

JULY 2019

# ***WHAT PLACE FOR SPACE: COMPETING SCHOOLS OF OPERATIONAL THOUGHT IN SPACE***

**RUSSELL RUMBAUGH  
THE AEROSPACE CORPORATION**

### **RUSSELL RUMBAUGH**

Russell Rumbaugh is a subject matter expert at The Aerospace Corporation's Center for Space Policy and Strategy. He has worked on defense policy, budgets, and acquisition for the Pentagon, Capitol Hill, and think tanks.

### **ABOUT THE CENTER FOR SPACE POLICY AND STRATEGY**

The Center for Space Policy and Strategy is dedicated to shaping the future by providing nonpartisan research and strategic analysis to decisionmakers. The Center is part of The Aerospace Corporation, a nonprofit organization that advises the government on complex space enterprise and systems engineering problems.

The views expressed in this publication are solely those of the author(s), and do not necessarily reflect those of The Aerospace Corporation, its management, or its customers.

Contact us at [www.aerospace.org/policy](http://www.aerospace.org/policy) or [policy@aero.org](mailto:policy@aero.org)

## Summary

The use of space is changing, with implications for U.S. national security. But there is not a consensus on how space is changing nor on how to best organize to achieve U.S. national security in space. This paper identifies six different schools of operational thought with different visions of what war will look like in the future leading to different technological and organizational preferences for how to prepare for those wars. These schools are:

1. *Space Control First.* Drawing on traditional naval and air power thought, this school presumes we must gain space control first to allow all other uses of space to proceed.
2. *Enable Global Missile War.* This school presumes that precision-guided missiles, ballistic and hypersonic, are poised to fundamentally change how war is fought so long as space-based capabilities for surveillance, targeting, and navigation are available.
3. *Keep the Plumbing Running.* This school presumes traditional military operations remain dominant, though dramatically more effective because of space.
4. *Frictionless Intelligence.* This school presumes the value of space for gathering strategic intelligence supersedes all other uses.
5. *Nukes Matter Most.* This school presumes nuclear war is so terrible a possibility that space's role in commanding nuclear weapons must supersede all other uses.
6. *Galactic Battle Fleet.* A final school sees even grander long-term uses of space for national security, including space-based weapons that can strike anywhere in the world, defense of the planet from any threat originating elsewhere in the universe, and exploitation of key orbital "terrain" beyond geosynchronous Earth orbit. To respond, this school sees a need in the future for as yet unrealized technologies.

While few people belong completely in one school at the expense of all others, identifying distinct schools allows us to better understand the choices being made today about how to organize and fund space for national security.

## Introduction

The use of space is changing, with implications for U.S. national security. Adversaries threaten U.S. space assets. Commercial industry offers new opportunities. Given widespread acknowledgement of these environmental changes, the president has proposed changes in the U.S. national security space enterprise, including a new U.S. Space Force, U.S. Space Command, and Space Development Agency. However, even as the U.S. national security enterprise reorganizes, there is not a consensus on how changes in the threat and commercial opportunities will affect the use of space for national security in the future. Different proponents identify different aspects of these changes as the most salient. These proponents therefore champion different solutions for how the U.S. government should reorganize national security space to adapt to those changes.

To provide a framework for understanding these differences, this paper bins many loosely associated and even competing ideas into a limited number of schools of thought on how the United States should operate in space to advance its national security. It identifies distinct schools based on their different views of war in the future and the technology and organization they see as necessary to prepare for that future vision. These schools each bring specific assumptions that lead to specific priorities.

This paper proposes six distinct schools of thought: Space Control First, Enable Global Missile War, Keep the Plumbing Running, Frictionless Intelligence, Nukes Matter Most, and Galactic Battle Fleet. Each of these schools is explored further in the following sections and Table 1 provides a summary of them. Together, these schools capture the bulk of contemporary thought on how the U.S. national security enterprise should operate in space.

## Implications

This paper does not evaluate the merits of each school. But by comparing them next to each other in a like way, it clarifies what is at stake in decisions today about how to organize space. General John E. Hyten, commander of U.S. Strategic Command, said, “We’re going to change the way we look at space. We’re going to look at space and we’re going to define our future, and we’re going to treat space like a warfighting environment.”<sup>1</sup>

How space is treated as a warfighting domain depends on which school dominates the new national security space organizations. Each of the schools of thought outlined in this paper has a coherent vision of future war, what space’s role in that future war would be, what technology should therefore be pursued, and some institutional base to argue for its vision. The space community should be aware of how these visions intersect or conflict. Too often, because space involves a small number of high-dollar decisions, members of the space community focus on specific programmatic decisions, leaving unsaid the broader explanation of why one decision is favored over another; thus, divergent intellectual currents remain unexplored. Instead, proponents of each school should be aware of the arguments other schools are making and the vision on which those arguments are based. The public should be aware of the logic used by the people it has entrusted with national security space, and decisionmakers should be aware there are distinct schools of thought, how they relate to each other, and how the competing visions inform potential decisions. Only with such an awareness will the decisions being made today be fully informed.

This paper cannot answer which school of thought will shape the new space organizations. It does not even argue which school of thought should shape

the organizations. But by describing the schools of thought in a common way, it provides a framework for understanding how each school of thought would shape the organizations differently than the others. Hopefully, in this time of change, this paper can serve as a resource to decision-makers, practitioners and the broader public.

