AIR WAR COLLEGE

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HYPERSONIC THREATS TO THE HOMELAND

STRATEGIC OPTIONS

by

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Biography

Lieutenant Colonel Henry R. Jeffress, III is assigned to the Air War College, Air University, Maxwell AFB, AL. He is an F-16 command pilot with over 2000 flight hours including over 500 instructor hours, 200 NVG and 116 combat hours over Iraq. He previously served as the Commander of the 367th Fighter Squadron, Homestead Air Reserve Base Florida, Director of Operations 80th Fighter Squadron, 8 FW, Kunsan AB, Korea. Lt Col Jeffress completed IDE as an AFIT student at UCCS. Other tours include Air Officer Commanding Cadet Squadron 26; Deputy Chief Warfighter Integration Office for USAF Warfare Center, as well as, executive officer to the Vice Commander. While stationed at Spangdahlem AB Germany, 23rd Fighter Squadron, he participated in Operation Iraqi Freedom and Operation Northern Watch, earning two Air Medals as well as an Aerial Achievement Medal.

Abstract

It is imperative the United States (US) accelerate its development within the field of directed energy weapons and guard against the emergence of hypersonic threats. Hypersonic weaponry shifts the strategic calculus of U.S. decision makers, increases stand-off capabilities and alters the deterrence equation of international actors. Directed energy weapons offer a feasible approach countering the proliferation of hypersonic threats to the homeland, safeguards the decision space of our nation's leaders and potentially strengthens military, diplomatic and economic instruments of power simultaneously.

Introduction

The divisive nature of the 2016 election revealed shades of a nation divided by partisan politics and an overall necessity to address domestic issues in the United States (U.S.). For evidence look no further than the 62.2 million voters supporting President Elect Trump. One could argue a significant portion of the voting public desires our nation's leadership reflect on internal housekeeping and make domestic conditions a priority.[1] Homeland security and the nation's borders were heated topics of debate throughout the presidential campaign. Chants of "build a wall" and of immigration reform were heard; however, one particular threat to the homeland was not heavily discussed throughout the election cycle. Presently, there is an open hypersonic weapons race between major world powers; it, potentially, could revise modern nuclear deterrence. These burgeoning hypersonic weapons will allow an enemy to penetrate U.S. sovereign airspace in a matter of minutes and deliver nuclear payloads onto U.S. soil.

The security of our nation is an inherent duty of the U.S. government (USG) and it is mandated for elected officials to prepare for the challenges of our volatile, uncertain, complex and ambiguous (VUCA) world. Our elected officials face the daunting task of strategic development and execution; however, no grand strategy is executed without the collaboration of government and the nation's populace. In order for a coherent grand strategy to survive bureaucratic infighting and prove itself feasible in the U.S. government, collaboration must take place. In a nation with a bureaucracy as large as the USG and an executive branch employing more than 4 million personnel; the alignment of strategic objectives is difficult.[2] Statesmen may find utility in leveraging national security and domestic job creation within their grand strategy in order to increase the probability of successful support of the administration's agenda. Domestic job creation and national security provide a common ground where statesmen from

both sides of the aisle may stand and work past partisan issues in pursuit of a strategy countering the hypersonic threat. Our nation's leaders cannot default on their oath to support and defend the constitution against this emergent threat as they prioritize tasks for the administration.

As tax dollars are allocated by congressional representatives, precedence must be given in regards to research and development (R&D) within the Department of Defense (DOD). Through R&D, senators and congressmen alike may tend to the U.S. domestic agenda, contribute to vital areas of interest on education, infrastructure improvements, and serve the public by safeguarding the nation from new threats. A governmental focus on defense spending and academic research helps create jobs, increases national security capabilities, and assists the development of methods to defend against an emergent hypersonic threat. Hypersonic weaponry shifts the strategic calculus of decision makers in the world, increases stand-off capabilities of enemies, and dramatically alters the deterrence equation of international actors. In fact, it is paramount the U.S. accelerate its development of directed energy weapons and guard against the emergence of hypersonic threats from Russia and China. In turn, hypersonic weapons will destabilize nuclear deterrence and revolutionize future warfare; therefore, the U.S. must employ an offset strategy to balance against this threat. Directed energy weapons offer a feasible approach to countering hypersonic weapons, safeguarding decision space and strengthening the military, diplomatic and economic instruments of power simultaneously. Elected officials must collaborate with each other and fund R&D of directed energy weapons to counter the emergence of hypersonic threats to the homeland.

