better or worse. The second piece in achieving command of space is coercion. Coercion "occurs short of open hostilities but may be the result of the implicit or explicit threat of detrimental action."[16] Presence in space is a prerequisite for coercion and impacts the degree to which a nation can employ it. Coercion in space may take on diplomatic, economic, or informational forms. Coercion through diplomatic means comes in the form of international agreements and other forms of norm establishing. Economic coercion can involve denying launch services, satellite construction services, or vital space technology to another nation. Informational coercion relies upon the use of space-based communications to transmit a viewpoint in opposition to a state's adversary. The US transmission of the Voice of America (VOA) broadcast into Iran using satellites is an example of informational coercion. This method of coercion is seen as disruptive enough that Iran actively jams satellites carrying VOA broadcasts.[17]

According to Klein, the final aspect of the command of space is command through force. Command through force usually only occurs when a state of open conflict exists between two nations. Returning to the core argument of Klein's work, command through force is achieved by ensuring one's own celestial lines of communication while denying those same lines to the enemy. Since the primary value of space lies in its usefulness for transmitting and gathering information, it is the ability to preserve access to information or to deny it to an opponent that

provides command through force. Klein's core concepts are sound though his Corbett-derived celestial line of communications approach is just one method for describing space power.

Building upon his definition of *space power* discussed earlier, Ziarnick's work mentioned above attempts to create a structure for space power theory that echoes JFC Fuller's theoretical work in detail and scope. He borrows from Clausewitz's famous work *On War* the concept that space, like war, must have logic and grammar. He argues that space may have its own grammar but not its own logic. The specific grammar in his theory is a modification of Mahan's assertion that the basis of sea power lies in commerce, bases, and ships. He modifies this into a grammar for space power, the basis of which lies in production, shipping, and colonies centered on access. Ziarnick develops this theory further with a logic that relies on economic, military, and political power. Ziarnick's theory is complex and well-developed, but it suffers from being too anticipatory to truly be useful today, though it may very well stand the test of time. Much as Jomini dominated 19th-century thinking while his contemporary Clausewitz's work suffered from anonymity, Ziarnick's work will probably age well as military and commercial space activities expand beyond Earth's orbit.

Among the most recent publications dedicated to the formulation of comprehensive space strategy is the aptly named *Space Strategy* by Jean-Luc Lefebvre that was only recently translated into English. To Lefebvre, the key to space power is "acquiring the human and technical resources to increase one's freedom of action, while aiming to reduce an opponent's."[18] Toward this end, he identifies 12 principles of space warfare broken into three categories that he labels preliminary, cardinal, and complementary. The preliminary principles center on space situational awareness, investment, public engagement, and training.[19] The cardinal principles include ensuring technical and physical access to space, avoiding the generation of orbital debris, and stealth. Finally, his complementary principles are to: take advantage of the physical geography of space, promote and protect non-physical lines of communication, promote resilience, and ensure effects are designed to influence events on Earth. Lefebvre's language and descriptions are awkward and often esoteric, but the essential elements of a valid space power theory are present if poorly developed.

Former Air Force officer and National Aeronautics and Space Administration engineer Jim Oberg proposed a more conventional space power theory than Ziarnick or Lefebvre. He describes *space power* as including all aspects of civil, commercial and military space activity.[20] The primary characteristic of space systems in Oberg's theory is their ability to view the world from orbit. This characteristic enables the most strategically relevant aspect of these space assets that is their

ability to transfer and gather information.[21] Moreover, since the commercial industry controls the vast majority of systems on orbit, it will be commercial platforms that transmit and gather the majority of information. Being the primary source of most information means that "it will be the commercial manufacturers, owners, operators, and users who will contribute the larger, if less clearly perceptible, aspects of space power."[22] Oberg cites the influence of the commercial industry as the largest complicating factor in determining a clear formula for developing a comprehensive theory of space power.