### **Caveats**

Though this paper seeks to describe all the schools of thought relevant to how space achieves U.S. national security, it still is limited in its scope and claims. First, this paper only seeks to describe the different arguments for how space might be used for national security. There are many other uses of space, including commercial efforts, scientific exploration, and even shaping the destiny of mankind. However, the scope of this paper does not include those ideas despite their frequent relevance to national security. For example, advocates of commercial companies often argue their services or products can best fulfill a school's goals either through dedicated assets or as commodities purchased by the U.S. government.<sup>2</sup> Others argue for national security capabilities because they seek to harness those capabilities for broader social goals, as with weather satellites and GPS, and advocates of space exploration can often pursue similar technology as both they and the national security space enterprise require similar capabilities to achieve their goals.<sup>3</sup> While these topics are an important part of the space policy debate, these perspectives are not based on differing visions of the future of war and the role of space, so this paper does not include them.

Second, for analytic purposes this paper sets out stark distinctions between the different schools of thought—but in practice most people are not proponents of only one school and instead accept partial beliefs of multiple schools. Even the most ardent proponents of specific schools would not want the other schools' preferences completely neglected. At the least, proponents of all the schools

often dream of yet more capability, which, if realized, would theoretically better be captured by the Galactic Battle Fleet school. For instance, Space Control First values satellites that can maneuver. If this maneuverability increases so much so that they act more like the spaceships of science fiction, that vision of war is better captured by the Galactic Battle Fleet school rather than the Space Control first school. Moreover, the United States has been able to leverage technology to achieve multiple schools' preferred capabilities in single programs. Ideally, these technological solutions will allow the United States to continue achieving the goals of multiple schools simultaneously. However, to better highlight differences between the schools, this paper draws the boundaries of each school sharply even if the lines blur in practice.

To explain the differences between the six schools, the following sections describe each school's vision of future war, the role of space in that war, its technological preferences and exclusions, and the organizations most commonly affiliated with the school.

## Space Control First



The school of Space Control First presumes we must gain space control first to allow all other uses of space to proceed uncontested. In formal U.S. Air Force thought, space control is a part of “space superiority.”

But space superiority also connotes excellent space capabilities that support terrestrial forces, like cutting edge sensors and communications channels. Describing this school as Space Control First clarifies that while these supporting capabilities are important, they are secondary to securing space assets, potentially by targeting adversary space assets.

### *Vision of Future War*

Space-based assets enable the U.S. military’s operations in powerful ways. Military units can maneuver easily relying on space-based precision navigation and timing; they can communicate around the globe to coordinate action no matter where they are; and they have more accurate weather, imagery, and other sensor data than ever before. So enabled, today’s U.S. military is more effective and lethal than any other force in history.

The Space Control First school emphasizes that space has become such a force multiplier, it will be an adversary’s first target.<sup>4</sup> Because U.S. adversaries know our military is so empowered by space, the adversaries will target U.S. space capabilities to take that advantage away and potentially deter the United States from taking action. Proponents of this school, however, argue space capabilities up until now were able to make terrestrial forces so effective only because space has been assumed to be a “sanctuary.” They point to China’s and Russia’s pursuits and fielding of a range of anti-satellite or counterspace weapons and argue

space is not only no longer a sanctuary but instead a central battle area.<sup>5</sup>

Future war will then escalate along a spectrum from reversible attacks against satellites like lasing and jamming through irreversible attacks involving kinetic anti-satellite weapons. Potentially, this could escalate all the way to nuclear explosions to incapacitate space assets, with each step all the more likely because adversaries can tell themselves each action is less escalatory than a terrestrial action because there are no direct U.S. deaths stemming from hostile acts in space.<sup>6</sup> In the strongest version of this argument, escalation of hostilities in space may happen without any parallel escalation terrestrially.

### *Role of Space*

This school sees space as the dominant asymmetric military capability. Without space assets, all other military capabilities degrade far enough to level the playing field or even give adversaries the advantage over the United States. Because of that dominance, space assets’ most important mission is defending space assets.<sup>7</sup> Only once space assets are secure—even during a shooting war—can space properly support the rest of the U.S. military.

In this way, Space Control First follows the logic of other military specialties. For instance, Alfred Mahan in the nineteenth century argued that the correct role of a nation’s navy was to defeat other navies because once done, the nation would have “command of the seas,” allowing them to trade, transport, and even blockade or provide fire support from the uncontested sea.<sup>8</sup> So supported, the nation could achieve any other goal it had. In the 1990s, John Warden offered a version of this argument for fighter jets elevating “air superiority” from an operational circumstance to an organizing principle.<sup>9</sup> Warden argued that because the opportunities to target what the enemy valued were

so great, yet these opportunities were contested only by the enemy's own fighters, those fighters should be the first priority of any war and all resources in war should initially be dedicated to U.S. fighters to destroy them. Once done, other military capabilities can be brought to bear. But until done, those other military capabilities will enjoy only degraded effectiveness anyway. Space Control First posits a similar logic for space. Without U.S. space assets, other military forces are dramatically less effective, so defending space assets must be the priority, potentially by attacking adversaries' own space systems that might threaten U.S. space assets.

As adversaries' own reliance on space increases, Space Control First also contains the logic that the United States can undercut adversaries by threatening their space assets, doctrinally termed *offensive space control*.