Countering the Threat

Recent trends of a resurgent Russia threat have amplified discussions at home and abroad in regards to North Atlantic Treaty Organization (NATO) priorities and the general validity of

the alliance. Revanchist activities by Russia including the illegal annexation of Crimea showcased Vladimir Putin's renewed assertiveness in the region and resulted in U.S. troop deployments to Poland.[3] Putin's resurgence on the world stage further clarifies a need for strategic vigilance in response to Russian engagements in Ukraine and the Baltic region. Russia's increased force level, as well as, military exercises along the borders of the Baltic States directly threatens NATO allies. Cable News Network (CNN) reported Putin's declaration or threat about any western attempts of encirclement as, "If you compress the spring to its limit, it will snap back hard: something you should remember."[4] Putin's rhetoric is clearly defiant of the international world order and Russia demonstrated its willingness as an actor on the world stage in both Crimea and Syria. The legitimacy of the Russian threat is undoubtedly real in Lithuania and to other NATO allies; therefore, the U.S. must decide on the ends, ways and means for dealing with a resurgent Russian threat. Elected officials must devise a strategy to counterbalance against a hypersonic threat from rogue states, preserve U.S. capability to counter transnational threats from non-state actors, and ready the nation for the post-Cold War era VUCA world.

The post-Cold War VUCA world is vastly different in regards to threat perception than in previous decades. In the past there may have been accusations of bloated threat estimates for the justification of military spending after the fall of the Soviet Union; however, the threat of terrorism increased military activities for the U.S. significantly following 9/11. Unlike the recent interventions in the Middle-East; a resurgent Russian threat is significantly more sophisticated and dangerous than the Afghanistan/Iraq campaigns. In spite of advanced technology within the U.S. military inventory, 4,514 US troops died in Iraq since 2003 and 2,392 casualties occurred in Afghanistan since 2001.[5] These military campaigns were fought against an enemy lacking

significant technical capabilities and the ability to constrain or contest U.S. dominance of the domains of air, land, sea, space and cyberspace. War with a near-peer competitor like Russia would be exceptionally costly in terms of lives and dollars; especially if the strategy is poorly conceived. While the U.S. military honed its counter insurgency skills in the Middle East, other nations allocated resources towards hypersonic technology to counter-balance U.S. military power.

A balance of power shift or at a minimum a contest is occurring in military technology with the emergence of hypersonic weapons. According to Popular Science Magazine, China successfully built a hypersonic wind tunnel in 2014 and achieved speeds of Mach 4 through Mach 9.[6] Imagine a world where national decision makers are warned of a possible nuclear missile launch with a potential impact time in Washington D.C. within minutes. This is a significant reduction in reaction time; albeit a hypothetical situation, one must consider if the bureaucracy of the DOD or the Executive branch is prepared for threat validation and response within a matter of minutes. Is the U.S. government capable of a decision cycle within this timeframe? According to multiple sources, Russia is estimated to field hypersonic missiles by the year 2020 capable of travel more than five times the speed of sound with ultra-maneuverable re-entry vehicles able to penetrate back into the earth's atmosphere.[78] On October 25, 2016, Russia successfully tested a hypersonic aircraft known as "article 4202" it travelled 15 Mach which is over 11,500 miles per hour![9] If this hypersonic aircraft flew from Moscow to Washington D.C. traveling approximately 4,900 miles, at speeds of Mach 15; it would reach D.C. in just over twenty-five minutes! Although, current ICBMs are capable of reaching the U.S. in approximately 30 minutes from Russia; hypersonic missiles, cruise missiles, and aircraft have the ability to fly within the atmosphere. The existence of mobile hypersonic missiles on

different platforms degrade the U.S.'s capability to predict enemy tactics, detect launches, and deter threats against the homeland. These implications hamper strategic calculations of U.S. decision makers, constrain options to intercept/destroy hypersonic missiles, and reduces strategic threat warning time for our nation. It is vital our nation's leadership seek capabilities to preserve decision space, counter the hypersonic threat, and provide options for defense against the speed and agility of these emerging hypersonic threats.