Further, Oberg argues that as commercial entities become increasingly internationalized and so available for purchase by anyone "that a common level of space support will soon be available to citizens of all nations, including their armies."[23] Since the time of his writing in 1999, this objective has largely been achieved. The level of detail and ease of availability of commercial imagery from tools like Google Earth and the ubiquitous embedding of the Global Positioning System in commercial devices brings a degree of space support to the average individual that even the US military was incapable of providing little more than a decade ago.

There are several additional tenets of Oberg's theory of space power that are worth considering. First, Oberg cautions that space power by itself "is insufficient to control the outcome of terrestrial conflict or ensure the attainment of terrestrial political objectives."[24] Oberg makes this point explicitly to avoid the mistakes made by early airpower theorists who consistently overpromised and underdelivered. In Oberg's opinion, the control of space is only important in relation to its ability to influence events on Earth. This is something that it can only do when working in conjunction with other elements of national power and only when a nation has adequate control of space.

This need for control leads to another tenet of Oberg's theory, that "control of space is the linchpin upon which a nation's space power depends."[25] Unlike Lupton's theory of space power mentioned earlier that argued for control of space "through the destruction of the enemy's space forces," Oberg takes a broader view.[26] Oberg argues that space control and, therefore, space power will accrue to the nation with the largest space presence. This again reinforces the importance of commercial systems since they increasingly represent the majority of systems on orbit. The nation with the most significant commercial space industrial base will have the largest presence on orbit and as a result, the greatest degree of space control and space power. The commercial aspect of space power emphasized by Oberg does not mean that military strategy is irrelevant in space; the objective remains preserving your own information flow while disrupting an opponent's information flow when necessary. It does mean that since the majority of information will flow over commercial satellites, any military strategy involving space

must account for their presence. In the end, even with its more commercial focus, Oberg's theory has much in common with Klein's theory of space power.

Both Oberg's and Klein's theories of space power place the primacy of information at the core of their theories, and its importance is highlighted in Lefebvre's theory. Both Oberg's and Klein's theories also develop the idea that the degree of presence in space is a large part of what gives a nation power and control over it. Oberg draws the connection between on-orbit presence and commercial systems explicitly while Klein only hints at it in his work. These theories also share the idea that actions in space are dependent on and in support of other war-fighting domains. The degree of agreement between the two theories points to several ideas that, taken together, form an adequate foundation for a functioning theory of space power:

- Space power is directly proportional to a nation's presence in space.
- The strategic value of space in our current era lies in the ability to transfer information through it and to gather information from it.
- Space is a supporting domain that is only relevant to the degree that it influences terrestrial events.
- These three core principles have varied implications for the development of an independent Space Force and the future of US space power.

The most obvious application of the first of these principles is that it provides a direct and simple method for measuring the relative space power of the US. Currently, the US has the largest presence on orbit with more than 800 military and commercial satellites active on orbit today, more than twice as many as China and Russia combined.[27] With the advent of small satellite constellations, that number is set to rapidly expand in the next decade. While these satellites will be individually smaller and less capable than most existing satellites, their collective capabilities far exceed those of any existing individual satellite. Concerns that the large number of satellites present in constellations can skew calculations of space presence and so are not valid proxies for space power are challenged by the technical achievement they represent. Satellite constellations signal that a nation has the necessary industrial base to mass produce satellites and access to a launch infrastructure that makes putting them in orbit economically feasible. Having this necessary base demonstrates that other factors that could also be used to measure relative space power, such as the number of launches or expenditures on space related programs, are largely supporting measures that are relevant only to the degree that they assist in achieving the end state of space presence.[28]

