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**Corbet, Mahan, Douhet?:
Old Theories For A New Model Of Space Superiority**

By

Ramsey Horn

Lieutenant Colonel, United States Space Force

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**CORBET, MAHAN, DOUHET?:
OLD THEORIES FOR A NEW MODEL OF SPACE SUPERIORITY**

by Ramsey M. Horn

Lieutenant Colonel, United States Space Force

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 present-day precision reconnaissance-strike complex upon which U.S. military operations have become dependent hinges on freedom of action gained through access to integrated space-based capabilities across the joint force. However, the U.S. risks losing control of the space domain as potential adversaries seek to counter the U.S. advantage. In response to the demonstrated threat from potential adversaries to hold at risk U.S. freedom of action in space, the U.S. initiated a years-long campaign in 2019 to re-organize and equip its space forces to preserve U.S. space superiority. Furthermore, the newly created U.S. Space Force has endeavored in the process of drafting and publishing service doctrine focused on competing and winning conflicts in space.

Spacepower, the Space Force's inaugural doctrine publication, presents a definition for space superiority but defers the development of a model for the construct to a future publication. This thesis examines the current Joint and Air Force model for space superiority and challenges its applicability to the current strategic and operational space environment. An analysis of air, maritime, and space theorists' proposals on command, control, and superiority in the commons highlights the limitations in the current space superiority model. The same analysis is then adapted to develop a new space superiority framework to address the current model's limitations. This thesis proposes the Model for the Command and Control of Space to enable Joint Force Commander decision making and risk mitigation with competing and fighting within the space domain.

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Chapter 1: Introduction

“I’m convinced that in the future, if we were to get into a conflict with a peer or near-peer competitor, we’re going to have to fight for space superiority. That’s a joint warfighting challenge.”¹
– Gen John “Jay” Raymond, Commander U.S. Space Command

Space-based capabilities fuel the American way of life and the American way of war and are dependent on continued U.S. freedom of action in space. However, the U.S. risks losing control of the space domain as potential adversaries seek to counter the U.S. advantage. Increased development and deployment of threat systems by near-peer competitors, coupled with increased aggressive actions within the domain, threaten the very foundation of American prosperity and military might. Freedom of action in space directly enables freedom of action in all other domains and the employment of all instruments of power while supporting decision-making from the strategic to tactical levels. Any loss in freedom of action in the space domain not only erodes U.S. military advantage but erodes U.S. advantage across all instruments of power.

The 1991 Gulf War, widely touted as the first space-enabled war, ushered in the modern American way of war. For the first time in conflict, the integration of space capabilities extended beyond strategic application to enable freedom of action at the operational and tactical levels. Through improved command and control, navigation and timing, intelligence collection, indications and warning, space capabilities enabled U.S. forces to gain marked advantage and swiftly defeat Iraqi forces. The successful integration, though fledgling, demonstrated the potential of space capabilities to bolster future force lethality by enhancing freedom of action across all domains.² The present-day space-enabled precision reconnaissance-strike complex, upon which U.S. military

¹ Kathleen H Hicks. “A Conversation with General Raymond.” *Center for Strategic & International Studies*, November 18, 2019. <https://www.csis.org/analysis/conversation-general-raymond>.

² Michael Sheehan, *The International Politics of Space*. (New York, NY: Routledge, 2007), 98.

operations have become dependent, was born from the lessons learned in the Gulf War.³ The integration of space capabilities today is now so ubiquitous within U.S. military operations that General Jay Raymond, as Commander, United States Space Command (USSPACECOM) professed, “there is nothing that we do as a joint and coalition force that is not enabled by space.”⁴

Freedom of action in space is central to enabling freedom of action across the joint force in all domains. However, the demonstrated threat from potential adversaries to hold at risk U.S. freedom of action in space threatens America’s way of war. A new model for the control of space is required to address limitations within the current space superiority model. The new model is necessary to provide the framework to better describe current or desired conditions within the operational environment. Conditions within the model are measured against friendly and adversary relative levels of freedom of action, as varying levels of control are obtained within the dimensions of time and space. By setting operational objectives to gain or maintain desired conditions within the new space superiority model, the Joint Force will be creating a level of space security critical to protecting and expanding U.S. national security interests.

The application of space-based effects goes far beyond military necessity. Advancements in, and integration of, space capabilities have afforded the U.S. and international community opportunities to bolster prosperity and quality of life. The social and economic fabrics of modern society have space-based services woven throughout

³ Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton, NJ: Princeton University Press, 2006), 133.

⁴ Gen John Raymond, *Media Roundtable with U.S. Space Command Commander Gen John Raymond*, August 29, 2019, transcript, <https://www.defense.gov/Newsroom/Transcripts/Transcript/Article/1949346/media-roundtable-with-us-space-command-commander-gen-john-raymond/>.

them. For example, a modern smartphone enables the average user to access precise navigation and timing capabilities, instantly execute banking transactions, access detailed geospatial imagery, and communicate globally, all powered by space-based services. Some space-based services are so entwined into daily American life and economic activities that users take for granted the service's impact. For many, the Global Positioning System (GPS) is simply a capability built into the map function of their smartphone that shows their current location and how to get from point A to B. However, GPS's timing and navigation service is a crucial multiplier for industries, such as finance, utilities, agriculture, telecommunications, and shipping.⁵ Current estimates put GPS's economic impact at \$1.4 trillion since 1983, 90 percent of which accrued in the past decade.⁶

The U.S. Chamber of Commerce estimates the U.S. space economy will grow drastically over the next 20 years, from current revenues of \$385 billion in 2019 to an estimated \$1.5 trillion by 2040, equating to five percent of U.S. Gross Domestic Product.⁷ Companies such as SpaceX, Amazon, OneWeb, and Planet Labs seek to blanket the Earth with mega-constellations of satellites, some numbering up to 12,000, to deliver globally accessible low-cost internet and imagery from space.⁸ Globally, 88

⁵ David Logsdon, "A Day Without Space," SpaceNews Magazine, last modified June 6, 2016. <http://www.spacenewsmag.com/commentary/a-day-without-space/>.

⁶ Alan C. O'Connor, Michael P. Gallaher, et al., *Economic Benefits of the Global Positioning System (GPS)*. (Research Triangle Park, NC: RTI International, June 2019), ES-1. 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.

⁷ Brian Higginbotham, "The Space Economy: An Industry Takes Off," Above the Fold, U.S. Chamber of Commerce, last modified October 11, 2018, <https://www.uschamber.com/series/above-the-fold/the-space-economy-industry-takes>.

⁸ Jonathan O'Callaghan, "The Mega Constellations Are Already Here. The Time For Polite Concern is Over," *Forbes*, last modified August 28, 2020, <https://www.forbes.com/sites/jonathanocallaghan/2020/08/28/the-mega-constellations-are-already-here-the-time-for-polite-concern-is-over/#6f079ef53b87>.

nations and international consortiums possess functioning satellites operated by national and commercial entities.⁹ The space domain is no longer the realm of the world's great powers but has become a global economic common warranting protection.

The growing interdependence of U.S. military and economic strength on space-based capabilities has led U.S. national leadership to recognize the importance of protecting unfettered access to space. Unimpeded access to, and the freedom of action within, space was first declared a vital national interest by President Bill Clinton in his 1997 National Security Strategy.¹⁰ Every president since has continued to restate this declaration in either a national strategy or space policy document.¹¹ President Donald Trump took the declaration a step further in his 2017 National Security Strategy, declaring any attempt to attack a component of the U.S. space architecture “will be met with a deliberate response at a time, place, manner, and domain of our choosing.”¹² This statement draws from a growing realization that space is no longer a benign domain, free from conflict. Over the past three decades, potential adversaries have actively sought to counter the ever-increasing U.S. advantage in space and exploit the dependency. These strategic competitors' actions have significantly increased the likelihood of conflict and war beginning in, extending to, or executing through the space domain.¹³

Intelligence estimates conclude U.S. adversaries and strategic competitors follow

⁹ “Satellites by Country or Organization,” N2YO, accessed December 18, 2020. <https://www.n2yo.com/satellites/?c=&t=country>.

¹⁰ U.S. President, *A National Security Strategy for a New Century*. (Washington, DC: The White House, May 1997), 12.

¹¹ National Security Presidential Directive-49, *U.S. National Space Policy*, (Washington, D.C.: White House, August 31, 2006), 1-2; Office of the President, *National Space Policy of the United States of America* (Washington, DC: White House, June 28, 2010), 7.

¹² U.S. President, *National Security Strategy*. (Washington D.C.: White House, December 18, 2017), 31.

¹³ U.S. Space Force, *Space Capstone Publication: Spacepower*, June 2020, iv.

the same path as the U.S., becoming ever more reliant on space-based capabilities to fuel their military strength and economic growth. Furthermore, China and Russia are developing, testing, and fielding new anti-satellite (ASAT) weapons to hold U.S. and allied space systems at risk.¹⁴ In 1999, two Colonels of the Chinese People’s Liberation Army proposed a strategy in their book, *Unrestricted Warfare*, to counter the United States’ space-enabled dominance. The book’s authors contend, “the first rule of unrestricted warfare is that there are no rules, with nothing forbidden.”¹⁵ As of this writing, Beijing has tested and fielded direct ascent ASAT missiles and kinetic kill vehicles in low earth and geosynchronous orbits. Furthermore, China has demonstrated rendezvous and proximity operations with potential co-orbital ASAT test-beds and expanded its electronic warfare and directed energy counterspace arsenal.¹⁶

Under President Putin, the Kremlin has sought to bolster its regional power and limit the United States’ ability to impede Russian freedom of action by developing counterspace capabilities, similar to China’s.¹⁷ The Kremlin’s most recent display of intent to challenge U.S. preeminence in space occurred between January and July of 2020. Kosmos 2542, declared by the Kremlin to be an inspector satellite, released the Kosmos 2543 small satellite. This satellite proceeded to actively stalk and approach

¹⁴ Director, National Intelligence, *Worldwide Threat Assessment of the US Intelligence Community*, (Washington, D.C.: Director of National Intelligence, January 29, 2019), 16-17. ASAT weapons are designed to incapacitate or destroy satellites. A range of weapons fall within this broad category. Examples of ASATs include, but are not limited to: Earth-to-Space missiles deploying kinetic-kill vehicles, satellites designed to kinetically impact another satellite, satellites designed to mechanically interfere with another satellite, satellites designed to electronically interfere with another satellite, and directed energy weapons such as high powered microwaves and lasers.