### **Technological Preferences**

To defend U.S. space assets and potentially attack adversaries' threatening space systems, Space Control First prioritizes focusing on a smaller number of defensible satellites, enhanced spacecraft maneuverability, and exquisite custody of priority space objects. A smaller number of satellites makes it possible to equip each of the satellites with the capability to defend itself or dedicate distinct assets to the task. However, to keep the number of satellites low, each satellite must be capable of accomplishing multiple missions. Spacecraft maneuverability allows those assets to confuse and even evade an adversary's hostile actions, sometimes by capitalizing on advanced orbital mechanics. In the extreme, spacecraft maneuverability may allow offensive action. Spacecraft must be designed and orbited to maneuver more aggressively than stationkeeping requires, sometimes forcing tradeoffs with other capabilities, including sensors. Finally, space objects must be tracked much more closely than is done today if maneuvering and orbital mechanics are used to confuse, evade, or potentially even attack

an adversary system. Today's space situational awareness is more focused on cataloging what is in space, presuming each object will likely follow the same orbit over its entire life. Maneuvering among these assets requires much more precise locations of key objects.

Some of these desired attributes share characteristics of traditional space assets. Economic reasons have driven reliance on a small number of highly capable satellites. All satellites must be maneuvered into orbit and kept on station in the face of radiation and other space weather. Many space assets have sensors to see out in space, across orbits, or down to the Earth. However, Space Control First requires exquisite versions of these capabilities to be effective according to its proponents.

---

***"I also talked about a Space Warfighting construct which started with a CONOPS, having the ability to command and control, having space situational awareness, being able to go fast to develop the capabilities that we need to defend our constellations and critical partnerships.... Over the past year we have turned a construct into reality, and it all boils down to its [sic] just warfighting."***

— General John Raymond  
"National Space Symposium 2018  
Keynote Address," April 17, 2018

---

### ***Most Common Organizational Affiliation***

Organizationally, the Space Control First school is most commonly associated with Air Force Space Command in Colorado, whose mission it is to operate most U.S. space assets, including defending them in the face of adversary action. With the creation of U.S. Space Command, these operational concepts will likely be more fully embodied even as Air Force Space Command retains its organize, train, and equip mission focused on acquiring space assets and training space operators. Both are likely

to be bastions of this school of operational thought. Proponents of the school often use the phrase “space is a warfighting domain” to emphasize space is not just a supporting capability but one under threat and with the ability to defend itself and potentially even strike back.

## Enable Global Missile War



targeting and command of U.S. missile strikes and warning and targeting of adversary missiles, both throughout their flight and on the ground before launch.

### *Vision of Future War*

Since the rise of accurate missiles and the sensors to target them, advocates have been arguing “present-day military establishments will probably be superseded by new, far more capable means and methods of warfare.”<sup>11</sup> In their view, traditional military units will not be able to survive in a battlefield swept by precision-guided munitions. Instead, advocates envision a war solely of long-range standoff weapons striking from afar targeted by long-distance yet very accurate sensors. Military units and tactics as currently known would be rendered obsolete. So far, however, the bolder claims of war based solely on long-range precision strikes by missiles have not been realized.<sup>12</sup>

The Enable Global Missile War school argues technological and commercial advances in space and artificial intelligence will finally make this way of war possible and it will inevitably be dominant because of its lethality. Proponents emphasize that global missile war is more likely than ever by pointing to adversaries emphasizing investment in long-range missiles. China may field more than 50 long-range, 100 medium- and intermediate-range, and more than 200 short-range missile launchers.<sup>13</sup> It also promoted its rocket forces to a full service in 2015.<sup>14</sup> Russia has long sought to harness long-range precision-strike, has invested in those

capabilities in recent years, and is now fielding previously banned intermediate-range missiles.<sup>15</sup> To proponents, this means adversaries are already implementing the force structure to fight a global missile war.

### *Role of Space*

This school sees space as the key to realizing this revolution. Only space can provide the global sensors and command and control to target, offensively and defensively, the long-distance missiles that can reach around the world and maintain their accuracy, including on the ground before they have even been launched. While today the U.S. military can field precision targeting and command and control in localized areas, it must first deploy forces into the area on traditional military systems, like ships and aircraft, and over longer distances, often relying on static targeting. Space, in contrast, could provide global, persistent, and dynamic coverage, making the only constraint the range of the missiles, which already have intercontinental range.

### *Technological Preferences*

For space to fulfill the promise of global persistent and dynamic coverage, space assets must make significant jumps in capability from what is possible today. Today’s space assets provide the widest geographic coverage, but that coverage is still not persistently global. This works when policymakers have already identified those regions they are most concerned about, but this lack of comprehensive coverage is unacceptable when an adversary might launch a missile from anywhere on Earth at any time. Today’s space assets provide the broadest coverage by being able to revisit the same spot over and over for years, but that coverage remains intermittent—not an issue when policymakers only need to know if significant changes are occurring over days. However, this lack of constant coverage is unacceptable if one needs to know *exactly* where

---

***“The United States will pursue greater integration of attack operations with active and passive missile defenses. The United States will seek to use the same sensor network to both intercept adversary missiles after their launch, and, if necessary, strike adversary missiles prior to launch.... The exploitation of space provides a missile defense posture that is more effective, resilient and adaptable to known and unanticipated threats.”***

— Missile Defense Review, Department of Defense, January 2019, p. 35-36.

---

missile launchers are (given their ability to move every couple of hours). Today’s space assets provide the greatest indication and warning of missile launches but still require integration with other sensors to track missiles throughout their trajectories.<sup>16</sup> While fine for defending known regions, to achieve truly global defense, space assets must be able to track—and maybe even target—missiles on their own. Other required advances may include spectral diversity, broader bandwidth, and higher frequencies.

Today, the most ardent proponents of this school argue proliferated low-Earth orbit constellations are the most likely avenue to field those technological capabilities. Proliferated constellations imagine

hundreds if not thousands of small-size satellites orbiting the Earth. For these advocates, such numbers can be deployed only in low-Earth orbit. A priority technological preference is perfecting a communications network among a proliferated constellation to enable satellites to work together, exploiting their sensors and with greater command and control of the entire constellation. While there are alternatives in how space might enable global missile war, a proliferated low-Earth orbit solution is currently dominating the conversation.