Using presence as a method of measuring relative space power is useful, though a more important question is why presence equates to power and how it can be applied. Space presence allows a nation to shape regulations and customary practice in orbit largely independent of other measures of national power. For example, Russia has an economy that is equivalent to South Korea's economy, but Russia's extensive space presence makes its actions and behavior in space a matter of ongoing global concern. In contrast, South Korea's limited space presence makes it a bit player in space policy.[29] The US has successfully leveraged its space presence to establish norms for the mitigation of debris on orbit and the sharing of tracking data on space objects among more than 67 nations and organizations.[30] This has established the nucleus of a shared international tracking network and established standards for notifications and messages. Domestic US regulations on debris mitigation in space have also served to establish the baseline for international organizations.[31] Even the international organization that serves as a forum for establishing space debris guidelines—the Inter-Agency Space Debris Coordination Committee—exists as the result of US leadership.[32] These examples demonstrate how a national space presence creates a need for regulations and norms that, in turn, set global standards that reinforce a nation's space power. The US has failed to effectively use its dominant presence in space through pushing beyond basic regulations and toward the creation of international treaties governing behavior in space that conform with its national objectives.

Since the end of the Cold War era, the US has actively opposed the creation of additional space-related treaties. Most notably, the US has resisted the Chinese and Russian-supported "Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects" (PPWT). China and Russia have updated the PPWT several times in an effort to win more support, but the US has consistently opposed these efforts. Calling the original version of the treaty and subsequent updates as "fundamentally flawed," US officials argue that the treaty lacks an adequate verification mechanism as well as any restrictions on ground-based antisatellite weapons.[33] According to the US representative to the Geneva-based Conference on Disarmament, these shortcomings in the PPWT mean that a nation "could develop a readily deployable space-based weapons break-out capability" shortly after withdrawing from the treaty.[34] This US resistance has not stopped China from continuing to push for a treaty designed to prevent an arms race in space. In 2018, China's assistant foreign minister again called for a joint international effort to prevent an arms race in outer space.[35]

Whether the PPWT is a diplomatic effort by Russia and China to gain military advantage or a genuine effort to avoid an arms race in space is impossible to

judge due to the lack of meaningful US counterproposals. A US counterproposal on arms control in space would test the sincerity of Russia and China to embrace arms control. Absent this proposal, the US is largely abandoning the diplomatic element of national power in space that is a consequence of its dominant space presence. Instead, the US is focused on the military and economic elements of components of space power. Recognition that space power has both hard and soft aspects is key to understanding the first foundational principle of space power articulated above and a key future role for any space-centered force.

The second foundational principle focuses on the primacy of space as an information-centric domain. It is the US military's unparalleled ability to transmit, gather, and leverage information that makes it the world's preeminent war-fighting force. Without it, US forces are severely handicapped at all levels to a degree that is not readily apparent. For the most part, the space linkages in US military systems are invisible to the user and so go underappreciated. Not so for potential US opponents. It is their recognition that US war-fighting capabilities are dependent on space systems that has spurred the current redefining of space as a war-fighting domain. No doubt the primary task for current and future space forces will be to develop methods for preserving these critical information nodes and links in the face of adversary interference or attack to preserve the US information advantage.

The third foundational principle, that space is a supporting domain, stems from the information-centric nature of military space described in the second principle.[36] Space is an enabling domain for terrestrial military operations. Actions that take place in space are relevant only to the degree that they impact events on Earth. Since it is information-centric, it makes little sense for military action in space to occur independent of terrestrial conflict. The destruction of an opponent's space assets while preserving your own is meaningless if the advantage that the resulting information dominance provides does not result in a desirable political outcome on Earth. Absent any other military action that capitalizes on the destruction of an opponent's space assets, no meaningful direct advantage has been gained by the attacker. Accepting the second principle, that the military utility of space is information-centric, inevitably leads to the conclusion that space remains primarily a supporting domain, albeit one where actions on the ground can also support its mission of preserving the advantages of information dominance.