¹⁵ Qiao Liang and Xiangsui Wang, *Unrestricted Warfare*, (Beijing: PLA Literature and Arts Publishing House, February 1999), 2.

¹⁶ Brian Weeden and Victoria Samson, *Global Counterspace Capabilities: An Open Source Assessment* (Secure World Foundation, June 2019), 1-1 – 1-24.
https://swfound.org/media/206970/swf_counterspace2020_electronic_final.pdf.

¹⁷ Weeden and Samson, *Global Counterspace Capabilities*, 2-1.

within 150 kilometers of a United States reconnaissance satellite.¹⁸ Following six months of cat and mouse tactics, Kosmos 2543 broke contact with the U.S. reconnaissance satellite. However, 2543's demonstration was not complete. In July 2020, Russia conducted what USSPACECOM assessed to be an on-orbit ASAT test when Kosmos 2543 released a kinetic-kill projectile.¹⁹ While U.S. officials did not disclose any impacts specific to the reconnaissance satellite, any unplanned large maneuver to avoid a threat has the potential to temporarily degrade a satellite's ability to fulfill mission requirements. Continued belligerent acts by Beijing and the Kremlin in space leave little doubt in the minds of U.S. leadership that American national interests in space are at risk, as evidenced by the establishment of the U.S. Space Command and the U.S. Space Force in 2019.

The Trump Administration established the U.S. Space Force to “ensure unfettered access to, and freedom to operate in space and to provide vital capabilities to joint and coalition forces in peacetime and across the spectrum of conflict.”²⁰ The fledgling service published its inaugural Space Capstone Publication, *Spacepower*, was published as the service's first independent doctrine. Within the document, the Space Force defines space superiority as “the relative degree of control in space of one force over another that would permit the conduct of its operations without prohibitive interference from the adversary while simultaneously denying their opponent freedom of action in the domain at the same time.”²¹ This definition is similar to definitions currently codified within Joint

¹⁸ Ibid., 2-8

¹⁹ Sandra Erwin, “U.S. Space Command Again Condemns Russia for Anti-Satellite Weapon Test,” *SpaceNews*, July 23, 2020. <https://spacenews.com/u-s-space-command-again-condemns-russia-for-anti-satellite-weapon-test/>.

²⁰ Donald Trump, Space Policy Directive-4, “Establishment of the United States Space Force,” *Presidential Memoranda* (February 19, 2019).

²¹ U.S. Space Force. *Space Capstone Publication: Spacepower*. June 2020, 30.

Publication 3-14, *Space Operations*, and Air Force Doctrine Annex 3-14, *Counterspace Operations*. While the definition remains valid, the existing space superiority model, built around the “Control of the Air Continuum,” is not sufficiently nuanced to describe the levels of control necessary in space to produce the desired freedom of action across the competition continuum.

Now is the opportune moment to challenge existing spacepower paradigms, as the Space Force deferred codifying a new space superiority model to a future operations focused Space Capstone Publication. Within a benign space environment, space superiority assumed the U.S. had control of space. This assumption resulted in a focus on space superiority as a space forces’ ability to deliver incomparable enabling combat effects to joint operations. However, the benign domain paradigm is challenged as competitors and potential adversaries shift the space domain’s character to one of continuous competition and potential conflict. Space forces must now establish control in the dimensions of time and space as a prerequisite to delivering the combat space effects upon which the U.S. Joint Force depends. The subsequent chapters build the case for and introduce the Model for the Command and Control of Space, designed to address the paradigm change in the space environment.

The concept of war extending to space is a novel concept for the Joint Warfighting community. The nature and character of war in the traditional warfighting domains of air, land, and sea are reasonably well understood. Chapter 2 baselines the reader on the key similarities and differences of warfare in space to the traditional warfighting domains. These characteristics serve as the foundational knowledge to comprehend the application of various war theory constructs to spacepower theory and

the subsequent control of space model analysis.

Chapter 3 explores the key tenants of spacepower and warfare theory to establish a framework for analyzing the existing and proposed models. Most theorists have relied heavily on strategic analogies to land, maritime, and air theory to develop their respective spacepower theories. Chapter 3 reviews the tenants from these theories related to establishing freedom of action in international commons. These tenants form the foundational framework for analyzing the control of space models.

Finally, Chapters 4 and 5 analyze the current space superiority model and the proposed Model for the Command and Control of Space, respectively. In addition to the analysis of the current model, Chapter 4 includes a brief overview of the Control of the Air Continuum to provide context for the origins of the existing space superiority model. Chapter 4 establishes arguments for why the current space superiority model is no longer sufficient for addressing the contemporary space domain. Chapter 5 introduces the Model for the Command and Control of Space Model, establishes definitions for new terminology, and makes recommendations for incorporation into future Space Force and Joint doctrine.

Chapter 2 – Nature & Character Of War In & Through Space

“The purpose of military power is to be prepared, and when called upon by the legitimate governing authority, to maximize violence within the constraints and limitations placed on it.”¹ – Dr. Everett Dolman

In his chronicle of the Peloponnesian War, Thucydides postulates that polities go to war based on an assessment of fear, honor, and interest.² Thucydides provided no distinct causation for war between the land and maritime domain, the two domains accessible for conflict in his time. As man has expanded access to new domains, such as air and cyberspace, Thucydides’ fear, honor, and interest continue to underpin sources of conflict between states as competition grows. Thucydides’ timeless axiom remains valid for the space domain.³ As states expand their interests within the realm, tie national honor and prestige to their space programs, and become increasingly dependent on the domain for economic and military might, the space domain, like all others, is postured to be a theater for conflict.

The Enduring Nature of War

As described by many warfare theorists, war’s enduring nature remains valid for wars beginning or extending into space. At its core, war is fundamentally political in nature, regardless of the domain. Warfare theorists across time echo the Prussian theorist Carl von Clausewitz’s axiom that war is an extension of policy by other means.⁴ Sun Tzu mused 2,300 years before Clausewitz that “war is a matter of vital importance to the state, the province of life and death.”⁵ While Clausewitz and Sun Tzu wrote on land

¹ Everett Carl Dolman, “Seeking Strategy” in *Strategy: Context and Adaptation from Archidamus to Airpower*, ed. Richard J. Bailey Jr., James W. Forsyth Jr., and Mark O. Yeisley. (Annapolis, MD: Naval Institute Press, 2016), 9.

² Robert B. Strassler, *The Landmark Thucydides: A Comprehensive Guide to the Peloponnesian War* (New York: Free Press, 1996), 43.

³ John J. Klein, *Understanding Space Strategy: The Art of War in Space* (New York, NY: Milton Park, 2019), 1.

⁴ Carl von Clausewitz, *On War*, trans. And eds. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1989), 81

⁵ Sun Tzu, *The Art of War*, trans. Samuel B. Griffith (Oxford: Oxford University Press, 1963), 63.

warfare theories, maritime theorist Sir Julian Corbett echoed their findings on the subjugation of war's object to politics. Corbett recognized that naval warfare, as with land warfare, is a form of political intercourse and a continuation of foreign politics.⁶

Airpower theorist Giulio Douhet challenged the understood character of war in his day due to the airplane's advent as a weapon of war. However, Douhet did not advocate that war's nature had changed due to war extending to a new domain.⁷ Consistency by theorists across the ages and warfighting domains on the political nature of war allows one to conclude that a war beginning within or extending to space must also be political in nature.⁸

The second dimension of war's enduring nature is the human or cognitive dimension. Clausewitz recognized that success in war ultimately resided within the faculties of the mind. Clausewitz assigned an entire element of the Paradoxical Trinity to the primordial passion, hate, and enmity associated with the people of a state.⁹ Furthermore, he defines war as "an act of force to compel our enemy to do our will."¹⁰ Within Clausewitz's maxim, human will is an intrinsically cognitive decision to select, or decide, among the various desires present. John Boyd's Observe, Orient, Decide and Act (OODA) Loop model builds upon the cognitive dimension of war. Boyd advocated that by implementing the model, one could get inside an opponent's decision cycle to gain an advantage. This model aligns with Clausewitz's theory on influencing an adversary's will and aligns with his concepts of military genius and *coup d'oeil*, or the ability to discern at

⁶ Julian Stafford Corbett, *Some Principles of Maritime Strategy* (Gloucestershire, United Kingdom: DoDo Press, 2011), 3-4.

⁷ Giulio Douhet, *The Command of the Air* (North Stratford, NH: Ayer Company Publishers, 2002), 7-10.

⁸ Klein, *Understanding Space Strategy*, 3.

⁹ Clausewitz, *On War*, 89.