Speed and agility are key components in hypersonic weapons and the proliferation of such a capability will drastically alter warfare; therefore, an agile and integrated defense posture provides a feasible response to emerging hypersonic threats. As an alternative to counter hypersonic weapons, directed energy weapons have increased in capability recently and offer a valid response these weapons. Directed energy weapons range from various types of lasers to microwave weapons. R&D breakthroughs with free electron and fiber lasers have increased laser power while reducing size for military applications. The military has begun to realize the potential advantages directed energy weapons offer combat systems and increased R&D into directed energy defense systems like the U.S. Navy exemplify the possibility of a feasible offset strategy against hypersonic missiles.

The U.S. Navy has deployed a directed energy weapon onboard the U.S.S. Ponce in 2014 and intends to increase future laser defense systems to 150 kilowatts (kW).[10] The Laser Weapons System (LaWS) is currently capable of targeting drones with a power output of 30 kW. The U.S. Navy plans to increase LaWS's power and could potentially boost its capabilities to an anti-ship weapon. Innovations in laser technology enable the military capability to target, track and concentrate intense energy on aircraft and flying weapons today. Hypersonic missiles construct a difficult problem for any defensive system and if they are required to intercept an

ICBM; they may need to be forward deployed in order to target the vehicle in the boost phase of flight. The U.S. military will need a defensive system adaptive enough to intercept ICBMs and other hypersonic vehicles like cruise missiles in the near future. A collaborative effort of commercial and public funded R&D will produce the best opportunity for a game changing technological breakthrough in directed energy weapons like the latest laser innovations over the past decade.

Laser innovations over time have increased the destructive potential of military weapons with the speed of engagement. The capability to target, track and engage at the speed of light all without any recoil, smoke trail or projectiles fundamentally changes the tactical, operational, and strategic environment. The application of destructive power from a distance happens near simultaneously from laser initiation to target impact and soldiers on the battlefield will find difficulty locating the source of the laser. Difficulty in target acquisition or attribution will provide unique changes to the fog and friction of war. The deployment of laser weapons systems may reduce logistical needs for weapons storage and alter planning assumptions dramatically as well. Future strategists must incorporate laser weapons systems into their ends, ways, means and risks equations. Current laser technologies may require larger vehicles in order to generate the high power outputs able to destroy robust targets; however, companies like Lockheed Martin have developed plans for smaller weapons grade high power fiber lasers.[11] These innovations have enormous implications for future developments and investments in R&D will help bridge the gap from the defensive systems of today to the integrated directed energy defensive or offensive systems of tomorrow.

Today, laser systems have already been integrated into defensive systems like Lockheed Martin's Air Defense Anti-Munitions (ADAM) system. This ground based system protects

soldiers against rocket threats and utilizes a 10 kW laser with an effective range out to about 1 nautical mile.[12] As the defense industry continues improvements and expands laser capabilities, the U.S. must take advantage and capitalize on these innovations. As laser power output increases and size is reduced, the military must incorporate laser technology into aircraft, ships, submarines, land vehicles and ground based facilities. Integrated laser defensive systems can potentially increase capabilities of the U.S. Department of Defensive (DOD) and create a network of defensive systems. Such systems allow capitalization upon multiple redundancies to contribute to overall defense of the homeland. The presence of integrated laser defensive systems abroad at overseas bases, on ships at sea, in the air, on alert aircraft and on submarines may produce the layered defensive capability the U.S. needs to counter the emergence of hypersonic threats. With a synchronized global network of defensive systems able to communicate with datalinks or other means; the U.S. will create a global integrated directed energy defense grid and increase its deterrence capability against hypersonic threats.