#### ***Most Common Organizational Affiliation***

Organizationally, this school is currently most closely associated with the Under Secretary for Research and Engineering, including the Missile Defense Agency and the Defense Advanced Research Projects Agency (DARPA), which report to the Under Secretary. A new organization, the Space Development Agency, has been created specifically to pursue space-based capabilities in line with the technological preferences of this school and also reports to the Under Secretary of Defense for Research and Engineering.

**Table 1: A Framework for Understanding: Six Schools of Operational Thought in Space Today**

School	Vision of Future War	Role of Space	Technological Preferences	Most Common Organizational Affiliation
Space Control First	Space-based conflict	The dominant military capability	Small numbers of defensible assets, maneuverability, and exquisite custody	Air Force Space Command
Enable Global Missile War	Long-range and lethal missiles sweeping away all other forces	Key to providing necessary sensor net	Persistent, global coverage; proliferated, low-earth orbit constellations	Under Secretary of Defense (Research and Engineering)
Keep the Plumbing Running	Traditional military units fighting like units	Empowering, but not decisive	Incremental improvement and availability	Military services
Frictionless Intelligence	Constant awareness of adversary activities not limited to wartime	The premier collection platform to populate the President's Daily Brief	High-quality sensors	Intelligence Community
Nukes Matter Most	Potential catastrophe of nuclear war	Critical to warning and command and control	Dedicated warning and hardening	U.S. Strategic Command
Galactic Battle Fleet	Threats to humanity beyond those known today	Superseding all existing weapons	Beyond what is possible today	No specific affiliation

## Keep the Plumbing Running



The school of Keep the Plumbing Running recognizes how dependent modern military operations are on space-based positioning, navigation, and timing; communications; targeting; weather; and early warning.

This school, though, prioritizes the military operations at land, sea, or air being supported by space capability.

### *Vision of Future War*

As with the Space Control First school, this school embraces the idea that today's U.S. military is empowered by space. However, this school does not accept that being empowered by space has made space all important. Instead, it believes future war will transpire much as it has in the past: traditional military units like ships, soldiers, and planes will fight one another, sometimes in more technologically advanced ways but always with a local force-on-force fight determining tactical, operational, and even strategic outcomes.

While proponents acknowledge space creates new dependencies, they are unconvinced that the strategic calculus of war will be changed, especially after shooting starts. Space assets may be vulnerable to kinetic attacks. But the adversary's ground stations, the adversary's tanks and ships using space capabilities, and even an adversary's leadership and people are vulnerable to kinetic attacks. Moreover, post-World War II, a number of conflicts remained limited in scope—geographically, by weapon type, or by participants. Proponents in this school are skeptical that a terrestrial conflict will inevitably extend to space, that a conflict in space will stay contained in space, or that forces reliant on space are the only way to win a war.

This school lumps together many different visions of future war. They include those who think future

wars will be decided on the high seas by large fleets, those who think wars will be decided by large land armies clashing on open plains or deserts, those who think future wars will be proxy wars involving irregular forces and stability operations, those who think future wars are unlikely to cross the threshold of open violence and instead involve constant low-level gamesmanship, and even those who think future wars will involve long-range strikes by conventional bombers. While these visions may conflict with each other, they agree on space's role: important, but not decisive.

### *Role of Space*

This school sees space assets as important but supporting capabilities. The purpose of space assets is to empower other military capabilities.<sup>17</sup> Therefore, space assets should be built and operated in a way that best supports other parts of the U.S. military. At the least, operations of space assets should not hinder in any way operations of terrestrial assets. At the most, the funding of space assets becomes an opportunity cost that must be weighed against investing more in terrestrial assets. To advocates for other uses of national security space, prioritizing these terrestrial assets prevents the investment that might allow space assets to achieve fundamentally new capabilities.

Proponents of this school are not Luddites, however; they recognize how technological advances have changed the ways wars are fought, but they are skeptical these advances will mandate wars are only fought in a certain way. They are skeptical because they do not share assumptions made by other space schools of operational thought. While they acknowledge how much space-based assets empower units, they also see technological alternatives to those space-based assets. GPS-guided weapons are great, but laser-guided weapons also provide precision without requiring space assets. Space-based communications are important, but terrestrial networks can provide connectivity that allow greater access, more flexibility, and even

greater bandwidth for localized fights. While they acknowledge that units are more effective using space-based assets, Keep the Plumbing Running proponents do not believe those units will stop fighting if they do not have access to space-based assets. Ships may not be able to target as accurately, but they will still search out and fight the adversary even if they cannot rely on space-based assets. Even when tank units are unclear of their own or the enemy's location, they will still seek to find the enemy and bring their organic firepower to bear. The war will go on, whether fought high-tech or not.

### ***Technological Preferences***

Technologically, this school prioritizes keeping existing space capabilities available and incrementally improving the capability. Today's U.S. military relies heavily on space. They therefore emphasize maintaining their access to existing space capability, which their other assets now use. Because that access already exists, this school can often presume space capability and not consider how to maintain it. These proponents often weigh in on technological preferences only when a capability seems endangered by a flawed acquisition program.