¹⁰ *Ibid.*, 75.

a glance.¹¹

War in space is subject to the human, or cognitive, nature of war despite its extensive use of remotely operated and autonomous systems. The Space Force's *Spacepower* publication recognizes that this enduring quality extends to the space domain. Despite being remotely operated, space systems are not static systems; they are designed, employed, and exploited by thinking agents. The prevalence of remote operations amplifies the importance of the space domain's cognitive dimension. Though occurring in a physical environment, the effects of war in space are often interpreted through virtual stimuli.¹² This creates a requirement for belligerents engaging in the space domain to understand how to create conundrums for their adversaries within the cognitive space.

War being a human endeavor causes the injection of uncertainty and disorder into the conduct of war. The presence of uncertainty and disorder is the third element of war's enduring nature. Sun Tzu believed that creating a state of chaos for the enemy leads one's force to attaining the war's object.¹³ Clausewitz's notion of friction recognizes that even simple actions become difficult when executed in the context of war.¹⁴ War in space is no different. Minimal norms of behavior lead to uncertainty in strategic competitors' intent, not only in war, but also in day-to-day activities executed in support of a combatant commander's campaign plan. This principle is highlighted by the actions of Kosmos 2543, as the U.S. was unable to discern the Kremlin's intent due to a lack of

¹¹ Clausewitz, *On War*, 100.

¹² U.S. Space Force, *Spacepower*, 8.

¹³ Edward O'Dowd and Arthur Waldron, "Sun Tzu for Strategists," *Comparative Strategy* 10, no. 1 (1991): 27, <https://doi.org/10.1080/01495939108402828>.

¹⁴ Clausewitz, *On War*, 119.

internationally recognized norms related to rendezvous and proximity operations. Furthermore, the distances involved in space operations make the attribution of acts difficult in some circumstances. Uncertainty in attribution makes discernment of the true nature of anomalous system conditions difficult.

Arguably, the most challenging aspect of the nature of war as applied to space warfare is the application of violence. According to *Joint Publication 1*, war is socially sanctioned violence to achieve a political purpose.¹⁵ Modern warfare challenges the notion that violence is restricted to actions between humans. The proliferation of remotely operated weapons systems capable of violently accomplishing military objectives has occurred in every domain. Advancements in technology and access to new domains for warfare further challenges the notion of violence being an application of force.

Political scientist and Johns Hopkins Professor of Strategic Studies, Thomas Rid, proposes a framework for understanding the changing character of violence in modern warfare. His framework establishes four methods of violence: force, energy, agent, and code. Furthermore, Rid acknowledges that violence may occur against and between animate and inanimate targets alike.¹⁶ As in all domains, the purpose of violence in the space domain is to deny, degrade, disrupt, destroy, or deceive space systems. Through the employment of ASAT kinetic-kill systems, directed energy weapons, and cyber-attacks, space-based systems are susceptible to three of the four violence vectors Rid proposes, with agent being the exception. Ground-based personnel and systems architectures are

¹⁵ U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1. (July 12, 2017), ix.

¹⁶ Thomas Rid, *Cyber War Will Not Take Place* (New York, NY: Oxford University Press, 2013), 12-14.

susceptible to all four. Through Rid's definition of violence, it is evident that war in space will be subject to this aspect of war's enduring nature.

Space warfare shares the enduring nature of war with all other warfighting domains. Just as Clausewitz described war in his day, warfare in space is a violent clash of opposing wills. The adversary is not the inanimate space system but the belligerent's mind and will behind the space system. Space forces must be ready to outthink and outmaneuver a thinking adversary seeking to counter U.S. advantage in space.

The Character of Space Warfare

Fortunately, as defined by *Joint Publication 1, Doctrine for the Armed Forces of the United States*, war has yet to begin or extend to the space domain.¹⁷ Hostile acts have occurred between competitors but have remained non-kinetic and limited in nature.¹⁸ These engagements typically have had minimal impact on achieving the overarching military operational objective. The lack of a historical context for space warfare requires the assessment of space warfare's character to be grounded in understanding the physical environment of space, the technologies currently employed and in development, and theories developed for space warfare. The assessment that follows relies on five assumed characteristics of space warfare to assess space superiority models: the inherent multi-domain and joint character of space, the dominance of the offense, constrained to near-earth and cislunar orbits, limited in means, and ongoing competition.

Space operations are inherently multi-domain and joint endeavors. Space

¹⁷ U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Joint Publication 1, July 12, 2017, I-2 – I-5.

¹⁸ To date, no nation is known to have purposely targeted another nation's on-orbit space system with a kinetic attack. All kinetic engagements have been test and development events executed against the testing nation's own asset. Hostile actions between nations include targeting space assets include GPS jamming, SATCOM jamming, rendezvous and proximity operations intended to demonstrate potential hostile capability.

architecture segments span across the terrestrial, electromagnetic, cyberspace, and space domains. The most basic satellite operation originates at a ground station with a command executed through a purpose-built computer network. This command is broadcast through the electromagnetic spectrum to be received and processed by the satellite. Data received from the satellite follows the same path in reverse. A belligerent attempting to interfere with space capabilities may choose an attack vector within any one of these domains to achieve desired effects. Furthermore, space systems produce combat effects in every warfighting domain, including communications, intelligence, precision navigation, and targeting data. America's way of war is now intrinsically linked to its dominant space capabilities.¹⁹

The current deployment of military space technology and force disposition by the U.S. and strategic competitors will initially limit space warfare to near-earth orbits. Military space capabilities predominantly reside in the low-earth, medium-earth, highly elliptical, and geosynchronous orbits. However, as state interests expand beyond the utilization of near-earth orbits to provide services to extract resources from celestial bodies, the physical realm for potential conflict expands. The Space Force and NASA recently announced a partnership to increase domain awareness in cislunar space, the area beyond geosynchronous orbits that encompasses activities around the moon. The partnership is in response to a growing interest by the U.S. and rivals, such as China, to increase operations within that region for exploration and resource development.²⁰ The

¹⁹ Mahshie, Abraham. "Space Warfighters Essential to 'American Way of Life' and 'American Way of War,' Says Gen. Jay Raymond." Washington Examiner, October 27, 2020. <https://www.washingtonexaminer.com/policy/defense-national-security/space-warfighters-essential-to-american-way-of-life-and-american-way-of-war-says-gen-jay-raymond>.

²⁰ Nathan Strout. "Space Force and NASA Focused on Cislunar Space in New Agreement." C4ISRNET, September 22, 2020. <https://www.c4isrnet.com/battlefield-tech/space/2020/09/22/space-force-and-nasa-focused-on-cislunar-space-in-new-agreement/>.

models evaluated in subsequent chapters apply to both near-earth and cislunar orbital regimes.

Space warfare will likely be a limited war. As defined by the Space Force, achieving space superiority requires gaining the necessary level of control to permit required freedom of action for operations without prohibitive interference while denying the adversary the same. Space supremacy takes dominance a step further by defining conditions in which one operates with relative impunity while denying freedom of action to the adversary.²¹ Corbett recognized that no nation could subsist upon the oceans or exclude others from them. It was best to control passage and communications within the commons.²² Similarly, no nation subsists or may entirely exclude other nations from space.

A desire to maintain access to and freedom of action within space will likely lead belligerents to exercise restraint. Spacepower theorist John Kline notes that the potential for escalation and debris generation in an orbital engagement would likely prove challenging for a return to antebellum conditions.²³ The challenge arises from the generated debris resulting in the Kessler Effect,²⁴ endangering the aggressor and neutral parties' space capabilities. The consideration for the generation of debris should weigh heavily in a belligerent's decision calculus when employing destructive means, driving

²¹ U.S. Space Force. *Space Capstone Publication: Spacepower*. June 2020, 59.

²² Corbett, *Some Principles of Maritime Strategy*, 56.

²³ Klein, *Understanding Space Strategy*, 2.

²⁴ Donald J. Kessler and Burton G. Cour-Palais, "Collision Frequency of Artificial Satellites: The Creation of a Debris Belt," *Journal of Geophysical Research: Space Physics* 83, no. A6 (June 1, 1978): 2637-2646, <https://doi.org/10.1029/JA083iA06p02637>. The Kessler Effect, also known as the Kessler syndrome or collisional cascading, is a theory proposed by NASA scientist Donald J. Kessler in 1978, in which the density of debris within an orbit is high enough that collisions between objects becomes more likely. As more objects collided with each other and generate more debris it creates a cascading effect of collisions and debris generation, rendering an orbit unusable for generations.

war in space to be limited in character.

Within the space domain, the actor in the offense has the advantage. Clausewitz argued that “the defensive form of warfare is intrinsically stronger than the offensive.”²⁵ However, as Colin Gray argues, the offense may have the stronger form of war in space.²⁶ This is due to a lack of terrain obstacles, the relative dearth of capital assets, and the global consequences of military success or failure. Satellites are vulnerable. They follow predictable orbits, fuel limits their life expectancy, speed of maneuverability is generally sacrificed for fuel efficiency, and the onboard ability to sense surroundings and deploy defensive capabilities is limited. These limitations combine to make current systems relatively easy to target and difficult to defend. However, this characteristic may change in time. The Space Force recognizes the need to bolster defensive capabilities in space. Efforts are underway to increase resilience, integrate self-protection countermeasures, harden satellites, improve maneuverability, expand domain awareness, and develop multi-domain combat solutions.²⁷

Within *Joint Doctrine Note 19-1*, the Department of Defense formally acknowledges that it had long employed an artificial distinction between peace and war, failing to adequately account for competition between states shy of armed conflict.²⁸ Competitors apply a blend of the instruments of national power deliberately designed to achieve strategic and operational advantage while avoiding legal or institutional thresholds for armed conflict. Within the space domain, the environment is primed for

²⁵ Clausewitz, *On War*, 84.

