

The Assassin's Mace: Motivations Driving China's Space Initiatives

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Abstract

US military might and competitive advantage is built upon space-based technology. However, the space domain is becoming increasingly congested, contested, and competitive. China, of particular concern, has invested heavily in capabilities to deny or degrade the US's ability to leverage these technologies, and presently has the ability to attack crucial US space platforms resident in all levels of Earth's orbit. As a result of rising geopolitical tensions, and China's lacking parity in military might, China views the space domain as presenting opportunity to equalize the strategic battlefield. Further, the US presently lacks the coherent whole of government space strategy, which is necessary to address this issue. This must change. Once developed, the US will need to play an active role in bringing the international community together to develop clearly defined and binding space protections. Failure to do so will result in intensified hostility in space, and increased likelihood of conflict

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The United States considers unfettered access to, and freedom to operate in, space to be a vital interest. Any harmful interference with or an attack upon critical components of our space architecture that directly affects this vital US interest will be met with a deliberate response...

— 2017 National Security Strategy¹

The United States (US) relies implicitly upon space-based technology as the foundation upon which much of its military might is built, and from which it draws considerable competitive advantage against potential adversaries. However, with the passage of time the relatively defenseless space-based platforms which enable these advantages are becoming increasingly vulnerable. In 2001, the Congressional Commission to assess US National Security Space Management and Organization (also known as the "Rumsfeld Commission") reported the following to Congress:

History is replete with instances in which warning signs were ignored and change resisted until an external, "improbable" event forced resistant bureaucracies to take action. The question is whether the US will be wise enough to act responsibly and soon enough to reduce US space vulnerability. Or whether, as in the past, a disabling attack against the country and its people—a "Space Pearl Harbor"—will be the only event able to galvanize the nation and cause the US Government to act. We are on notice, but we have not noticed.²

The Commission's findings were sobering, and although their report is now seventeen years old, our military and civilian dependency upon vulnerable space-based technology has only grown – and based on the actions of our adversaries, China in particular, it is apparent that they have taken note.

The Space Domain: A Global Common

International law recognizes four global commons, or resource domains which reside outside the sovereignty of any one country. These global commons are: the high seas; the atmosphere; Antarctica; and outer space.³ By virtue of being recognized as

global commons, each of these domains is mandated to remain free and open for use by all. As such, with regard to space, there can be no national claims for sovereignty within outer space or upon any celestial bodies. As articulated within the 2010 US Space Policy, space systems of all nations have the right of passage through space and the ability to conduct operations without interference, and that the purposeful interference with space systems, to include their supporting infrastructure, will be considered an infringement of a nation's rights.⁴ In an effort to enable its relative command of space, the US has committed to employing deterrence and defense measures for space systems belonging to the US and its allies.⁵

Command of the Sea

Many similarities, along with some important distinctions, can be drawn from the juxtaposition of the concepts of "command of space" and "command of the sea." By its very nature space has multiple similarities to the sea. Both are vast global commons in which freedom of navigation and the ability to utilize its benefits are of vital interest to the US. Akin to command of the sea, the command of space reflects the degree to which one party can use the global common to exploit its benefits (control of space), while also being capable of denying its benefits to an adversary (space denial).⁶

As espoused by Julian Corbett, command of the sea does not imply a necessity to command the totality of the sea, nor does it mean having to maintain command of a portion of the sea in perpetuity, rather it means the ability to utilize (and deny) a specific area of the sea for a specified period of time.⁷ Corbett's concept of command of the sea also rings true for command of space. Further, this ability to leverage the commons, or to deny an adversary the ability to use the commons, is specifically the driving emphasis behind space or sea warfare.⁸ While nations may invest heavily upon assets designed

to influence command of sea or space, it is not the command of the physical area in space or the sea that is of value, instead value comes from the ability of the physical space to have effects on the land. These effects may be in the form of lines of communication, as is a primary tenant associated with command of the sea, or it may be in the ability to apply the benefits which space-based systems enable such as command and control of forces, precision guided munitions, or missile defense.