Despite their only occasional interest, proponents of this school do value advancing technologies in space. As the space age has matured, both militarily and commercially, essentially everyone can see the value of space-based capabilities. However, because they are concerned about balancing advancing space-based technology and the development and fielding of other terrestrial assets, proponents of this school can be skeptical of the value of unproven technologies, especially ones that require paradigm shifts. The fielding of GPS is a canonical case study. The eventual military users of the system were skeptical of the system, preferring to advance existing methods of navigation like inertial guidance.<sup>18</sup> Only when proven during the Gulf War did the broader military embrace GPS.

---

***“Army Maj. Gen. Daniel P. Hughes and Navy Rear Adm. Christian ‘Boris’ Becker stressed the importance of joint cooperation and incremental modernization to deliver systems that enable expeditionary operations by providing U.S. forces with resilient communications in the harshest environments [like]...urban, jungle or mountainous terrain.”***

— “Army, Navy leaders: New Technology, Joint Collaboration Advance Comms for Asia-Pacific,” U.S. Army PEO C3T and U.S. Navy PEO C4I Public Affairs, February 12, 2015.

---

### ***Most Common Organizational Affiliation***

Organizationally, this school is most commonly associated with the military services. The military services all have visions of war that do not prioritize space, even as they rely on space-based assets. This school is affiliated with the legacy term “force enhancement,” which emphasizes the role of space in making other forces more effective. The military services tend to think of space as a utility like plumbing, which will always be available for use given minimum investment needs are met. The groups most sensitive to this dynamic are the Army and Navy space cadres who interface between the Air Force space operators or acquirers providing the capability and their parent service using the

capability.<sup>19</sup> Because it accommodates a broad range of visions in how future war might play out, this school includes a very large number of proponents with influential positions in Department of Defense decisionmaking.

## Frictionless Intelligence



The school of Frictionless Intelligence represents the original national security mission for space.<sup>20</sup> It prioritizes space's ability to provide senior policymakers, particularly the president, intelligence of adversary

activities. For this school, the ideal goal is being able to peer into adversaries' activities with no interference, confusion, or friction. Space capabilities offer unrivalled penetration and near-uncontested awareness of these activities, just as they did at the dawn of the Space Age.

### *Vision of Future War*

Frictionless Intelligence focuses more on ensuring the president has insight into what other nations are doing than preparing for future wars. This may include investigating those nations' war preparations but also encompasses other activities such as diplomatic negotiations, economic investments, and staying apprised of cultural and political developments. For Frictionless Intelligence, the highest priority is on avoiding strategic surprise: a fundamental shift in a nation's role in the international system, whether an unexpected military move, technological advance, or societal change. Frictionless Intelligence argues the primary concern must be ensuring the senior-most U.S. policymakers are not taken by surprise and understand the context of their decisions.

While Frictionless Intelligence is wary of the increase in space threats, it is focused on constant awareness and not just wartime performance. Space threats to Frictionless Intelligence are chronic rather than acute and fit in the traditional understanding of spy-vs.-spy games of espionage and counter-espionage. Frictionless Intelligence is more concerned with an adversary's ability to deny and deceive than to destroy. While adversaries are

harnessing technological advances to increase their denial and deception methods, these methods remain descendants of traditional efforts like hiding activities under cover.

### *Role of Space*

Today, space still provides many of the advantages for collecting intelligence as it did in the early Space Age, making it critical to gather information on other nations' activities, intentions, and capabilities. In the 1990s, the military lamented its lack of access to the Intelligence Community's (IC's) space assets and the information they produced. These complaints—lodged at a time of depressed strategic competition—led to greater focus on leveraging intelligence space assets for military use and not just for strategic intelligence consumers. These efforts culminated in 1995's Presidential Decision Directive 35 that gave top priority to “supporting our troops and operations, whether turning back aggression, helping secure peace or providing humanitarian assistance.”<sup>21</sup> Though the IC accepted this direction, the logic of the Frictionless Intelligence school continued to emphasize the importance of strategic intelligence to senior policymakers.<sup>22</sup> That priority remains the focus of the strongest strands of the Frictionless Intelligence school even as proponents acknowledge the need to fulfill other missions as well.

### *Technological Preferences*

Because intelligence is best collected if the adversary does not fully understand U.S. capability, to protect those capabilities this school prioritizes secrecy over all other technological or operational concerns. The strongest advocates of this school may even accept degraded capabilities for other intelligence purposes, including supporting military operations in order to preserve the effectiveness of systems providing strategic information. Given these priorities, Frictionless Intelligence may unconsciously create technological barriers to sharing information gleaned from space systems.

---

***“The Commission believes that ensuring a proper balance between strategic and tactical requirements—in terms both of the use of current NRO systems and of the design of future NRO systems—is a matter of utmost national security importance.... There also appears to be no effective mechanism to alert policy-makers to the negative impact on strategic requirements that may result from strict adherence to the current Presidential Decision Directive (PDD-35) assigning top priority to military force protection.”***

— “The NRO at the Crossroads,”  
Report of the National Commission for the  
Review of the National Reconnaissance Office,  
November 1, 2000, p. 51.

---

Frictionless Intelligence further prioritizes advances in sensor capabilities to improve what can be collected in space; processing for better dissemination (albeit focused on intelligence collection and analysis rather than operational relevance); and unpredictability to limit adversaries’ ability to counter these capabilities. Frictionless Intelligence is more concerned with how well a

place is observed than with how often it is observed. Frictionless Intelligence also values global coverage less than localized coverage because it is most concerned with slow-developing trends, and systems can be retasked or even redesigned as the specific regions of focus change.<sup>23</sup>

In recent years, Frictionless Intelligence’s priorities have not been in conflict with other schools’ technological preferences because space assets have been so capable they can meet the priorities of both Frictionless Intelligence and other schools. However, Frictionless Intelligence does have distinct preferences and, if forced to choose, would prioritize secrecy and precision over other capabilities.