²⁶ Colin S. Gray, *Weapons Don't Make War: Policy, Strategy, and Military Technology* (Lawrence, Kansas: University Press of Kansas, 1993), 14-16.

²⁷ Edward Ferguson and John Klein, “The Space Review: The Future of War in Space Is Defensive,” *The Space Review*, December 19, 2016. <https://www.thespacereview.com/article/3131/1>.

²⁸ U.S. Joint Chiefs of Staff, *Competition Continuum*, Joint Doctrine Note 19-1, June 3, 2019, 1.

competition. The lack of internationally recognized norms of behavior in space has enabled a strategic environment where nearly continuous competition occurs because red lines are ambiguous, if they exist at all.²⁹ Actions employed by competitors are typically indirect and designed to probe a competitor's threshold for interference.³⁰ China and Russia's development of direct-ascent and co-orbital ASAT systems, Russia's recent activity with Kosmos 2543, and the expanding use of rendezvous and proximity operations by China in geosynchronous orbit are all examples of rival attempts to compete with and deter the U.S. without initiating hostile activity.³¹ Russia and China's competitive actions within the domain seek to inhibit U.S. freedom of action and deter U.S. interference in Russian and Chinese affairs.

For wars beginning or extending to the space domain, the nature of war remains constant with wars throughout time. However, the character and conduct of war in space, driven by the domain's unique physical properties, bears consideration in developing a space superiority model. Adopting superiority models from other domains, while informative, will fall short of accounting for the space domain's unique characteristics. The next chapter will delve deeper into spacepower theory and space superiority to explore these unique characteristics. It will conclude with the identification of requirements a space superiority model must meet to maximize its utility.

²⁹ Klein, *Understanding Space Strategy*, 10.

³⁰ U.S. Joint Chiefs of Staff, *Competition Continuum*, Joint Doctrine Note 19-1, June 3, 2019, 8.

³¹ Brian Weeden and Victoria Samson, *Global Counterspace Capabilities: An Open Source Assessment* (Secure World Foundation, June 2019), ix - xix.

Chapter 3: Theory of Spacepower

“For wherever two men meet, conflict is inevitable.”¹ – Giulio Douhet

Strategic analogies with land, maritime, and air warfare theory are foundational to spacepower theory development. Admittedly, strategic analogies present some inherent limitations in their applicability when transposed between domains. However, the lack of war beginning or extending to space robs spacepower theorists of the historical context and evidence germane to strategic theory development. However, as John Sheldon and Colin Gray note in their essay on space strategy, the use of strategic analogies, while not perfect, affords a “necessary step on the road to creating and developing an enduring and universal theory of spacepower.”² Spacepower theorist John Klein highlights that the use of strategic analogies grounded in the enduring nature of war and framed by the historical context in other domains fulfills Clausewitz’s imperative to educate the commander’s mind.³ This chapter reviews and analyzes spacepower theory’s significant themes to build a framework to critique current and proposed space superiority models.

Defining Spacepower

The cornerstone of American military might is the nation’s ability to project power globally through an integrated joint force. The Joint Staff defines power projection as “the ability of a nation to apply all or some of its elements of national power to rapidly and effectively deploy and sustain forces in and from multiple dispersed locations to

¹ Giulio Douhet, *The Command of the Air* (North Stratford, NH: Ayer Company Publishers, 2002), 3.

² John Sheldon and Colin Gray, “Theory Ascendant? Spacepower and the Challenge of Strategic Theory,” In *Toward of Theory of Spacepower: Selected Essays*, eds. Charles D. Lutes and Peter L. Hays with Vincent A. Manzo, Lisa M. Yambrick, and M. Elaine Bunn (Washington D.C.: National Defense University Press, 2011), 12.

³ Klein, *Understanding Space Strategy*, 20.

respond to crises, to contribute to deterrence, and to enhance regional stability.”⁴ Of note, this definition does not limit the concept of power projection to military action alone. The definition implies a whole of government approach to projecting power by encompassing all elements of national power. Additionally, it alludes to the globally integrated nature of joint operations. Any definition of spacepower should align with this joint definition.

A review of spacepower definitions reveals nuances in the application of the concept. Spacepower theorist Brent Ziarnick channels Billy Mitchell in his definition of spacepower. Mitchell defined air power “as the ability to do something in the air.”⁵ Similarly, Ziarnick defines spacepower, in its rawest and simplest form, as “the ability to do something in space.” He maintains that the main interest of a maturing space power is the ability to do anything in space.⁶ This spacepower definition lacks clarity and intent. The overly simplified definition fails to capture the essence of why a state pursues spacepower capabilities. Thus, Ziarnick’s definition implies spacepower exists purely for the sake of space forces or entities. By this definition, a state does not pursue spacepower to achieve an end. Spacepower is the end. Ziarnick’s definition is a space for space’s sake approach to spacepower.

David Lupton provides more comprehensive spacepower definitions in his book, *On Space Warfare: A Space Power Doctrine*. Lupton’s definition recognizes that spacepower is delivered by more than just the military element of space. He ties the use of spacepower directly to the pursuit of national goals. His definition states, “spacepower

⁴ U.S. Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02, April 12, 2001, 332.

⁵ William Mitchell, “Winged Defense” In *Roots of Strategy*, ed. David Jablonsky (Mechanicsburg, PA: Stackpole Books, 1999), 425.

⁶ Brent Ziarnick. *Developing National Power in Space: A Theoretical Model* (Jefferson, North Carolina: McFarland & Company, Inc., 2015), 26.

is the ability of a nation to exploit the space environment to pursue national goals and purposes and includes the entire astronautical capabilities of the nation.”⁷ What is not clear in his definition is the role of all elements of national power in securing the ability to exploit space. While one may assume the four elements of national power are at play within Lipton’s definition, the failure to explicitly declare their role within the definition causes it to fall short of perfect.

Similarly, the editors’ introduction to *Toward a Theory of Spacepower* offers a definition that incorporates entities other than a state but recognizes its importance in achieving an entity’s purpose or goals. They define spacepower as “the ability to use space to influence others, events, or the environment to achieve one’s purposes or goals.”⁸ The issue here, though, is according to this definition, spacepower is agnostic to the state. Any space-faring entity, state-run or commercial, wields spacepower. More broadly interpreted from this definition is that a subscriber to space-based services may possess spacepower. This view is too broad in its application of who can actually exert spacepower. While these two definitions afford a richer articulation of spacepower than Ziarnick’s, they still fall short in being fully developed.

The DoD’s *2020 Defense Space Strategy* and the Space Force’s *Spacepower* doctrine provide the most precise spacepower articulations. For the DoD, spacepower is “the sum of a nation’s capabilities to leverage space for diplomatic, information, military, and economic activities in peace or war in order to attain national objectives.”⁹ The

⁷ David Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, AL: Air University Press, 1988). 7.

⁸ Charles D. Lutes and Peter L. Hays with Vincent A. Manzo, Lisa M. Yambrick, and M. Elaine Bunn eds., *Toward of Theory of Spacepower: Selected Essays* (Washington D.C.: National Defense University Press, 2011), xiv.

⁹ Department of Defense. *Defense Space Strategy Summary*. June 2020, 2.

Space Force adds to the definition, stating that spacepower is “the totality of a nation’s use of space capabilities in pursuit of national prosperity and security. Space is simultaneously a source and conduit through which a nation can generate and apply diplomatic, informational, military, and economic power.”¹⁰ Both definitions align with DoD’s definition of power projection. Furthermore, the definitions display spacepower’s utility across all elements of national power and applicability across the competition continuum. Because the Space Force spacepower definition fully accounts for the entirety of a nation’s space enterprise, the role of all instruments of national power, and is applicable across the competition spectrum, this paper will use this definition moving forward.

Freedom of Action

One of the most critical factors to the success of executing military operations is the commander’s ability to obtain and maintain freedom of action, or the ability to act effectively at the time and place of one’s choosing.¹¹ While freedom of action is not a unique tenant of spacepower theory, it is important to stress spacepower’s role in securing freedom of action across all domains. For the Space Force, spacepower’s purpose is to preserve U.S. freedom of action in space. The theory goes, freedom of action in space enables freedom of action in all other domains and improves overall Joint Force lethality.¹² This is due to the interdependence of joint warfighting capabilities on space-based capabilities. As such, the Space Force views the preservation of freedom of

¹⁰ U.S. Space Force. *Spacepower*, xii.

¹¹ Milan N. Vego, *Joint Operational Warfare: Theory and Practice* (Newport, RI: U.S. Naval War College, 2009), X-49.

¹² U.S. Space Force. *Spacepower*, 59.

action as an operational imperative across the competition continuum.¹³

Effective execution of joint functions is the lynchpin to gaining and maintaining freedom of action in all domains.¹⁴ The joint functions are the groupings of capabilities and activities that enable the Joint Force Commander to integrate, synchronize, and direct joint operations. For the U.S., no joint function operates effectively without unfettered space access. Joint Publication 3-14, *Space Operations*, dedicates an entire chapter to describing the integral role space operations play in executing each joint function.¹⁵ This role is only possible when freedom of action in space is secured. Space freedom of action is the foundational element upon which all other domain actions are optimized or enabled.

The ability to exercise the initiative in any operation is wholly dependent on the freedom to act.¹⁶ Any space superiority model should be founded and measured on each competitor's or belligerent's relative freedom of action in relation to each other. The measure of freedom of action is not absolute. Milan Vego writes, "freedom of action is invariably subject to certain political, diplomatic, military, economic, social, legal, and environmental limits."¹⁷ Additionally, changes within the strategic environment inevitably dictate the level of freedom of action required to achieve one's objectives. Because freedom of action in space is central to the success of joint military operations, this paper assesses the ability of each model presented in Chapters 4 and 5 to describe varying levels of freedom of action in the dimensions time and space.