Reframing the Contribution to Victory

While recognition that space is an information-centric domain that supports terrestrial war fighting provides clarity of military purpose, it also creates difficulties for a separate Space Force. Martindale and Deptula's final unmet condition

for a separate service—that it demonstrate the capability to produce direct combat effects in and from space—is based on the idea that airpower needed to demonstrate that direct combat effects in and from the air "significantly contributed to victory" in World War II.[37] Martindale and Deptula are not alone in hinging their argument against a separate Space Force on this point. This same line of argument is one of the fundamental points that the Air Force Association makes against a separate Space Force.[38] Their objections are understandable. The inability of current space forces to create direct combat effects harkens back to the earliest days of airpower when aircraft were only used for reconnaissance and seen as little more than toys. It was only after aircraft demonstrated that direct combat effects delivered from the air could directly contribute to victory that arguments for a separate Air Force gained traction. Relying on this paradigm for service creation, the opponents of a separate Space Force have a valid point. The difference is that modern military dominance is now nearly synonymous with information dominance, not only straightforward kinetic effects.

Information has always been vital to success in warfare. Accurate knowledge of the disposition of an opponent's forces has always been critical to a commander's ability to bring kinetic effects to the desired location in pursuit of victory. What has changed is that in modern warfare the true challenge is no longer placing a kinetic effect on a specific location; rather, it is determining the correct location to place the kinetic effect. Without space-enabled information, effective targeting on the modern battlefield is not impossible, just very difficult. Space might not directly create kinetic effects on the ground, but it does directly contribute to victory. If kinetic effects are no longer the only way to provide a critical contribution to victory, perhaps the metric that opponents of a Space Force are relying on is just misinterpreted.

The specific arguments that Martindale and Deptula make in support of establishing kinetic effects as a prerequisite for a separate service can be deconstructed into two pieces. The first is implicit, that a separate service must operate in a defined domain. The second part of the arguments is that a separate service must provide a key contribution to victory from that domain. Space clearly meets the first condition and has arguably achieved the second condition as well. Using this reframed version of their fifth condition as the case against a separate Space Force looks much weaker. In fact, using an information-centric approach to contribute to victory as a precondition for a separate service also supports the case for an independent Cyber Force as well, especially given the vital linkages between cyber dominance and the effective distribution of information gathered or transmitted by space systems. Establishing the principle that a service can significantly contribute to victory by gathering and distributing information that enable kinetic

effects rather than delivering kinetic effects directly is the core idea that must be understood for a Space Force to gain equal footing with the other services.

Conclusion

There are valid arguments for and against the creation of a separate Space Force that must be addressed even as the new force is in the process of creation. The two unmet conditions identified by Martindale and Deptula are representative of these arguments. Their concerns are also much closer to being met than it first appears. The first unmet condition—the lack of a general—theory of space power is edging closer to fulfillment. The reality is that an accepted and comprehensive space power theory is impossible given the paucity of real-world experience of conflict in space, though foundational principles discussed here provide a simple baseline for understanding the military utility of space in our current era. The second unmet condition—the inability to produce direct combat effects in and from space—is possible to reframe based on the fundamental logic that led to the development of the condition. Once reframed as the ability to materially contribute to victory, the case for a separate Space Force becomes much stronger. In a future where the degree of information dominance will determine victory or defeat, the contribution of information-centric domains must be taken as seriously as those that focus on providing kinetic effects. This is true even if information-centric domains remain in support of those domains that can provide kinetic effects. Recognition of this difference will allow a future Space Force to stand on even footing with its more traditionally kinetic peers. ✪

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Notes

1. Lt Col Michael Martindale and Lt Gen David A. Deptula, "Organizing Spacepower: Conditions for Creating a US Space Force," Mitchell Institute Policy Paper 16, August 2018, http://docs.wixstatic.com/.
2. Joint Publication (JP) 3-14, *Space Operations*, 10 April 2018, GL-6, https://www.jcs.mil/.
3. Curtis E. LeMay Center for Doctrine Development and Education, Air Force Doctrine, Vol. 1, chap. 3, https://www.doctrine.af.mil/.
4. JP 3-14, *Space Operations*, GL-9.
5. David E. Lupton, *On Space Warfare* (Maxwell AFB, AL: Air University Press, 1988), 7.
6. Dana J. Johnson, Scott Pace, and C. Bryan Gabbard, *Space: Emerging Options for National Power* (Santa Monica, CA: Rand Corporation, 1998), xi.