#### ***Most Common Organizational Affiliation***

Organizationally, the school of Frictionless Intelligence is most commonly associated with the IC, which has responsibility for keeping senior policymakers informed, though it also has responsibility to other customers as well. The senior-most policymakers, however, stress the importance of the strategic information the IC provides, requiring the IC to prioritize that mission.

## **Nukes Matter Most**



national technical means verification of arms control agreements.

### ***Vision of Future War***

Nuclear war remains the most catastrophic outcome of state-on-state conflict. Nuclear weapons have a destructive scale fundamentally different than all other uses of force and are tightly coupled to globe-spanning delivery systems. Though the world has experienced “only” two hostile uses of nuclear weapons 75 years ago, proponents of this school emphasize that as the most catastrophic—even if not the most likely—possibility, nuclear war should be the United States’ top national security priority. Most proponents do not claim that its top-priority status means Nukes Matter Most should receive the greatest funding or even attention, nor do they dispute the greater likelihood of other visions of future war. But because of its catastrophic nature, proponents of this school argue that when a conflict or even tension between priorities arises, matters of nuclear war should take precedence.

### ***Role of Space***

Nuclear deterrence is the second original mission of national security space and remains dependent on space-based capabilities today. U.S. nuclear forces depend on space for indications and warning of an attack and for command and control to respond to an attack. Only space can provide the coverage—even in areas to which adversaries deny the United States access—necessary to monitor the potential start of a nuclear war. Only space can host the communications necessary to reach U.S. nuclear

forces deployed around the world without a lengthy and visible support tail.

Space also plays a critical role in monitoring compliance with arms control agreements and setting the baseline for the United States’ understanding of what and how a nuclear war might play out. When the United States and the Soviet Union first began agreeing to arms control, national technical means—the reconnaissance satellites—provided the ability to verify compliance when the two adversaries were unwilling to be more open with each other and remained skeptical of the other’s motives.

### ***Technological Preferences***

As with other schools, Nukes Matter Most values technological advances across the spectrum of space capabilities. But this school makes technological demands on space assets other schools do not. It distinguishes itself from other schools because of how much it favors specific attributes like hardening against electromagnetic effects of nuclear weapons and dedicated warning of strategic nuclear attack within strict timelines. These attributes are demanding in design, often requiring sacrificing other capabilities. The other schools may resist those tradeoffs but Nukes Matter Most accepts them readily.

In recent years, the demands of Nukes Matter Most have not prevented advances in other areas. Secure satellite communications and missile warnings were extended to conventional, theater-based forces using the same platforms providing the secure, hardened nuclear war communications and the dedicated missile warnings. But many of these systems still favored the Nukes Matter Most school. Current plans involve separating satellite-based nuclear command and control from conventional and tactical command and control and giving them each dedicated systems. An entire new constellation of missile warning and tracking is being pursued,

driven largely by the Enable Global Missile War school. As these programs develop, the overlap between the nuclear- and conventional-supporting systems may shrink. But as long as the nuclear-supporting systems meet the needs of nuclear deterrence, this school is not against other systems.

#### **Most Common Organizational Affiliation**

Organizationally, this school is most commonly associated with U.S. Strategic Command (USSTRATCOM), which has had the responsibility of preparing for and responding to nuclear war for almost 30 years. While both the Air Force and Navy provide nuclear forces and command and control, their systems all support other missions as well. Only USSTRATCOM is dedicated to nuclear deterrence. For the last 20 years, USSTRATCOM has been responsible for space operations as well, though in practice Air Force Space Command has dominated this conversation, not least because within USSTRATCOM nuclear deterrence has always taken precedence over space operations more broadly. With the creation of U.S. Space Command, USSTRATCOM is likely to focus even more narrowly on nuclear deterrence and how space systems support it. Nuclear war is, however, a catastrophic enough threat that USSTRATCOM often finds high-level support for its priorities, even if those senior levels do not spend the bulk of their time focused on nuclear deterrence.

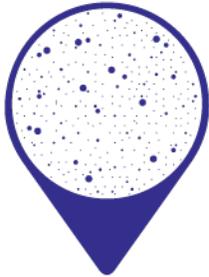
---

***“Yet, deterrence depends not only on a modernized triad but also on survivable systems for decision-makers to understand the nature of a nuclear attack, and to command and control the response... The United States’ strategic “thin line” is the communications network, much of it spaceborne, that connects our nuclear weapons, sensors and related systems to the president and his national security team.”***

— Admiral Dennis C. Blair (ret.)  
“Why the U.S. Must Accelerate all Elements of Space-based Nuclear Deterrence,”  
Defense News, February 7, 2019.

---

## Galactic Battle Fleet



The school of Galactic Battle Fleet remains distinct because of its focus on scenarios requiring yet-to-be developed technology and applications, including space-based attack of terrestrial targets, planetary defense, and manned space combat. Proponents of this school in the near-term support other schools but always hope to advance longer-term goals as well.