¹³ Ibid., 28.

¹⁴ U.S. Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0, October 22, 2018, xiii.

¹⁵ U.S. Joint Chiefs of Staff, *Space Operations*, Joint Publication 3-14. April 10, 2018, II-1 – II-18.

¹⁶ Vego, *Joint Operational Warfare*, X-51.

¹⁷ Ibid., X-49.

Supremacy & Superiority vs. Command & Control

The 2017 National Security Strategy, 2018 National Defense Strategy, and the 2018 Nuclear Posture Review acknowledge that the U.S. military superiority and space superiority over rivals is narrowing. This view shifts from the predominant viewpoint held by many policymakers and military leaders since the Gulf War, which took U.S. military superiority for granted. The space domain was long considered a benign domain, which led to the belief that U.S. space superiority would be uncontested in conflict. However, during the period of unrivaled superiority following the Gulf War, U.S. competitors remained undeterred. Rather than abandoning efforts to balance with Washington due to an appearance of insurmountable advantage, competitors significantly increased efforts to close the U.S. superiority gap. While the U.S. remained focused on the global distribution of power, rivals bolstered their advantage by increasing their local distribution of power through asymmetric capabilities.¹⁸ These capabilities erode U.S. military advantage, including advantages gained through space capabilities. As a result, U.S. superiority in space is challenged and can no longer be assumed.

Space superiority has stood alone as the term to describe the operational level condition desired for space operations. There exists no underlying construct to describe the conditions, or degree of control, required to achieve freedom of action in space, and therefore, space superiority. It is time to consider a more descriptive construct for superiority, with normalized terminology, to describe desired strategic and operational conditions. This section will first review current definitions, implications, and limitations

¹⁸ Evan Montgomery, “Unpacking Overmatch: Three Questions About U.S. Military Superiority,” War on the Rocks, July 6, 2018. <https://warontherocks.com/2018/07/unpacking-overmatch-three-crucial-questions-about-u-s-military-superiority/>.

of space superiority terminology before reviewing maritime theory's applicability to space.

Current Joint and Space Force definitions for space superiority are closely aligned and have remained structurally consistent through several iterations of doctrinal rewrites. The Space Force defines space superiority as “the relative degree of control in space of one force over another that would permit the conduct of its operations without prohibitive interference from the adversary while simultaneously denying their opponent freedom of action in the domain at a given time.”¹⁹ The new service's definition is sound for describing overarching desired operational conditions during armed conflict. Furthermore, it speaks to the warfighting ethos the Space Force is attempting to instill within its ranks. However, it does not provide a definition or framework for control. Additionally, it falls short in describing strategic conditions and fails to account for a continuous state of competition.

In both armed conflict and competition, planners must consider whether the achievement of military objectives requires localized or global space superiority. In the context of space operations, localized superiority can vary in form, including superiority over a specific orbit, a portion of the electromagnetic spectrum, or over a specific region of the Earth. The Space Force definition implies a global operational condition. The only variable within the definition is time, acknowledging that superiority is temporal. Achieving global space superiority, even for a short duration, requires marshalling immense resources. Localized superiority may enable economy of force. Furthermore, in competition, global superiority is likely unnecessary and provocative.

¹⁹ U.S. Space Force, *Spacepower*, 30.

The third critique of this definition is that it is zero-sum in nature. The definition implies that any gain in freedom of action by U.S. space forces must come at the adversary or competitor's expense.²⁰ For actions within the level of armed conflict, this may hold true. However, for actions below armed conflict, it is arguable that gains in freedom of action in space by one competitor do not necessarily equate to a loss in freedom of action for another. For example, deployment of a new satellite does not necessarily equate to a loss of freedom of action to other spacefaring entities if the satellite does not interfere with another's operation. In the same vein, repositioning a satellite may afford greater freedom of action to one entity but does not necessarily equate to the loss of freedom of action to another if no interference occurs. As norms of behavior in space become more readily accepted by the international community, the intent of actions becomes more transparent, further advancing positive-sum freedom of action. Admittedly, this notion is dependent on the exercise of restraint and is fragile in a world with little trust between competitors.

In addition to space superiority, the Space Force introduced the conditions of space supremacy and space parity in its capstone doctrine publication, *Spacepower*. Neither of these terms is currently captured within joint doctrine and appear to be carryovers from air doctrine and the Control of the Air Continuum. *Spacepower* defines space supremacy as one side's ability to conduct operations with relative impunity while denying space domain freedom of action to an adversary.²¹ However, in the following sentence, the idea of space supremacy is immediately discounted. The Space Force acknowledges this condition is "not always desirable, or attainable against a peer

²⁰ Kenneth P. Grosselin, e-mail message to the author. August 19, 2020.

²¹ U.S. Space Force, *Spacepower*, 30.

adversary, and should not be the unconditional goal of military space power.”²² As noted above, restoration of antebellum conditions is unlikely following the escalation of hostilities to the point of generating debris. To achieve space supremacy will likely require the physical destruction of an adversary’s on-orbit systems.²³ Gaining space supremacy may contradict the goal of attaining a better peace through war. Space supremacy is more likely to erode overall security and accessibility to the space domain for all space-faring entities and degrade its utility as a global common.

Space parity offers utility in describing conditions in competition and armed conflict when neither has achieved superiority. *Spacepower* defines parity as “any condition where no force derives a relative advantage over another at a given time.”²⁴ This definition requires expansion. First, while it acknowledges the condition is temporal, it fails to denote a spatial aspect. The Space Force definitions for superiority, supremacy, and parity all imply a global condition. Space forces are more likely to pursue localized versus global superiority and parity conditions due to resource constraints, distances involved, and the exercise of restraint. Additionally, using the word “derives” implies the two sides are actively seeking to establish superiority over the other. In periods of competition, restraint may preclude the need for possessing superiority at a given time or place. Parity in freedom of action can exist as the status quo condition.

Furthermore, the definition of parity does not account for the existence of more than one type of parity. Various forms of parity may exist when rivals actively compete for superiority. For example, parity in an offense-dominant future differs from parity in a

²² Ibid., 30.

²³ Klein, *Understanding Space Strategy*, 2.

²⁴ U.S. Space Force, *Spacepower*, 30.

defense dominant future. In these two futures, the associated freedom of action in space is different. In an offense dominant future, both sides maintain capabilities so effectively that neither side gains the required freedom of action to generate meaningful combat power. Neither side has reliable access to space, so neither side possesses an advantage. In a defense dominant future, space weapons are ineffective. Both sides can operate with impunity to generate combat power, as neither side gains the advantage. Parity remains, but in a different form.²⁵ The distinction between offensive and defensive dominant parity is crucial as it drives different operational pursuits to gain an advantage.

As highlighted earlier, space superiority, supremacy, and parity are focused on describing an overarching operational level condition. However, within the current construct, the concepts lack clarity in describing the level of control or freedom of action necessary to achieve these states. Furthermore, planners should consider strategies the U.S. and its allies and partners can execute to favorably shape the strategic environment to one conducive to internationally accepted norms, and thus, U.S. interests. A modification to existing maritime theory may provide the necessary construct to describe strategic and operational conditions in space.

Several spacepower theorists have invoked maritime theory as an analogy for space warfare theory. The maritime theories proposed by Alfred Mahan and Julian Corbett offer some utility in expanding the available descriptions for operations conducted within vast global commons. Both naval theorists introduced individual concepts of “command of the sea” and “control of the sea” to elucidate the dynamic nature of naval supremacy in vast oceans when securing lines of communication

²⁵ Kenneth P. Grosselin, e-mail message to the author. August 19, 2020.

(LOCs).²⁶ The Space Force's *Spacepower* publication acknowledges the importance of securing physical and logical LOCs in space. This acknowledgment makes exploration of maritime theory prudent for expanding upon the concept of space superiority.

Historically, command of the sea has described a relative strategic condition between two or more navies, in which one gained a marked superiority over the other.²⁷ Corbett viewed command of the sea as an enabler to sea control. Through command of the sea, naval powers can disperse a fleet to execute sea control to specific areas as required.²⁸ Corbett viewed command as a general type of superiority, while he viewed control as delimited by time and space. Robert Rubel, former dean of the Center for Naval Warfare Studies at the U.S. Naval War College, takes the concept further. Rubel contends that command of the sea extends to operations conducted outside of armed conflict. He argues that Corbett conflates the definition of command between describing a condition of relative strength between two fleets and the status of an area of water. Rubel's view on the matter is that command of the sea is a balance of power between naval forces, irrelevant of control of maritime spaces. Command of the sea is a statement of relative power between navies and the perceptions that attend asymmetry in power in both war and peace. It is a strategic condition in which actors shape their actions in accordance with perceived U.S. Naval superiority.²⁹

Elevating command of space from the operational to the strategic level in both war and peace aligns it with U.S. space policy. Rubel contends command is a condition in

²⁶ Klein, *Understanding Space Strategy*, 21.

²⁷ Rubel, Robert C, "Command of the Sea: An Old Concept Resurfaces in a New Form." *Naval War College Review* 65, no. 4 (Autumn 2012): 22, <https://apps.dtic.mil/dtic/tr/fulltext/u2/1001885.pdf#:~:text=Whereas%20command%20of%20the%20sea%20denotes%20a%20specific,fleet%2C%20then%20one%20has%20some%20degree%20of%20command.>

²⁸ Corbett, *Some Principles of Maritime Strategy*, 101-104.