Through the creation of a global integrated directed energy defense grid, U.S. leaders could incorporate domestic land based directed energy facilities along the coastal regions of the U.S. Such facilities will serve as point defense assets for Homeland Security while simultaneously becoming a catalyst for job creation. These facilities could be integrated into early warning systems for response to hypersonic threats. The integration of directed energy defensive systems with Space Based Infrared Sensors (SBIRS) and early warning radars already in operation will save costs. By capitalizing on Terminal High Altitude Area Defense (THAAD) system capabilities already in existence and coordinated use of platforms in air, space, land and sea the U.S. may achieve the strategic ends it desires for maintenance deterrence equations and international order. Through proper investment in R&D of directed energy systems, U.S. leaders

can fulfill their sacred duty to the public trust and defend the homeland against the emergence of hypersonic threats.

U.S. leaders must emphasize the importance of defense of the homeland in response to this hypersonic arms race hastily. Riki Ellison, Chairman of the Missile Defense Advocacy Alliance believes guidance and policy should be developed in support of defensive capabilities against hypersonic threats. Other nations have modernized and the U.S. must do so as well or accept critical defensive vulnerabilities. As our nation addresses its deficiencies in Homeland Defense; its focus should include integration of future capabilities with existing and future platforms. The formulation of a robust directed energy defensive network with the capability of multiple response options can counter hypersonic threats before and after launch. The proposed network incorporates the utilization of directed energy weapons, electronic attack methods, cyber systems, kinetic missiles, intercept weapons for boost/mid-course/terminal phase, command, control, communications datalinks, air platforms, land-based weapons, sea-borne platforms, and space-based early warning sensors.[13] The creation of the proposed defensive network will aid in the denial, disruption, degradation, deterrence and dissuasion of our enemies objectives and provide a necessary method for safeguarding the decision space of U.S. leadership.

Safeguarding Decision Space

Decision space is critical for reflection when complex problems occur and without ample time; poor decision making can lead to catastrophic results. Hypersonic weapons greatly reduce reaction time, where hypersonic travel is categorized as speeds above Mach 5. Any weapon of this caliber presents tactical, operational and strategic challenges for warriors and leaders of any nation. Recent R&D breakthroughs with hypersonic weapons have occurred with cruise missiles and boost-glide intercontinental ballistic missile (ICBM) hypersonic weapons. Currently,

Russia, China, India and the U.S. are in competition for this emergent technology.[14] Due to the emergence of nuclear capable hypersonic precision weapons, potential exists for destabilization of mutually assured destruction equations. The unforeseen security implications of decreased second strike capability within nation states further complicates nuclear deterrence in the world. If a nation state can attack all geo-strategic locations of another country before the enemy launches a counter strike, how will negotiations be affected? What if this nation is Russia or China and they possess the ability to place nuclear weapons on Washington DC, New York, Chicago, and Los Angeles in less than twenty minutes? The current nuclear triad of the U.S. is not enough to counterbalance the hypersonic threat. The time for questions is past due and U.S. leadership must decide how it will address the threat of hypersonic weapons and outfit the nation's warriors with a suitable offset strategy to counter this emergent threat.

The capabilities of hypersonic weapons are problematic for the defense of the U.S. homeland. As other nations seek prompt global strike capabilities through hypersonic weaponry, they will destabilize nuclear deterrence equations and the international world order. The security dilemma Russia, China, India and the U.S. face unfolds in the regime of threat perception and before the entire world. It is extremely difficult to ascertain the true intent of other actors on the world stage, especially if those nations often engage in deception. As other nations forge ahead with hypersonic tests and achieve breakthroughs with this new technology, there is increased risk of conflict. U.S. leaders have to prepare for an existence in a hypersonic weapons world and incorporate the ways and means for survival of the nation.