### *Vision of Future War*

The universe is unimaginably vast. It is possible a greater threat to humanity lurks in the far distances of space that will trump all of mankind's internecine conflict. Concerns about these possibilities motivate one variant of the Galactic Battle Fleet school. This threat might be natural, like planetary defense from a meteor or asteroid. Or the threat might be manmade, like an adversary exploiting Lagrange points or the moon to threaten activity in space.<sup>24</sup> Another manmade threat might be the need to regulate commerce in space with force, calling for a space coast guard, or even a need to militarily colonize space.<sup>25</sup> At the most extreme, it is a threat from the vast reaches of space not natural but from another intelligent species.<sup>26</sup>

Another variant imagines space weapons that supersede any existing weapons systems, even nuclear weapons. Space-based weapons that can strike terrestrial targets offer reach, lethality, and surprise unmatched by today's weapons.<sup>27</sup> For some proponents, the first nation to achieve such weapons will be able to force other nations to bend to their preferred political outcomes requiring the United States to pursue them.<sup>28</sup>

Whether proponents want mankind prepared for threats in or from the deep reaches of outer space or think space can force mankind to transcend its current divisions, they find common ground in

envisioning national security outcomes driven by technologies well beyond existing forces.

### *Role of Space*

Outer space is central to this school of thought. It is the limitless possibilities of space that open up new vistas—and threats—for mankind. It is space that will transcend our current geopolitical constraints.

### *Technological Preferences*

Technology that will overwhelm today's forces is definitionally beyond what is possible today. This school's defining preference, therefore, is pursuing such technology. Because such technology is beyond what is possible, this school finds itself supporting the technical capabilities other schools are pursuing as a way station to new possibilities in

---

***“The Moon could be the ideal location to launch intercepting missions to hazardous asteroids. Hazardous asteroids could be slowed down to not hit the Earth, by ramming heavy spacecraft into them. This mitigation method is known as the kinetic impactor approach, and is considered to be the most technologically mature approach to mitigate hazardous asteroids.”***

— Thomas Drake Miyano  
“Moon-Based Planetary Defense Campaign,”  
Journal of Space Safety Engineering,  
Volume 5, Issue 2, June 2018.

---

space. Space Control First might generate enough maneuverability to make science-fiction-like spacecraft a possibility. Enable Global Missile War offers the possibility of a global sensor and command and control net that can be retrofitted with Earth-striking space weapons. Frictionless Intelligence and Nukes Matter Most have already provided the political support to advance technology beyond the dreams of early space visionaries.

### ***Most Common Organizational Affiliation***

There is no single organizational home for this school. Some proponents are attached to scientific or research organizations as they push technology, though they often favor solely peaceful uses of such technology and underestimate the security threats proponents of this school. Some proponents are too troubled by the political demands of existing organizations to hold an affiliation. Because of these dynamics, one sign of this school's proponents is their dissatisfaction of existing organizations, even those dedicated to space. Proponents often identify themselves by emphasizing that the grandest visions of space will not match existing organizations, and so future space organizations should be organized differently. One common proposal is to use naval ranks to distinguish Galactic Battle Fleet organizations from existing Air Force- or Army-based rank structures.<sup>29</sup>

This school matters organizationally because it provides a near-constant push for change as it seeks to transcend today's order. Yet this school has few immediate goals to be gained, making it a potential partner for all other schools in pursuing organizational change, resources, or new technology.

## Conclusion

These six schools of operational thought capture most of the ideas being advanced today in the debate about organizing national security space. Space Control First focuses on an unmanned war in space. Enable Global Missile War presumes the sweeping away of old modes of war with the arrival of a reconnaissance-strike complex. Keep the Plumbing Running insists on continuity in how wars are waged, albeit ever more empowered by space. Frictionless Intelligence and Nukes Matter Most concentrate on already traditional roles for space. And, finally, Galactic Battle Fleet envisions space changing mankind's future completely.

By considering these ideas as discrete schools, this paper better identifies the assumptions each makes about how wars of the future will transpire, what role space will play, and what technologies and organizational structure should thus be pursued. Because the assumptions and implications in each of these categories differ, each school would organize and fund national security space differently. Conversely, when decisions are made about how to organize or fund national security space, those decisions will likely favor or hurt the schools unequally. Sometimes decisions can achieve multiple schools' preferences, but at other times a decision will force a choice among the schools' preferences. Today, proponents of each school are jockeying to see their visions and preferences dominate.

But this jockeying of ideas is not clear to many. Proponents of schools may not fully understand the assumptions and arguments of other schools. They may not appreciate how best to accommodate or contest the arguments being made by proponents of other schools. Decisionmakers themselves may not understand how proposals they are considering tie back to assumptions each school is making. Also, if proponents of each school cannot help decisionmakers understand, decisions may be made in a vacuum. Decisionmakers may not realize they

are choosing an option that is based on assumptions with which other decisionmakers do not agree. In the worst-case scenario, decisionmakers may seek compromise among the proponents only to choose a solution that achieves none of the schools' goals and leaves national security space worse off than if any one school was supported.

This paper offers a framework for clarifying where the schools of thought are competing with each other. It clarifies the assumptions each school makes and the implications of those assumptions. By doing so, this paper hopefully helps everyone involved in the debate about how space should be organized and funded regardless of their own preferred school of thought.

Space is an area of utmost importance to everyone, yet it is a field dominated by a small group of experts, who themselves are divided on what is most important about space in achieving U.S. national security. The better those divisions are understood, the better the nation can prepare for the future when making choices about how to organize and fund space.

## Acknowledgments

Thanks to Dr. Michael P. Gleason for his continuing engagement with the ideas in this paper and to Michael A. Leon and Erin Ryan for their invaluable reviews. As an external reviewer, Ben Friedman's incisive comments are also appreciated.