Command of Space

However, there are also some important distinctions between the command of the sea versus command of space. Unlike the sea, the cost associated with challenging or denying the dominance of one nation in space can be relatively low. A nation with little or no space infrastructure can contest a dominant nation's command of space by using a spectrum of antisatellite (ASAT) capabilities ranging from targeted frequency jamming impacting a single space platform all the way out to high-altitude nuclear detonations generating a corresponding electromagnetic pulse (EMP) which can destroy large quantities of space systems.⁹ An additional difference is the potential permanence and detrimental impact which results from kinetic engagements. At sea, the effects resultant from the sinking of a ship, although costly to the losing nation, are momentary. However, the destruction of space platforms generates destructive debris which can remain in orbit for hundreds of years, and that poses a significant threat to other co-orbital satellites. With this as a foundation, the totality of threats to space command deserve further attention.

Threats in the Space Domain

As promulgated in the *2011 US National Security Space Strategy*, the challenges in space are growing exponentially more complex as a result of it becoming increasingly “congested, contested, and competitive.”¹⁰

Space Congestion

With the passage of time, proliferation of technology, and reduction of costs associated with space technology, the orbital space surrounding Earth is becoming increasingly consumed by active space systems and inactive debris.¹¹ Additionally, the increasing number of satellites are overwhelming the limited radio frequencies required for their operations.

There are presently more than 1,700 active satellites orbiting the earth at elevations ranging from approximately 200 km above the earth’s surface out to over 40,000 km.¹² As the population of satellites increases, the corresponding congestion in space will become a challenge. Conservative estimates predict that over the next 10 years, more than 9,000 additional commercial satellites will be placed into orbit.¹³ Further, the “low-Earth” orbital region (less than 2,000 km) is expected to grow significantly more congested as a result of an exponential increase in the number of tiny softball sized satellites commonly referred to as “cubesats.” Given their relative low cost to buy and launch, coupled with their increasing capabilities, the number of these cubesats (which are typically non-maneuverable and therefore cannot avoid collisions) is predicted to increase from the current population of a few dozen, to several thousand in the near future.¹⁴ Additionally, in June 2015, the American company SpaceX filed a proposal to test and initiate production of a fleet of more than 4,000 small nanosatellites which would be launched over a period of 15 years.¹⁵ As a result of these and other

developments, thousands of small satellites will foreseeably densely populate the orbits around the earth in the near future.

Contested Space

As articulated by Vice President Pence, who concurrently serves as the chairman of the US National Space Council, "Space is vital to our national security...our adversaries are aggressively developing jamming, hacking, and other technologies intended to cripple military surveillance, navigation, communication systems. In the face of these actions Americans must be as dominant in space as we are here in Earth."¹⁶

The launches of the Russian Sputnik-1 in 1957 and the US Explorer-1 in 1958 established the precedence which cemented space as a global common.¹⁷ However, these "space ambassadors" also triggered a corresponding realization of the potential wartime benefits which could be obtained from the unimpeded overwatch which space enables, and as such, they also served as the catalyst for the genesis of US and Russian ASAT programs.¹⁸ In 2006, China demonstrated its nascent ASAT capability when it used a ground-based laser to blind a US satellite.¹⁹ Then, in 2007, China showcased its possession of a direct-ascent ASAT missile which it used to destroy an active satellite at an altitude of around 850 kilometers above the earth.²⁰ In 2013, China launched an ASAT missile approximately 31,000 kilometers into space displaying their ability to directly target satellites in the uppermost level of Earth's orbit (near a geosynchronous-orbit, which is about 35,000 kilometers).²¹ Of note, prior this event, satellites in this deep-space geosynchronous-orbit were perceived by the US to be beyond any adversary's reach, and as a result these satellites are relatively few in number and each is packed with key strategic capabilities.²²

China's development and deployment of innovative co-orbital "space stalking" ASAT weapons has exponentially escalated tensions in the space domain. In 2008 China began to test and demonstrate this new space-based ASAT capability, which utilized co-orbital aggressor "space stalker" satellites that are maneuvered into close proximity of a target satellite and then disable the target by using an explosive charge, fragmentation device, laser, radio frequency weapon, jammer, or robotic arm.²³ Between 2008 and 2014 the Chinese were observed on multiple instances conducting activities which included: maneuvering satellites into close proximity of the International Space Station and other satellites; ramming a stalker satellite into a target satellite thereby knocking the target off its orbital course; and using a stalker satellite with a robotic arm to attack and disable target satellites.²⁴ Considering the space stalkers' potential to simultaneously maneuver in mass into close proximity of multiple target satellites residing at all levels of orbit, and to then conduct a synchronized attack, this development is game-changing evolution as it enables the Chinese to lie in wait and then engage multiple key US satellites presumably before any defensive action could be taken.