In order for the U.S. to continue maintenance of international order, the national decision-making apparatus of the U.S. must address tactical, operational, and strategic dilemmas created by hypersonic weapons. Perspective on U.S. decision-making can be gained through John

Boyd's Observe, Orient, Decide, Act (OODA) loop. In a tactical situation a warfighter makes decisions as he or she observes the environment; then the warfighter makes a conscious choice based upon their perceptions.[15] This decision cycle is an iterative process where the warfighter assesses and adapts their approach to the tactical problem; then the warfighter starts a decision-making sequence all over again. Consider a hypothetical fighter pilot in flight versus a dynamic adversary. The fighter pilot performs numerous decision cycles in relation to enemy aircraft maneuvers. The unpredictability of the enemy and the speed of enemy maneuvers further complicate the decision making ability for the pilot. When the fighter pilot is exposed to an enemy who forces a shift in timelines or reduces available decision time; consequently, the fighter pilot is placed at a disadvantage and often acts with incomplete information. This time compression might happen in the observation, orientation or decision phase and result in less informed actions from the fighter pilot. The implications of timeline shifts and decision space time compression are threats to tactical practitioners, operational war planners and strategists as well. U.S. leaders and operational war planners are not immune to the threat of time compression when decision-making is involved and hypersonic weapons will significantly reduce engagement times, as well as, decision space on the battlespace of the future.

As hypersonic weapons reach the battlespace of the future, U.S. leaders and operational planners will make critical assumptions about the operational environment/wartime strategy. Operational planners critically analyze the world and decide how the application of force might meet U.S. political ends. As planners work through strategy they must consider enemy capabilities and the unique challenge hypersonic weapons bring. A key concern of strategists should be enemy capability of direct force on U.S. centers of gravity in minutes from the other side of the world. The absence of a defensive grid or ability to degrade this course of action by

the enemy is frightening. In the near future, the U.S. could face a situation where nuclear payloads will possibly strike the homeland from a hypersonic missile, aircraft, or cruise missile and our leaders must decide the appropriate response. The inevitability of a hypersonic threat situation is upon the U.S. and it would behoove the U.S. to pursue an offset strategy capable of the preservation of precious decision space. The procurement of an integrated directed energy weapon defensive grid must happen and R&D support from a unified whole of government effort is paramount for the protection of the U.S. homeland.

Strengthen Instruments of Power

A whole of government approach to the procurement of an integrated directed energy weapon defensive grid offers a capability to counter hypersonic weapons and will have crucial implications for the entire world. In the event the U.S. achieves a networked defensive directed energy capability, it can blanket the globe with robust defensive assurance and increase diplomatic leverage in regions where enemies attempt anti-access and area denial (A2/AD) strategies against the U.S. Economic opportunities may also increase and strengthen ties in contested regions around the globe through security cooperation, deployments and regional exercises. The U.S. defense industry could be revolutionized through R&D support for the technological advancement of directed energy weapons. The creation of directed energy point defense facilities within this global grid can spur job growth in the U.S. Land based defensive facilities can be built to protect major cities and critical infrastructure in point defense scenarios; subsequently, the construction of these facilities will spur economic growth as the nation develops the necessary logistical supply chains to connected and sustain point defense facilities. This defensive grid initiative can help stimulate R&D for hyper loop transportation and high speed railways for the aging infrastructure within the U.S. The economic benefits of R&D

support for directed energy weapons have untold potential and may become a revolutionary technology for the U.S. economy to build upon, much like the inception of the internet.

The economic benefits of directed energy research may change the U.S.'s future drastically. The costs of R&D might initially detract the casual observer from the overall benefits of directed energy systems; however, the potential exists to save funds through efficiency at later dates, as budget experts factor in lifecycle costs. Although it might cost billions of dollars for the initial production of weapons systems, there will be significantly less costs in munitions expenses. Instead of spending money to replenish rockets, bullets and missiles, soldiers will just recharge laser weapons. Instead of incurring maintenance costs for ordnance and munitions storage expenses budget dollars can be saved and repurposed elsewhere since lasers have unlimited magazines. The most recent price tag on a U.S. Navy laser system was $53 million with a ceiling of $93 million in a contract with Northrup Grumman.[16] It is estimated it should cost about one dollar per shot of a laser systems capable of targeting drones and small boats. If for some hypothetical reason, the price per laser shot is increased to one thousand dollars per shot, it still pales in comparison to the cost of a Patriot Battery PAC-3 missile cost of $3.43 million per copy in 2012 dollars.[17] Munitions expenses alone make directed energy weapons development a feasible strategic choice for the U.S. and these weapons will compliment weapons systems already in the U.S. inventory.