## References

- <sup>1</sup> General John Hyten, U.S. Air Force, “John H. Glenn Lecture on Space History,” June 13, 2018.
- <sup>2</sup> An extreme version of commercial developments fundamentally changing US national security space is James Clay Moltz, “The Changing Dynamics of Twenty-First-Century Space Power,” *Strategic Studies Quarterly*, Spring 2019.
- <sup>3</sup> National Research Council, “The Global Positioning System: A Shared National Asset,” The National Academies Press, 1995.
- <sup>4</sup> Adam P. Jodice and Mark R. Guerber, “Space Combat Capability . . . Do We Have It?,” *Air & Space Power Journal*, November–December 2014
- <sup>5</sup> “Challenges to Security in Space,” Defense Intelligence Agency, February 2019.
- <sup>6</sup> General John Hyten, U.S. Air Force, “Questions and Answers,” Mitchell Institute Breakfast Series, June 20, 2017.
- <sup>7</sup> B. T. Cesul, “A Global Space Control Strategy,” *Air & Space Power Journal*, November-December 2014
- <sup>8</sup> Alfred Thayer Mahan, *The Influence of Sea Power on History*, 1890.
- <sup>9</sup> John Warden, *The Air Campaign*, Air University Press, 1989.
- <sup>10</sup> For a discussion of the reconnaissance-strike complex concept, see Thomas Mahnken, *Technology and the American Way of War Since 1945*, (Columbia University Press: 2008), pp. 176-177.
- <sup>11</sup> Andrew Krepinevich, “The Military-Technical Revolution: A Preliminary Assessment,” Prepared for the Office of Net Assessment, July 1992, p. 1.
- <sup>12</sup> Barry Watts, “The Evolution of Precision Strike,” Center for Strategic and Budgetary Assessments, 2013 and Michael O’Hanlon, “A Retrospective on the So-Called Revolution in Military Affairs, 2000-2020,” Brookings Institution, 2018.
- <sup>13</sup> “Ballistic and Cruise Missile Threat,” National Air and Space Intelligence Center in collaboration with Defense Intelligence Ballistic Missile Analysis Committee, June 2017.
- <sup>14</sup> Michael S. Chase, “PLA Rocket Force Modernization and China’s Military Reforms,” Testimony Before the U.S.-China Economic and Security Review Commission, February 15, 2018.
- <sup>15</sup> Roger McDermott and Tor Bukkvoll, “Russia in the Precision-Strike Regime: Military Theory, Procurement and Operational Impact,” Norwegian Defence Research Establishment, August 2017 and Matthew Schwartz, “Russia Says It Will Build New Missile Systems Within 2 Years,” NPR, February 6, 2019.
- <sup>16</sup> “Elements: Sensors,” Missile Defense Agency website, <https://www.mda.mil/system/sensors.html>, accessed April 2019.
- <sup>17</sup> “Army Space Support as a Critical Enabler of Joint Operations,” AU.S.A Background Brief No. 97, December 2003.
- <sup>18</sup> Glenn Kent, “Thinking About America’s Defense: An Analytical Memoir,” RAND: 2008, p. 189-91.
- <sup>19</sup> Chadwick D. Igl, Candy S. Smith, Daniel R. Fowler, and William L. Angermann, “568 Balls in the Air: Planning for the Loss of Space Capabilities,” *Joint Force Quarterly* 90.
- <sup>20</sup> Walter McDougall, . . . the Heavens and the Earth: A Political History of the Space Age, (New York: Basic Books, 1985), chapters four through ten. Also see Peter Hays, “Struggling Towards Space Doctrine: U.S. Military Space Plans, Programs, and Perspectives During the Cold War,” Tufts University Fletcher School of Law and Diplomacy, unpublished dissertation, 1994, p. 61-79.
- <sup>21</sup> William J. Clinton, “Remarks by the President at the 50<sup>th</sup> Anniversary of the Central Intelligence Agency,” press release b the White house, Office of the Press Secretary, September 16, 1997.
- <sup>22</sup> “IC21: The Intelligence Community in the 21<sup>st</sup> Century,” Staff Study, U.S. House of Representatives Permanent Select Committee on Intelligence, June 1996.
- <sup>23</sup> John Kringen, “Rethinking the Concept of Global Coverage in the U.S. Intelligence Community,” Institute for Defense Analyses, NSD-5491, May 2015.
- <sup>24</sup> G. Harry Stine, *Confrontation In Space*, (Englewood Cliffs, NJ: Prentice-Hall, Inc. 1981) and
- <sup>25</sup> For space coast guard, see Cynthia McKinley, “The Guardians of Space: Organizing America’s Space Assets for the Twenty-First Century,” *Aerospace Power Journal*, Spring 2000 and Michael Sinclair, “Model a Space Force on the Coast Guard,” U.S. Naval Institute Proceedings, September 2018. For a military role in space colonization, see Konrad Szocik, Tomasz Wójtowicz, and Leszek Baran, “War or peace? The possible scenarios of colonising Mars,” *Space Policy*, November 2017.
- <sup>26</sup> Travis Taylor, Bob Boan, R.C. Anding, and T. Conley Powell, *An Introduction to Planetary Defenses: A Study of Modern Warfare Applied to*

Extra-Terrestrial Invasion, (Brown Walker Press: 2006).

<sup>27</sup> Jonathan Shainin, “Rods from God,” *New York Times Magazine*, December 10, 2006 and Robert Preston, Dana J. Johnson, Sean J. A. Edwards,

Michael D. Miller, Calvin Shipbaugh, *Space Weapons, Earth Wars*, (RAND: 2002).

<sup>28</sup> Everett Dolman, *Astropolitik: Classical Geopolitics in the Space Age*, (Frank Cass: 2002).

<sup>29</sup> Jacqueline Klimas, “Trump to approve lean Space Force,” *Politico Pro*, February 18, 2019.