China has also developed a myriad of other robust ASAT weapons which include: space mines; high and low-energy lasers to dazzle, blind, or damage space sensors; high-powered microwave weapon systems; electronic warfare involving a diverse array of frequency jammers; and cyber-attack capabilities to hack or spoof the control and functioning of satellites.²⁵ As previously mentioned, at the extreme end of the spectrum of threats facing all space-systems is the reality that China has a program at the ready, which they refer to as their "Samson option," that involves the detonation

of nuclear weapons in space and thereby precipitate an EMP which is capable of degrading or disabling large portions of global space-based systems.²⁶

Space Competition

Space has become increasingly competitive as a result of the growing number of space actors, including countries, companies, consortiums, academia, and even individuals.²⁷ With the continued development of new and less expensive technologies associated with space activities, in concert with the recognition and maturation of new space-based markets and resources, an ever-growing number of players will be found in space. While this increase is itself a neutral development, the resulting amplified space congestion and corresponding enhanced opportunity for an adversary, such as China, to contest others' space capabilities under the veil of increased anonymity of action are issues which could have detrimental implications to US military and civilian space-based systems.

Motivations Behind Chinese ASAT Initiatives

Ironically, it was the Reagan Administration's development of the Strategic Defense Initiative (SDI) and its consequent erosion of the effectiveness of China's nuclear might that served as a catalyst for China's initial investment in ASAT technologies in the late 1980s.²⁸ Since that time China has invested heavily in the development and deployment of these weapons, and its military and governmental agencies have generated multiple studies and documents which focus on the advantages and opportunities which China can exploit from ASAT technology. Two consistent themes are: whoever commands space will control the earth; and the center of gravity in military operations has transitioned from the sea, to the air, and is now found in space.²⁹

Sun Tzu

The wisdom of the ancient Chinese military General and strategist, Sun Tzu, is revered by the Chinese, and his teachings are the centerpiece of the curriculum at the Chinese military's highest educational institute, the People's Liberation Army (PLA) National Defense University (PLANDU).³⁰ Additionally, Sun Tzu's seminal work, "The Art of War," is used as a textbook which is provided to all Chinese officers and enlisted soldiers and sailors.³¹ As such, it bears value to consider the lessons of Sun Tzu when seeking to understand the motivations which drive the Chinese ASAT initiatives. For example, Sun Tzu said, "speed is the essence of war, take advantage of the enemy's unpreparedness, travel by unexpected routes and strike him where he has taken no precautions."³² When considering the Chinese development of space stalker ASATs, there are direct parallels to Sun Tzu's direction to, "appear at places which the enemy must hasten, move swiftly where he does not expect you," as well as his guidance that "to be certain to take what you attack is to attack a place the enemy does not protect."³³ Chinese initiatives to retain anonymity from attacks perpetrated also ties to Sun Tzu's teachings which advise, "subtle and insubstantial, the expert leaves no trace; divinely mysterious, he is inaudible; thus he is master of his enemy's fate."³⁴

Assassin's Mace

For insight on the perspective of at least a portion of the senior Chinese PLA leaders, the following insights were extracted from three books published by the PLANDU between 2001 and 2005, each authored by a different Chinese PLA Colonel.³⁵ A consistent theme in all three books was the imperative that China covertly deploy an assortment of sophisticated ASAT weapons and keep them hidden until the timing is optimal for their use, and then when the moment for utilization arrives all recommend

leveraging the weapons in such a way as to retain deniability or to guarantee military success.³⁶ Dovetailing into this vision, the authors reference the possession of ASAT weapons as being China's "assassin's mace."³⁷