7. Brent D. Ziarnick, *Developing National Power in Space: A Theoretical Model* (Jefferson, NC: McFarland, 2015), pt. 239.

8. Ziarnick, pt. 209.

9. Mahan Alfred Thayer, *The Influence of Sea Power Upon History 1660–1783* (New York: Dover Publications, 1987), 400.

10. Quoted in Peter J. Hugill, "German Great-Power Relations in the Pages of 'Simpicissimu,' 1896–1914," *Geographical Review* 98, no. 1 (2008): 2.

11. Charles L. Glaser, *Rational Theory of International Politics* (Princeton University Press, 2010), 238–43.

12. Julian S. Corbett, *Some Principles of Maritime Strategy* (The Perfect Library, 2016), 81.

13. Thayer, *Influence of Sea Power Upon History*, 589.

14. John J. Klein, *Space Warfare: Strategy, Principles, and Policy*, 1st ed. (London, New York: Routledge, 2006), 60.

15. Klein, 60.

16. Klein, 63.

17. "Iran Jams VOA's Satellite Broadcasts," *Voice of America News*, 5 October 2012, https://www.voanews.com/.

18. Jean-Luc Lefebvre, *Space Strategy* (Hoboken, NJ: John Wiley & Sons, 2017), 214.

19. The terms used here to summarize Lefebvre's are not literal from his work but rather the author's summary to remain concise. For instance, rather than simply using the term *engagement*, Lefebvre says: "elicit a sense of wonder turned toward the stars."

20. James E. Oberg, *Space Power Theory* (Colorado Springs, CO: US Air Force Academy Government Printing Office, 1999), 125.

21. Oberg, 125.

22. Oberg, 125.

23. Oberg, 126.

24. Oberg, 127.

25. Oberg, 130.

26. Lupton, *On Space Warfare*, 118.

27. "UCS Satellite Database," Union of Concerned Scientists, accessed 26 July 2018, https://www.ucsusa.org/.

28. An argument can be made that the supporting aspects of space presence such as ground and launch infrastructure/capability are direct rather than supporting measures of space presence. However, these are supporting measures only. For example, a nation with hundreds of ground stations but no satellites on orbit is irrelevant in the space domain and could not be described as having a space presence while a nation with hundreds of satellites, but only one or two ground stations, has a large space presence. It might be militarily vulnerable to losing access to its space assets, but it still has a large space presence.

29. "GDP Ranking Data Catalog," World Bank Group, accessed 4 May 2019, https://datacatalog.worldbank.org/.

30. Crosier Clinton, "United States Strategic Command Space Situational Awareness Sharing Program Update," 3 February 2016.

31. Inter-Agency Space Debris Coordination Committee, "IADC Space Debris Mitigation Guidelines," September 2007, http://www.unoosa.org/.

32. George M. Levin and Walter Flury, "Inter-Agency Space Debris Coordination Committee (IADC)," February 1997.

33. Jeff Foust, "U.S. Dismisses Space Weapons Treaty Proposal As 'Fundamentally Flawed,'" *Space News*, 11 September 2014, https://spacenews.com/.

34. Foust, "U.S. Dismisses Space Weapons Treaty Proposal."

35. "China Calls for Int'l Efforts to Prevent Arms Race in Outer Space," *XinhuaNet*, 5 July 2018, http://www.xinhuanet.com/.

36. The term *supporting* is used in a doctrinal manner and not to denigrate the importance of the space domain. It may in fact be a center of gravity in Clausewitzian terms as a "hub on which all power and movement depend."

37. Martindale and Deptula, "Organizing Spacepower," 3.

38. Air Force Association, "AFA Position on the Proposed Establishment of a Space Force," 10 April 2019, https://www.afa.org/.