²⁹ Rubel, "Command of the Sea," 23-24.

which actors perceive the U.S. as enjoying superiority and shape their actions accordingly. More specifically, they shape their action in a way that is “congenial to U.S. interests, especially as it relates to the maintenance of the global security system.”³⁰ This approach deviates from the current space superiority definition, which attempts to describe the ability to affect freedom of action at the operational level. Elevating command of space to the strategic level serves to focus national efforts to effect global perceptions of U.S. and allied strength in space to dissuade competitors from subversive activities in the domain. This effort is a significant focus of the 2020 Defense Space Strategy.³¹ Shifting the command of space to a strategic lens broadens the context for space security from one that is purely military in scope to a whole of government and industry scope.

From command at the strategic level extends control at the operational level. Control directly enables operational freedom of action through the protection of physical and logical lines of communication. Here too, the maritime and space domains appear to share commonalities. Control is obtained primarily through the employment of one’s forces in the form of major operations. However, control is not necessarily gained solely by the forces dedicated to the contested domain. For example, a fleet in coordination with shore-based elements may gain localized sea control. Similarly, obtaining control in the space domain is achieved by employing joint forces across multiple domains. Forces involved in space control operations may include assets on-orbit, launched terrestrially to space, employed between terrestrial elements, or through the cyber and electromagnetic domains. As with sea control, the span of control is delimited by the dimensions of time

³⁰ Ibid., 24.

³¹ Department of Defense, *Defense Space Strategy Summary*, June 2020, 7-9.

and space.

Similar to control in other domains, the span of control in the space domain is measured first in the dimension of space as either general or local. Furthermore, the dimension of space in this description may be either within the physical or logical terrain. Achievement of general control of space occurs when an adversary can no longer act in a prohibitive way to a state's use of its LOCs. It enables the unfettered use of space for all elements of national power. Corbett and Klein contend this condition also means the adversary cannot adequately defend his own LOCs.³² General control is the stronger side's ability to carry out operational tasks in the manner, time, and location of its choosing.³³

Local space control is gained or maintained within a subset of the domain, which is operationally significant for achieving operational objectives.³⁴ Furthermore, it occurs when a force prevents the adversary or competitor from interfering with passage and communications within a theater of operations. In space, this can equate to control over a swath of the geosynchronous belt, geo-transfer orbits, or specific regimes within the electromagnetic spectrum, to name a few examples.

Control in the dimension of time is either persistent or temporary. Persistent control exists when time is no longer a vital factor in the execution of space operations. Persistent control occurs when the adversary's ability to reconstitute his forces or recover his position in space is remote.³⁵ This condition does not preclude the adversary from acting. Instead, it reduces the adversary to a level in which their actions in space will no

³² Klein, *Understanding Space*, 24.

³³ Vego, *Joint Operational Warfare*, II-51.

³⁴ *Ibid*, II-51.

³⁵ Corbet, *Some Principles of Maritime Strategy*, 252.

longer significantly impact the conflict's outcome.³⁶ It is important to note that persistent general control is likely only through the functional annihilation of the enemy's space capability, an improbable likelihood.

Temporary control exists when control is gained for a specific period to achieve a specific objective. For Corbett, gaining temporary control may be achieved by containment of the adversary force or deception operations designed to focus the adversary away from the target region.³⁷ Vego also recognizes that temporary control may often result from either side's inability to gain a decision, and thus the weaker side falls back on the defensive.³⁸ Furthermore, Klein contends a defensive posture strong enough to prevent an opposing space power from executing uncontested operations within or through the specific region achieves temporary control.³⁹

Command & Control of Space Model Requirements

Admittedly, no model for describing variable degrees of superiority, command, control, or freedom of action will be perfect. None of these conditions can be quantified. Instead, the conditions are limited to expression in broad terms. The following two chapters assess the usefulness of the current model for space superiority and the proposed Model for the Command and Control of Space. Neither model attempts to quantify the variables within the models but expresses the variables' dynamic nature along either a continuum or gradient.

The review of space warfare characteristics and maritime theories on command and control of the sea offers four requirements for assessing the models in the following

³⁶ Klein, *Understanding Space Strategy*, 25.

³⁷ Corbet, *Some Principles of Maritime Strategy*, 253.

³⁸ Vego, *Joint Operational Warfare*, II-52

³⁹ Klein, *Understanding Space*, 25-26.

chapters. The first requirement will analyze each model's ability to account for both the strategic and the operational environment. The second measures the models in their utility and applicability across the competition continuum. The following measure reviews each models' ability to describe nuanced degrees of freedom of action across the dimensions of time and space. The final measure assesses the model's recognition of the potential for positive and negative-sum gains in freedom of action by actors, in addition to zero-sum gains.

Chapter 4: Legacy Model Review

“Space superiority is not America’s ordained right. We cannot take it for granted.” – General David Goldfein

The current model for space superiority owes its lineage to the Air Force’s air superiority model. Known as the Control of the Air Continuum, the model’s construct is a horizontal scale of air superiority, ranging from adversary air supremacy at one end of the spectrum to friendly air supremacy on the opposing end, as seen in Figure 1.

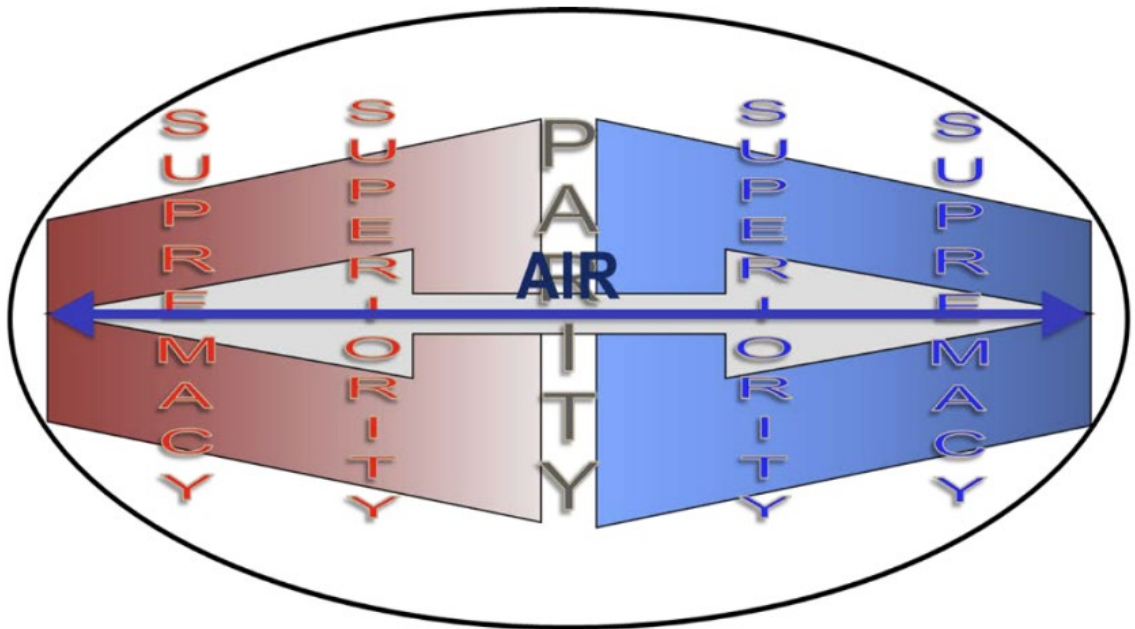


Figure 1. Control of the Air Continuum¹

This model works well for air operations, as it focuses on gaining an advantage over the adversary in an armed conflict. Within this model, destruction and suppression of an enemy’s air and air defense assets lead directly to gains in freedom of action. For air operations below armed conflict, internationally recognized norms of behavior and aviation laws generally afford the necessary freedom of action through international and

¹ U.S. Air Force, *Air Force Doctrine Annex 3-01: Counterair Operations*. (Montgomery, AL: Curtis Lemay Center, September 6, 2019), 4-5.

sovereign airspace to enable operations. What this model does not account for is air operations conducted within the competition continuum. However, it is not uncommon for a competitor to challenge international airmanship norms when the U.S. conducts airborne reconnaissance operations in proximity to a competitor's sovereign airspace or military operations. Similarly, for space operations, gaining an advantage over an adversary must often occur in a state of competition to gain or maintain desired freedom of action. As structured, the current model for space superiority, mirrored on the Control of the Air Continuum, focuses on armed conflict and does not afford the degree of flexibility necessary within its lexicon to be useful to describe conditions across the competition continuum.

Air Force and joint doctrine for space operations view gaining superiority over an opposing space force as the key to achieving the necessary freedom of action to create desired effects within the operating environment.² This view of superiority is through the lens of armed conflict. As discussed above, air operations outside of armed conflict enjoy well-defined norms of behaviors and laws to assure the safety of flight and freedom of action as well as recognition of a nation's sovereign airspace. Importantly, recognized norms serve to highlight abnormal behavior to enable warning and protection. The lack of norms in the space domain related to space traffic management and rendezvous and proximity operations allows competitors to mask potentially hostile activities and encroach within perceived unsafe operating distances.³ The activities of Kosmos 2543 are

² U.S. Air Force. *Air Force Doctrine Annex 3-14: Counterspace Operations*. (Montgomery, AL: Curtis Lemay Center. September 6, 2019) 6-7; U.S. Joint Chiefs of Staff. *Space Operations*. Joint Publication 3-14. April 10, 2018, I-3 – I-4.