The concept of an "assassin's mace" harkens to ancient Chinese folklore which tells of a hero who uses a hidden weapon to unexpectedly and swiftly deal a deadly blow upon a far more powerful opponent.³⁸ Accordingly, the authors view ASAT technology as the weapon which provides China the opportunity to strike a debilitating blow, specifically upon the disproportionately more capable US military. The authors make a multitude of additional recommendations which include masquerading ASATs under the guise of civilian satellites, the use of high-density clouds of plasma placed in the path of satellites to disrupt their operations, the use of stealth satellites, jamming transmissions, and the firing of ASAT missiles from submarines to further complicate attribution.³⁹

Taking the High Ground

According to, "*A Study of Space Operations*", published in 2013 by the Chinese PLA Academy of Military Science, "Whoever is the strongman of military space will be the ruler of the battlefield; whoever has the advantage of space has the power of the initiative; having 'space' support enables victory, lacking 'space' ensures defeat."⁴⁰ Similarly, the 2013 China Academy of Military Science book, "*Science of Military Strategy*," expresses the position that space is the new "high ground" and that lacking space superiority causes disadvantage in all other domains.⁴¹ This book also predicts that future wars will likely begin in outer space and cyberspace and further states that,

“achieving space superiority and cyber superiority are critical for achieving overall superiority and being victorious over an enemy.”⁴²

Curbing Chinese Anti-Satellite Threats

Current International Strategy

Multiple diplomatic initiatives have been undertaken in an effort to enable secure and peaceful space operations. The first such agreement, the “Outer Space Treaty of 1967,” remains the most fundamental and impactful. Since its initial signing in January 1967, 126 nations have agreed to be bound by this treaty, including the US and China, along with most other industrialized nations of the world.⁴³ Encompassed in this treaty was the protection of availability of space and all celestial bodies for use by all mankind, the protection of ownership of space based platforms, and the agreed upon expansion of international law into space.⁴⁴ All actions in space were required to be “in the interest of maintaining international peace and security and promoting international cooperation and understanding.”⁴⁵ Regarding the weaponization of space, all signatories to the 1967 Treaty agreed to not place any nuclear weapons, or any other weapons of mass destruction on celestial bodies or in any other space platform.

Two additional United Nations (UN) conventions also intended to shape activities in space are as follows. The 1972 “Convention on the International Liability for Damage Caused by Space Objects,” provided a system for assessing liability for damage caused by space objects wherein the nation or agency responsible for causing damage with or to space based systems would be liable for those damages.⁴⁶ The 1974 “Convention on Registration of Objects Launched into Outer Space,” required nations to notify the UN after an object has been launched into outer space, and to provide descriptive information which includes orbital parameters and a general statement of the purpose of

the space object, thereby enabling all nations to have insight into the intended overt purposes of all satellites launched.⁴⁷

Beyond these agreements, several additional proposals focused on increasing the restrictions of weaponization of space have been, and continue to be, brought to the UN and other agencies for consideration. However, these proposals have been incapable of resolving current tensions, and many have been thinly veiled attempts to reduce the US's military advantage.⁴⁸ An example was the proposed "Treaty on Prevention of Deploying Weapons in Outer Space, Using or Threatening to Use Force against Objects in Outer Space," which was co-sponsored by China and Russia in 2014.⁴⁹ Considering the specifics of this proposed treaty, which would not prohibit ground-based ASAT missiles, lasers, and electronic jammers, or stalker satellites, the intent behind this treaty appears to be the degradation of the US missile defense capabilities.⁵⁰

Current US Military Space Strategy

During the opening ceremony for the first US National Space Council meeting on November 7, 2017, Vice President Pence proclaimed, "the truth is that America entered this new millennium without a coherent policy, a coherent vision for outer space, and in the absence of American leadership, other nations have seized the opportunity to stake their claim in the infinite frontier."⁵¹ This lack of a coherent US space policy further implies that the US lacks a comprehensive whole of government space strategy.⁵²

Militarily, the US continues to evolve and take steps intended to further safeguard American space systems. Currently the US Joint Space Operations Center (JSpOC) monitors the movement of all satellites, and multiple efforts have been made to further improve US space situational awareness in order to enable more accurate attribution for

any nefarious space activities, and to improve satellite collision avoidance.⁵³ To this end, by using a combination of ground based optical and radio telescopes and four Geosynchronous Space Situational Awareness Program (GSSAP) satellites, which were launched between 2014 and 2016, the National Space Defense Center (NSDC) is able to perform a “space neighborhood watch” capable of monitoring all activity in within the vital furthestmost geosynchronous orbit.⁵⁴