Directed energy weapons like lasers are a strategic choice for the U.S. DOD and the continued support of laser development is essential for survival on the battlefield of tomorrow. Research and improvement must be made in reloads and heat dissipation techniques for directed energy systems to become a viable offset strategy. Improvements have already been made in areas of laser cooling, Lockheed touts each time one of its laser systems discharges, the same

process also cools it.[18] Elected officials should note, budget dollars spent on directed energy weapons develop are not resources wasted on science fiction and lasers are already operational in the U.S. military today. Numerous laser innovations have already re-shaped the battlespace upon which U.S. war fighters operate. Aircraft defensive systems currently use lasers to dazzle the seekers on missiles in combat zones today and the next evolution of directed energy weapons will help commanders win battles, planners succeed in campaigns, and strategists secure victory.

As the hypersonic era encroaches and strategists attempt to secure a U.S. victory, the U strategic potential of a directed energy weapons must be harnessed. Future strategists must prepare for potential contingencies in the hypersonic world or risk defeat. Significant limitations still exist for current laser defensive system technology in regards to power depletion over distance. R&D support is required to overcome directed energy weapon limitations; therefore, the strategy for defense of the homeland should incorporate a mixture of kinetic and non-kinetic defensive systems to bridge the gap in technology and capability. Military defensive systems should include a blended architecture integrating Patriot missiles systems, Terminal High Altitude Area Defense (THAAD) systems and directed energy weapons for hypersonic projectile interception in multiple flight regimes. The sustainment and improvement of legacy systems along with directed energy platforms will provide built in redundancy along with improved capability for the Homeland Defense mission. As our nation prepares for a hypersonic future and invests in an offset strategy; it would be prudent for strategists to prepare for setbacks as the U.S. develops directed energy weapons capability.

Conclusions

Experienced scholars often warn against technology masquerading as strategy and it would be unwise not to consider a possible future where directed energy weapons fail in the

stabilization of deterrence in the hypersonic era. As strategists forecasts possible futures the U.S. might face, one must consider at least four different alternatives. The first alternative is directed energy weapons are developed and the capabilities commensurate to such systems are enough to stabilize deterrence in our global world. This is world where peace and U.S. interests are met largely through strengthening the world order with an integrated directed energy weapons defensive grid. This is also a future where the funding for this project is allocated appropriately and the system is integrated into air, land, sea, space and cyberspace capabilities. A challenge in this future will be the decision on if the technology is shared with allies and how to incorporate benefits with the commercial sector. It is important to explore the weaknesses of directed energy systems technology and forecast when others nations can create similar capabilities. In this future the U.S. must prepare its logistical supply chain for the support of directed energy weapons systems, repair its aging infrastructure to support directed energy point defense systems, and find space in the budget for these initiatives. In order for this future to take place a whole of government approach will be required to reach a future outcome where directed energy weapons successfully work as an offset strategy to counter the hypersonic threat.

A second possible outcome the U.S. must be prepared to face is directed energy weapons systems are unable to negate the threat of hypersonic weapons. In this future, the research and development results in a failed system unable to successfully deter the nation's enemies from the employment of hypersonic weapons on the homeland. The development of directed energy weapons fail to produce capabilities intercept/destroy hypersonic weapons; consequently, deterrence equations are destabilized. A challenge of this future will be how to manage a forward presence capable of countering hypersonic threats at the source, attack ballistic missiles in the boost phase and react quickly enough to destroy vehicles employing hypersonic cruise

missiles through other means. Another significant challenge will unfold as the U.S. tries to balance the risk of escalation with the existence of hypersonic weaponry capable of nuclear and conventional delivery modes. The diplomatic implications of hypersonic weapons are not negligible in this future and the U.S. existence in a future with hypersonic enemies is probably more likely to escalate to full-scale nuclear war.