³ Audrey M. Schaffer "The Role of Space Norms in Protection and Defense." *Joint Forces Quarterly* 87, (4th Quarter 2017): 88. <https://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-87.aspx>.

prime examples. The Kremlin took advantage of the lack of clearly defined norms to obfuscate the intent of their activities and potentially threaten a U.S. reconnaissance satellite. The lack of internationally recognized norms enables competitors to challenge access to and operations within the space domain. In turn, any model for space superiority must account for variable levels of control in the dimensions of time and space across the competition continuum.

A consequence of constraining space superiority thought to armed conflict is a limited view on parity. Air Force and Space Force doctrine define parity as no force having control or advantage over another. Air Force doctrine provides additional context, stating that in a state of parity, significant interference occurs between both sides, and the condition is fleeting. This state of parity is marked by intensely contested battles with maximum effort exerted. However, as discussed in Chapter 3, parity may exist in different forms. First, it may exist in a condition where both sides exercise restraint, and all parties enjoy unfettered freedom of action. This form of parity aligns with Corbett's description of a parity condition in which neither side controls the sea. Corbett viewed a perpetual state of dispute outside of limited regions of control as the nominal condition for the sea commons.⁴ Corbett's idea of a perpetual state of dispute in the maritime domain is similar to the contemporary operating environment in space. The alternative state of parity exists within competition or armed conflict. Within this state, freedom of action is contested and varies in form, depending on the existence of an offense dominant or defense dominant future. The current continuum model fails to account for the variable states of parity.

⁴ Corbet, *Some Principles of Maritime Strategy*, 77.

A superiority model based on a linear continuum creates an unnecessary bias, or insatiability, for achieving greater degrees of superiority or supremacy.⁵ This approach can create a bias for escalation. However, current spacepower doctrine admits that supremacy may be undesirable or unachievable.⁶ Constraining spacepower thought to linear constructs risks unnecessarily limiting flexibility within operational schema while simultaneously precluding restraint. Biasing towards escalation risks negatively impacting the legitimacy and credibility of U.S. actions. For example, it is doubtful the U.S. would seek to establish conditions in which Russia or China lost access to their space-based strategic capabilities, such as missile warning. However, the current model would suggest that operational designs should trend toward escalation to achieve that end should conflict begin or extend to space.

Reliance on a continuum model for superiority implies that freedom of action is a zero-sum construct. Within the air superiority model, achieving freedom of action in armed conflict is inherently zero-sum. The destruction or degradation of an adversary's aircraft and air defense capabilities is the predominant method for gaining air superiority. The greater the destruction levied against the adversary, the greater the diminishing effect on the adversary's ability to control the air. Thus, as one side gains greater freedom of action in the air, the other correspondingly loses freedom of action.

Extrapolating the air superiority continuum model to the space domain demonstrates that it has merit in describing shifts in freedom of action for the domain, though only in armed conflict. In armed conflict, belligerents directly interfere with each

⁵ Kenneth P. Grosselin, Lead Author of USSF *Space Capstone Publication – Spacepower*, e-mail message to the author. August 19, 2020.

⁶ U.S. Space Force, *Spacepower*, 30.

other's ability to access, maneuver within, and exploit the space domain, similar to actions taken to gain air superiority. However, as discussed before, consideration must be given to the Kessler Syndrome when considering kinetic attacks on a satellite. Depending on the attack methodology employed and the volume of debris generated, attempts to gain superiority through kinetic strikes could result in a negative-sum condition for freedom of action within the affected and intersecting orbital planes.

Alternatively, competition can afford opportunities for positive-sum gains in freedom of action within the space domain. However, this notion is predicated on competitors exercising restraint. Historically, as nations gained access to and operated within the space domain, positive-sum gains in freedom of action were generally the norm. One's ability to gain freedom of action did not preclude or reduce another's freedom of action to operate. However, one may argue that while freedom of action was not challenged within the space domain, the gain resulted in reduced freedom of action for a rival within another domain. For example, improved space-based intelligence collection degrades a rival's ability to operate unobserved and challenges their ability to achieve surprise. The argument here is not incorrect. Militaries desire access to space to gain advantages over potential adversaries within multiple domains, thus reinforcing the zero-sum argument. However, for the sake of comparing competing models, the scope of comparison is constrained to freedom of action within the space domain. With this constraint in place, one must consider that the potential for positive-sum gains in freedom of action in space exists. The superiority continuum model does not account for this.

The final critique of the legacy model for space superiority is its inability to simultaneously account for strategic and operational environments. Control of space

extends directly from the ability of an actor to command space. Chapter 3 highlights that the command of space at the strategic level enables the U.S., its partners, and allies to deter and influence competitors and potential adversaries. The intent is for aligned nations and associated space industry to exert influence through all instruments of power to shape actions and norms of behavior in such a manner that U.S. interests, predominantly unfettered access, is preserved. The continuum model is structured to focus on the operational level of war, lending itself useful only for contingency operations. However, its utility is limited when applied to setting conditions within a campaign plan.

The continuum model for superiority fails to meet the criteria set in Chapter 3 for being a reliable model to describe superiority, command, or control in space. The model's focus on armed conflict restricts its utility across the competition continuum and creates a bias for escalation. That same narrow focus precludes the model from accounting for nuanced levels of control across time and space and fails to consider alternative parity states. Finally, the model's scope is for the operational environment alone. Chapter 5 proposes the Model for the Command and Control of Space to address the continuum model's limitations.

Chapter 5: Model For The Command & Control Of Space

“Infinite games are played by known and unknown players...no exact or agreed upon rules... there is no such thing as ‘winning.’ The primary objective is to keep playing, to perpetuate the game.”¹ – Simon Sinek

As evidenced in the previous chapter, the current space superiority model is too narrowly focused and provides an inadequate lexicon for describing freedom of action within the space domain. This chapter proposes a new model for space command and control to address the legacy model’s limitations. The proposed Model for the Command and Control of Space, graphically represented in Figure 2, abandons the legacy linear continuum. Featured prominently in the new model is a gradient of control in the

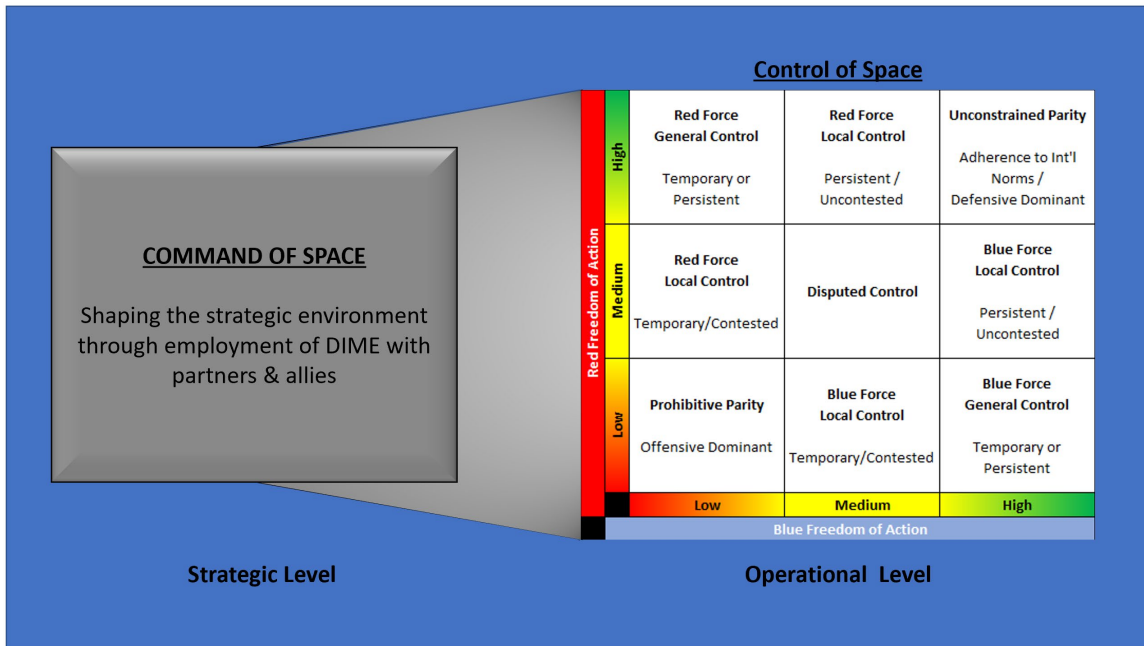


Figure 2. Model for the Command and Control of Space²

¹ Simon Sinek, *The Infinite Game* (United States: Penguin Random House, 2019), 3-4.

² This is an author-created model based on an e-mail conversation with Major Kenneth P. Grosselin on August 19, 2020. Maj Grosselin proposed an initial model based on a gradient. What is depicted in Figure 2 is a modification and expansion of Maj Grosselin’s initial idea. Maj Grosselin is the principal author of the USSF Space Capstone Publication, *Spacepower*.

dimensions of space and time at the operational level, enabled by the command of the domain at the strategic level. The Model for the Command and Control of Space attempts to capture a more nuanced approach to reflecting the variable states of freedom of action. It achieves this by adapting Corbett's command and control of the sea theory, as applied to the space domain by John Klein. However, the theory behind this model differs from Corbett and Klein's theories as it elevates command of space to the strategic level, while control of space reflects conditions at the operational level. Furthermore, the model builds upon their theories by introducing multiple types of parity.

The Model for the Command and Control of Space first attempts to close the gap between the strategic and operational environments, which the current model does not address. As discussed in Chapter 3, Rubel contends that command, as applied to the maritime domain, is a condition in which actors perceive the U.S. as enjoying superiority. As a result, competitors shape their actions in a way that is "congenial to U.S. interests, especially as it relates to the maintenance of the global security system."³ Through this lens, Rubel elevates command to the strategic level. The proposed model above adopts Rubel's approach to command.