Organizationally, a new Joint Interagency Combined Space Operations Center (JICSpOC) was created in October 2015, and renamed as the NSDC in April 2017, with its main purpose being to protect satellites from potential attack.⁵⁵ The NSDC will develop and test options to safeguard space systems, and based on its findings, will promulgate new space system tactics, techniques and procedures in support of both military and interagency space operations.⁵⁶

As the DOD creates new satellites, they are being developed with enhanced maneuverability to improve evasion potential from attacks, more resistant to jamming and other non-kinetic attacks, and providing them with enhanced radar systems to enable greater capability to track objects in space and thus provide the US better space situational awareness.⁵⁷ Additionally, space system architectures are being strengthened and made more resilient by co-use partnerships with other nations and commercial firms, and via other cross-domain solutions.⁵⁸ These are all important improvements, and significant steps forward; however, US space-based capabilities remain vulnerable.

Operationally, the DOD has mandated that its force prepare for the consequences of lost or degraded space capability and that they develop the ability to

operate in these environments by use of education, training, and exercises.⁵⁹ An example of this was the February through March 2018 conduct of the DOD exercise “Red Flag.” During this exercise members of all four service branches as well as units from the British Royal Air Force and the Royal Australian Air Force were subjected to limited GPS jamming which forced the exercise participants to work around the problems created while continuing to accomplish assigned missions.⁶⁰ Although this activity is an important step, the reality is that much work remains to be done to truly prepare the DOD from the tactical level and up to be prepared to operate in a space contested environment.⁶¹

While these initiatives represent progress, considerable work still needs to be done to prepare the US for the potential implications of Chinese aggressions against US space-based systems.

Recommended Whole of Government Strategy

A comprehensive US strategy must be developed and implemented to address the threats faced in the space domain, and President Trump laid the groundwork necessary for this in June 2017 when he reinstated the National Space Council which had ceased to operate in 1993.⁶² In his Executive Order reinstating the council, the President directed its members to provide him with “an assessment and recommendations for the national space policy and strategy” by June 2019, with updates to be provided annually thereafter.⁶³ This council is ideally suited to develop the required national policy, and corresponding whole of government strategy, considering its members include key national leaders such as the Vice President, the Secretaries of State, Defense, Commerce, Transportation, and Homeland Security, the Chairman of the Joint Chiefs of Staff, the National Security Advisor, and the Director of National

Intelligence. As this council develops national policy and strategy, the following are recommended ways for their consideration.⁶⁴

Cultivate a Chinese Partnership

China's known ASAT weapons along with the high probability of their possessing additional unknown covert capabilities, coupled with their published aggressive visions for utilization of space as an "assassin's mace" against the US, make the cultivation of a genuine space partnership between the US and China difficult. However, the potential resultant gains from this partnership for the US and China in particular, and for the rest of the world in general, are of such magnitude that the Herculean efforts necessary to overcome this divide are justified.

Similar to the US and Russian cooperation associated within the International Space Station, the US needs to seek opportunities for shared connections and interests with the Chinese. Notably, the Chinese have already demonstrated a willingness to work collectively via their multi-national cooperation with the European Space Agency on a space weather observatory.⁶⁵ Additionally, the Chinese have overtly promulgated their receptiveness to this interaction. In China's defense "White Paper" released in January 2017, China postulated multiple opportunities regarding cyberspace relationships which have close parallels to space. In this document China speaks of cyberspace being used to promote economic and social development, maintain international peace and stability, and improve the well-being of mankind.⁶⁶ It states that "countries should strengthen a dialogue and cooperation on the basis of mutual respect, equality and mutual benefit, and build a peaceful, secure, open and cooperative cyberspace and a multilateral, democratic and transparent international Internet regime."⁶⁷ Additionally, it articulates the imperative for the development of a universally

accepted international code of conduct within the UN framework.⁶⁸ By applying these same assertions to space and space based-systems, fertile ground can be found for the cultivation of a US and China partnership.