As strategists contemplate U.S. existence and viability in a world with hypersonic enemies, a third possible future to consider is directed energy weapons are only able to deliver partial capabilities against hypersonic threats. In a world where limitations on technology are inherent, the U.S. must prepare a hybrid response for this outcome. This future delivers directed energy weapons solutions only effective in some regimes and not others. This is probably the most likely future the U.S. will embark upon. Consider laser technology in its current state, challenges of weather, power over distance problems, adaptive threats and non-compliant enemies; directed energy weapons will probably produce viable offsets in the shorter ranges of missile defense. As incremental advances are made it will be possible to increase capability, preserve decision space, and achieve strategic deterrence against the hypersonic threat. A challenge in this future is a never static enemy. Strategists have to prepare for a world where the U.S. is not completely dependent on one particular type of technology and develop hybrid solutions to foster incremental growth and sustainability of directed energy weapons systems.

A hybrid kinetic and non-kinetic solution to the hypersonic threat is the optimal course strategists should consider in the VUCA world. This solution is crafted around a mixture of capabilities, built in redundancies and gives the U.S. options. It is a high end/low end capability complimenting in a synergistic approach and complicates the enemy's efforts to nullify U.S. deterrence. The use of kinetic weapons systems similar to THAAD and Patriot missiles along

with directed energy weapons platforms (laser/microwave) could provide ample capability to deter and defeat hypersonic threats. The combination of similar capabilities in multiple air and space assets along with cyberattacks in the hybrid solution can increase deterrence and counter the emergence of hypersonic weapons.

Despite the probability of a successful hybrid solution future, a final future strategists should consider is the emergence of a new technology or capability discovered to counter hypersonic weapons. It is the possible creation of a radical new technology neither kinetic nor directed energy able to negate the emergence of hypersonic weapons. It is difficult to imagine what it could be, yet and still funding reserves must be kept to pursue R&D for such a venture. One cannot stipulate what exactly this technology will be, but the possibility exists science may have a breakthrough in some area and potentially alter the world in drastic ways. The possibilities are endless, but the ability to allocate resources quickly may determine if a country can defend its borders or not.

As the U.S. defends its borders, the ability to strategically forecast threats, resource R&D, and prepare our nation for the future will determine our trajectory for years to come. Whether by design or luck, the U.S. is a global leader in the world and must counter aggression or risk losing power on the international stage. Whether this is soft power or military might, perceptions matter and the world of identity politics is pervasive. Should the deterrence equation lessen enough for Russia to violate the sovereignty of our NATO allies; the U.S. will be forced to respond. The response given when hypersonic weapons are pointed at the Pentagon will better equipped with the incorporation of a directed energy weapon defensive grid.

As U.S. statesmen prepare for situations involving the emergence of hypersonic weapons, they must contemplate the potential motives of international actors in any response. Based upon

careful consideration of the actions of countries like Russia and China the U.S. must prepare for future with hypersonic weapons. The most plausible course of action strategist should consider to address the emergence of hypersonic threats is a hybrid directed energy weapons defensive grid solution. The procurement of directed energy weapons across multiple platforms is not only feasible, it embeds redundancy into capability. A hybrid approach does not abandon kinetic efforts to counter the threat; it amplifies the synchronization of a network of capabilities against hypersonic missiles. The hybrid directed energy weapons defensive system grid will counter-balance/offset some of the consequences if directed energy weapon development fails to deliver capability in some regimes of hypersonic missile defense. Directed energy research will impact the entire world and elected officials have a strategic choice before them. Through support for R&D and the creation of a directed energy weapon defensive network system the U.S. will simultaneously defends its sovereignty, address domestic concerns in the U.S., create jobs, strengthen infrastructure and stabilize the deterrence equation.

Hypersonic technological achievements have been observed around the globe and these new weapons will destabilize nuclear deterrence and revolutionize future warfare. Consequently, the U.S. must employ an appropriate offset strategy to counterbalance against hypersonic weapons or risk defeat. Directed energy weapons offer a feasible approach to countering hypersonic weapons, safeguarding decision space, and strengthening the military, diplomatic, and economic instruments of power simultaneously. The allocation of resources towards R&D for directed energy weapons will provide security options for the U.S. and open potential avenues for revolutionary technological changes in our world.

Notes

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