Within the space domain, applying the theory of command focuses on shaping the strategic environment to promote acceptable norms of behavior and restraint across the international community. As stated in the 2020 National Space Policy, unfettered access to space is a vital national interest. Furthermore, the policy expands beyond U.S. access, recognizing the right of all nations' unimpeded access to space, including for national security. The disclaimer within the document is that the U.S. is prepared to deter and

³ Rubel, "Command of the Sea," 24.

defeat any adversary that threatens the benefits derived from space.⁴

With the position of National Space Policy as its basis, the command of space becomes a statement of the relative power of space forces and the perceptions of asymmetry in power. This asymmetry transcends across the spectrum of conflict.⁵ The achievement of command in the space domain occurs by employing all instruments of national power to set the conditions necessary to establishing control, as required, at the operational level. Furthermore, attaining command of space is dependent on the U.S. ability to align partners and allies to U.S. interests to deter competitors in space. This cooperative approach is a line of effort in the 2020 Space Defense Strategy.

The second element a valid model for space superiority must meet is its applicability across the competition continuum. Previous models for space superiority solely focused on establishing conditions in armed conflict. The proposed model extends its utility to a world in a state of enduring competition. Ideally, space fairing parties exercise restraint towards each other's space-based capabilities. However, should escalation in competition occur, the model must be flexible enough to encompass variable states of freedom of action in time and space.

Within the proposed model, unconstrained parity describes the condition where no actor gains a marked advantage over another. In its idyllic form, unconstrained parity results from the exercise of restraint. Within this state, all actors possess unfettered access to space. In an alternative form, unconstrained parity describes a defensive dominant condition. In this scenario, actors possess defensive capabilities, which render the use of

⁴ Office of the President, *National Space Policy* (Washington D.C.: Government Printing Office December 9, 2020), 1.

⁵ Rubel, "Command of the Sea," 24.

offensive capabilities ineffective. Both actors maintain a high degree of freedom of action.

Unfortunately, the reality of the space domain today is it is a competitive and contested domain. As highlighted in Chapter 1, Russia and China seek to compete directly with the U.S., and her allies, to prohibit unrestricted freedom of action and unfettered access to space. Russia's actions in the Kosmos 2543 event are a perfect example of a direct challenge to U.S. freedom of action through the indirect engagement of its reconnaissance system. Russia exploited ambiguity in international norms to maneuver within proximity of a U.S. reconnaissance satellite under the guise of inspection. However, these same maneuvers are nearly identical to repositioning for a kinetic or non-kinetic engagement.⁶ In response to ambiguous intentions, any satellite operator in a similar situation must determine whether to maneuver to evade a potential collision or attack. Depending on the maneuver parameters, a maneuver has the potential to remove a satellite from operations for a period of time.

The Model for the Command and Control of Space attempts to describe a situation, such as the Kosmos 2543 event, through the concepts of Disputed Control or Temporary Local Control. Within Disputed Control, neither actor achieves a high level of freedom of action as both seek to gain an advantage over the other in time and space, though neither fully controls the object. Disputed Control may exist at any point along the competition continuum as belligerents compete for advantage in freedom of action, shifting towards local or general control as one side capitulates. Within Temporary Local

⁶ W.J. Hennigan, "Exclusive: Russian Craft Shadowing U.S. Spy Satellite, Space Force Commander Says." *Time*. Last modified February 10, 2020. <https://time.com/5779315/russian-spacecraft-spy-satellite-space-force/>.

Control, the span of control is constrained locally in physical or logical space. However, the control is maintained temporarily to achieve desired effects. In a temporary application of control, the targeted element is capable of reconstitution following removal of the effect; thus, kinetic engagement is unlikely under this condition.

The concepts of General Control, Persistent Local Control, and Prohibitive Parity predominantly apply to armed conflict. These conditions represent an escalation in hostilities and violence to improve one's level of freedom of action while reducing another's. As Corbett states, general control is not a necessary condition to be met to gain operational success.⁷ The Space Force appears to agree with this sentiment in its discussion of space supremacy in *Spacepower*.⁸ Furthermore, achieving general control on the scale of the space domain's physical and logical terrain is likely to prove cost, time, and risk prohibitive. Planners must consider the restoration of antebellum conditions when partaking in armed conflict within the domain. The unique environment of space makes restoration of antebellum conditions in the aftermath of General Control, or in the legacy term, Space Supremacy, difficult. As such, whether persistent or temporary, a form of local control is likely to be the ideal state for a belligerent in armed conflict.

Prohibitive Parity is the least desirable condition. Within Prohibitive Parity, escalation has failed to achieve freedom of action for either side. Both inflict sufficient offensive effects upon each other to prevent either from gaining freedom of action. Prohibitive Parity describes the offensive stalemate of an offense dominant future. This condition may exist locally or generally, though locally is most likely due to the vastness

⁷ Corbett, *Some Principles of Maritime Strategy*, 252.

⁸ U.S. Space Force. *Spacepower*, 30.

of the space domain's physical and logical terrain. Prohibitive Parity does not necessarily imply a kinetic stalemate but can result from either non-kinetic or kinetic engagements or a combination of the two.

The Model for the Command and Control of Space accounts for variable levels of freedom of action, the third criterion for validity. No quantitative approach exists for measuring freedom of action. It is a subjective measure based on an actor's perceived ability to effectively execute desired operations at a time and place of their choosing.⁹ This model attempts to represent how freedom of action between competitors may ebb in strength, scale, and duration depending on means employed, ends pursued, and countermeasures executed. Furthermore, this model accounts for multiple levels of freedom of action existing simultaneously in individual physical and logical regimes across a theater of operations or areas of responsibility. This model also deemphasizes, though not eliminates, the perception of an insatiable drive to increase one's level of control. What it does do is expand the operational planner's palette for expressing desired conditions and injects a consideration for restraint when designing tailored operations to set desired conditions.

The final condition this model meets is to consider freedom of action in terms other than zero-sum. The condition of Unconstrained Parity, with all actors enjoying a perceived high degree of freedom of action, is an inherently positive-sum condition. One actor's gain within the domain does not necessarily equate to a loss to another in this condition. However, this condition is a fragile construct, relying on a high degree of trust between actors, founded on established norms of behavior, and underpinned by restraint.

⁹ Vego, *Joint Operational Warfare*, X-49.

Without established norms and trust, Unconstrained Parity is an unsustainable condition.

The Model for the Command and Control of Space does not directly account for the potential of a negative-sum dynamic, though it does imply the potential for it.

Prohibitive Parity is the most logical place for a negative-sum dynamic to exist.

Depending on the degree to which either actor had freedom of action prior to initiating hostilities, and the chosen means of engagement will dictate whether a negative-sum dynamic exists within Prohibitive Parity. However, Prohibitive Parity is not the only control condition in which a negative-sum dynamic may manifest itself. Except for Unconstrained Parity, all other control conditions have the potential to result in a negative-sum dynamic should a miscalculation lead to the initiation of the Kessler Effect.

The Model for the Command and Control of Space fulfills the criteria for being a reliable model to describe the command and control necessary to achieve desired freedom of action. By expanding the model's scope across a gradient of freedom of action for friendly and adversary actors, the model achieves utility across the competition continuum. Furthermore, it eliminates the bias for escalation and injects a consideration for restraint. Finally, reenvisioning freedom of action as a construct other than zero-sum offers the opportunity for broader cooperation to establish international norms of behavior to deescalate tensions within the domain.

Chapter 6: Conclusion

The U.S. has long enjoyed a marked advantage in its military power, in part, enabled by the integration of space-based capabilities across all joint functions. Strategic competitors have witnessed the Joint Force's deepening dependence on and advantage gained through space capabilities. These same competitors seek to counter U.S. advantage through the employment of asymmetric ASAT capabilities targeting U.S. vulnerabilities in space. This inflection point in history, space becoming a warfighting domain, necessitates a concerted review of all space theory and doctrine to posture U.S., partner, and allied space forces to maintain domain access and maximize freedom of action.

The Space Force began revising space doctrine with the release of *Space Capstone Publication, Spacepower*, in June 2020. This document is a positive step toward shifting U.S. military space thinking from a myopically focused space force enhancement posture towards a force postured to deter, compete, and if necessary, win in a competitive and contested space domain. However, the reliance on legacy terminology without an underlying model to differentiate it from legacy schools of thought may prove problematic. The Space Force must revise its model for space superiority for its operations focused doctrine document, yet to be published.

The Model for the Command and Control of Space proposed in this paper directly addresses the limitations of the current Space Superiority Continuum Model. The elevation of command to the strategic level bridges the concept of superiority between the strategic and operational levels. The recognition of multiple types of parity and dynamic levels of freedom of action, and a shift away from a focus on insatiability,

enables the model to be applicable across the competition continuum. Finally, it recognizes the unique character of the space domain's operational environment, accounting for conditions where access and freedom of action gains may be something other than zero-sum.

The space domain's future remains unknown. However, current trends point to a further increase in competition between major state actors. It is the view of the author that the erosion of trust between competitors, driven by fear, interest, and lack of norms, negatively impacts all competitors' freedom of action in the domain as they posture to counter their competitor's next move. The appearance of positive-sum access to space by the public is but a fragile shroud masking the space domain's true contested character. It will require restraint and clear-eyed leadership by the U.S., its partners, and its allies to shape the strategic environment towards increased stability to enable unfettered access to space. Until that happens, the U.S. must be prepared to respond to competition and conflict in space. The Model for the Command and Control of Space aligns U.S. military space thought towards operations across the competition continuum.

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