Economically, China, akin to the US, continues to invest heavily in all facets of the space domain, and as a result they too have in interest maintaining space as secure and available global common. China has publicly professed that its goal through the next decade is to out-perform all other nations in space, and to this end they have invested significant wealth in increasing their constellation of satellites.⁶⁹ As of August 2017, the Chinese had more than 200 satellites, making them the second most active nation in space behind only the US.⁷⁰ This significant investment by the Chinese, makes the preservation of access and security in space a shared interest between the US and China which provides opportunity for the two nations to work together toward this common goal. As such, if properly deliberated, solutions and relationships cultivated between the US and China regarding the space domain have the potential to catalyze ripple effects which permeate all other domains and can potentially defuse the present tensions between the two great nations.

Diplomacy is Key

While every element of US national power will have a role to play in the synergistic strategy, none will be as important as diplomacy. Ultimately the only effective counterbalance to the present congested, contested, and competitive nature of space is through the application of internationally agreed upon and enforced rules and norms. This reality provides the US with a unique opportunity to exert its global leadership, and to actively shape the resultant outcome to ensure inclusion of considerations such as regulations which stipulate self-defense authorizations in the

face of new threats such as space stalking ASAT technologies. Furthermore, as new space laws are established, the US needs to leverage this opportunity as a vehicle to communicate to the international community what the US response will be for any illegal attacks on our military or civilian space systems. This unambiguous deterrence strategy will lend additional legitimacy to a potential US response against an adversary for hostile activities in space.

Many great initiatives and recommendations were presented during the June 2016 UN Committee meeting on the Peaceful Uses of Outer Space.⁷¹ This particular forum included: discussions on five different UN treaties on outer space; pressures to strengthen international cooperation on the peaceful uses of outer space; the preservation of space for peaceful purposes and ensuring the long-term sustainability of outer space; concerns over space debris; and concerns over frequency congestion.⁷² The US needs to take advantage of opportunities such as this, and use them as possible to show open-mindedness, and a willingness to give some ground in order to reap the benefits of obtaining international community support for agreed upon constraints and restraints within the space domain. The fact that China has repeatedly submitted proposals to this and other UN bodies, even if those submissions were largely contrary to the desires of the US, presents an opportunity with too much potential for the US to not participate. The 2017 National Security Strategy states that the US will “consider new arms control arrangements if they contribute to strategic stability and if they are verifiable,” so with this as a foundation it is time for the US to apply its diplomatic capability to develop a new path to stability and security in the space domain for all the world’s benefit.⁷³

Commercial and Multinational Participation

The commercial sector along with the US's multinational partners will also need to be part of the collective solution. While the US will continue to develop and deploy space capabilities, the functionality that these systems enable on their own cannot match the collective capabilities which result from their synergistic utilization with those systems belonging to commercial entities and from other nations. Additionally, the commercial arena will continue to cultivate new and innovative advances in technology which the US will be require in order to maintain cutting edge capabilities. Commercial industry also enables other benefits such as redundancy in platforms upon which US vital systems can flow, cost reductions, and the availability of otherwise unavailable capability. An example of how the commercial sector is filling a gap in US capability is in launch capacity. Since 2011 NASA astronauts have had to transit to the International Space Station via Russian transport craft, at a cost which amounted to \$76,000,000 per person as of February 2018; however, starting in mid-2019 US astronauts will instead be launched using SpaceX rockets.⁷⁴

Multinational engagements also provide considerable opportunity within the space domain. As of August 2017, 65 satellites are registered specifically as multinational in ownership, while many more are shared in either a bilateral or multinational construct.⁷⁵ The US needs to make efforts to increase this number, and similarly should seek opportunities to multi-nationally share its satellites to the greatest extent possible, as the corresponding interdependence will cause the actions of nefarious actors to have increased number of impacted parties, and as such will serve as a dissuasive factor. Additionally, the space domain presents the unique opportunity to bring all nations together, as it is a commonality which exists above us all. For

example, the Sierra Nevada Corporation, which is building the unmanned “Dream Chaser” space plane to fly cargo to the International Space Station for NASA, is already working with the UN to give 84 member countries affordable access to space.⁷⁶

According to the CEO of the Sierra Nevada Corporation, “space is multigenerational and a bridge to bring cultures and worlds together.”⁷⁷

“Dull the edge of the Assassin’s Mace”

The US should take actions which mitigate the threat of an ASAT attack. Additionally, the US needs to message its ability to continue to operate effectively notwithstanding the loss or degradation of space-based technologies. By so doing, the US will effectively minimize the value resultant from an ASAT attack, as the potential gains an adversary will achieve as a result of an attack will pale in comparison to the losses which will be inflicted upon that aggressor as a result.

This will require continued financial investment in government systems as well as in cooperative partnerships with commercial industry and other nations. To this end, the FY2016 DOD budget included over \$5 billion in investments to enable the US to be better postured for contested military operations in space, and the FY2017 budget expended over \$7.2 billion on space-based systems.⁷⁸ In 2018 the Secretary of Defense made the commitment for a continuation of this level of investment, requesting \$9.8 billion for space requirements, of which \$7.8 billion was ultimately approved.⁷⁹ Looking forward, the FY2019 budget includes a request for \$9.3 billion for space based systems, particularly focusing on enhancing resiliency in military SATCOM, overhead persistent Infrared (OPIR) capabilities, and positioning, navigation, and timing (PNT), while also seeking to expand US space launch capability (partnering with US commercial providers).⁸⁰

These important investments must continue into the future; however, competition for resources will foreseeably become more aggressive in the future as the US federal debt continues to grow and the military budget constricts. For context, in February 2018 the growing US federal debt stood at nearly \$21 trillion, with the annual cost associated with servicing this debt amounting to more than \$458 billion in FY2017.⁸¹ In spite of this debt complication, the US must continue to prioritize investment in space-based technologies in order to retain the competitive military advantage it provides. Further, this investment in space technology should be networked beyond the DOD to encompass a synchronized effort across the US interagency, among US partners and allies, and into the commercial sector.

Building upon the international collaboration already in place in arenas such as global meteorology and the World Health Organization's public health surveillance, the international community in concert with the commercial realm need to interconnect capabilities to provide the unquestioned real-time space situational awareness necessary to ensure that aggressive actions in space are attributable. While immediate response for hostile actions may not always be an option, at a minimum what must be ensured is the ability to effectively conduct the forensics necessary to attribute the origin and intent behind aggressive activities in space.

While continued improvements in space-system mobility, redundancy, resiliency, and hardening against threats such as cyber or laser attacks are fundamental to defending against ASAT weapon threats, additional mitigating actions are needed. These actions include the requirement for the DOD to force the conduct of in-depth training in environments in which space-based technologies have been degraded and

even completely shut down. While this has been mandated for several years by US leadership, including the President and Secretary of Defense, the reality is that the DOD is not fully carrying out this direction.⁸² Military members at every level, from the individual up to the collective whole of the DOD must be forced to work through the challenges that are presented by a contested space environment. Beyond training, the DOD needs to seek alternate technologies, or to revive previously maintained capabilities such as the use of physical wire for communications, to ensure that mission accomplishment is not impeded as a result of denial of space-based systems. Ultimately, the US military must be able to fight and win its nation's battles with, or without, the advantages provided by space.

Conclusion

The majority of world relies heavily upon space-based technology to meet its needs, and the US is deeply dependent upon space for its military advantages and civilian requirements. While significant resources continue to be invested in the space domain, existent international laws, multinational alliances, and defensive technologies are currently incapable of providing credible insurance against adversarial aggression in space. Although adaptations continue to be implemented to better protect them, US space systems are presently in danger, with China in particular having the ability to inflict significant damage. China's posturing activities, which are indicative of their desired ability to take "Command of Space," make it clear that they have reflected on the wisdom provided by Sun Tzu and are attempting to apply it to their advantage. It is now incumbent upon the US to understand the implications of China's actions, and to develop and implement an effective whole of government strategy in response. The question that remains is if it will be the damage caused by the Chinese use of their

“assassin’s mace” or a “space Pearl Harbor” that ultimately forces the US to shift away from its dependence upon the space domain, or if the US will double down on its dependence by strengthening its relationships with its global partners and allies to address and defuse the threat before such an event forces its hand.

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