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Anthony J. Behrens, Colonel, U.S. Army

Paper Advisor: Dr. William Bundy and Mr. Walter Bonilla

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14. ABSTRACT

The Army's Integrated Battle Command System (IBCS) will integrate sensors, shooters and mission command with multiple defensive and counter-fire capabilities. The Navy's Cooperative Engagement Capability (CEC) is similarly designed. To maintain a position of advantage over the evolving air and missile threat, the Department of Defense requires a joint fire control and sensor optimization platform immediately adaptable and capable of updating mission command functions across the battlespace to effectively counter anti-access and area denial (A2/AD) strategies in a multi-domain operating environment.

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Joint Air and Missile Defense Mission Command:
A Singular, Intelligent Multi-Domain Platform and Culture

Anthony J. Behrens
Colonel, U.S. Army

A paper submitted to the Faculty of the United States Naval War College, Newport, Rhode Island in partial satisfaction of the requirements of the Admiral Samuel L. Gravely, Jr. Advanced Research Program.

May 29th, 2018

Abstract

The Army's Integrated Battle Command System (IBCS) will integrate sensors, shooters and mission command with multiple defensive and counter-fire capabilities. The Navy's Cooperative Engagement Capability (CEC) is similarly designed. To maintain a position of advantage over the evolving air and missile threat, the Department of Defense requires a joint fire control and sensor optimization platform immediately adaptable and capable of updating mission command functions across the battlespace to effectively counter anti-access and area denial (A2/AD) strategies in a multi-domain operating environment.

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I am grateful to many mentors and contributors for their efforts in the development of this paper, to include Army Brigadier General Randall McIntire, Brigadier General Clem Coward, Colonel (Retired) Joseph DeAntona – all graduates of the U.S. Naval War College, and the Director of the Gravely Advanced Research Program, William F. Bundy, PhD and Walter Bonilla. Technical and idea support was contributed by my fellow classmates and members of Raytheon Integrated Defense Systems and the IBM Corporation's Watson program in the course of dedicated research.

I thank my family for their unwavering support and dedicate this work to my wife, Princess, for her committed care of Army Families and my late brother, Rick, a former Naval Intelligence Officer who contributed significantly to the application of artificial intelligence for defense applications. Their inspiration quietly sustains me every day.

I further dedicate the ideas in this paper to the Soldiers, Sailors, Airmen, Marines and Coastguardsmen we lead; that they may only benefit from expert, compassionate and disciplined leadership. They deserve our very best!

Author's Note

Portions of this paper are derived from a collection of the author's research and writing throughout the academic experience at the United States Naval War College 2017-2018. All portions of this paper are the author's own, independent work.

ANTHONY J. BEHRENS
Colonel, U.S. Army

Peer Review

This paper has been peer-reviewed by a fellow Gravely Advanced Research Program classmate.

JEANETTE SHEETS
Commander, U.S. Navy

Preface & About the Author

As a young Army Air Defense Officer, I experienced a time when our military air and missile defense systems shared little commonality. Interoperability, even today, much remains the task of dedicated operators and leaders to coordinate across service divides. Over the years, we've adopted an operating concept of Joint Integrated Air and Missile Defense, or JIAMD, however, we struggle to achieve system, doctrinal and organizational interoperability throughout the Department of Defense and among internal military department systems. This paper is designed to provoke thought on how the Department and the services can continue to merge our IAMD cultures and solutions beyond service remedies and achieve lasting change in Joint military defense operations.

Colonel Tony Behrens is a career Army Air Defense Artillery officer. He has held leadership, staff and command positions from the platoon, Patriot fire unit, battalion, brigade, and general officer staff levels. He commanded the first Patriot Advanced Capabilities (PAC) 3, Configuration 3 battery in support of OPERATION SOUTHERN WATCH in Kuwait 2002, and later, OPERATION IRAQI FREEDOM beginning March 19th 2003. Colonel Behrens planned and coordinated the return of Army IAMD to the Middle East on behalf of the 32d Army Air and Missile Defense Command from 2006 to 2009 and, in 2008, served as the Operations Officer (S3) of the 11th Air Defense Artillery Brigade headquarters, the first to forward deploy to the Middle East since 2003.

Colonel Behrens later commanded the 3d Battalion, 43d Air Defense Artillery while deployed to the U.S. Central Command theater of operations in 2014 and integrated a forward deployed AN/TPY-2 missile defense battery. Upon redeployment, he integrated all five existing Terminal High Altitude Area Defense (THAAD) batteries at Fort Bliss, Texas into the battalion and supported multiple THAAD test and deployment operations. Colonel Behrens transitioned 3-43 ADA to assume responsibility of testing the Army's newest distributive mission command capability, the Integrated Battle Command System (IBCS).

Most recently, Colonel Behrens served as the Air Defense and Multi-Domain Task Force Organizational Integrator on the Army Staff in Washington, D.C. He developed the initial organizational and stationing concept for the return of the Army's short-range air defense (SHORAD) capabilities, assisted in the permanent stationing of THAAD to Guam and the Republic of Korea, led Army IAMD planning in support of the European Reassurance Initiative, and established the Chief of Staff of the Army's initial vision for the use of multiple Army capabilities in a single multi-domain organization. While at the Pentagon, Colonel Behrens advised an Army committee as it leveraged big data analytics to research suicide risk among Soldiers and Veterans. Colonel Behrens holds a Master of Public Administration and National Security Policy and, upon completion of this program, will be conferred a Master of National Security and Strategic Studies. Colonel Behrens' follow-on assignment will be as the capabilities manager for the U.S. Army's integrated air and missile defense systems world-wide at the U.S. Army Fires Center of Excellence (FCoE), Fort Sill, Oklahoma.

Contents

Definitions of Terms & Acronyms

A2/AD	Anti-Access and Area Denial
AIAMD	Army Integrated Air and Missile Defense
CEC	Cooperative Engagement Capability (U.S. Navy)
C2BMC	Command and Control, Battle Management, and Communications (DoD)
FBX	Forward Base X-Band (Radar) (U.S. Army)
GMD	Ground-based Midcourse Defense (U.S. Army)
GBI	Ground-based Interceptor (U.S. Army)
IBCS	Integrated Battle Command System (U.S. Army)
IFPC	Indirect Fire Protection Capability (U.S. Army)
JIAMD	Joint Integrated Air and Missile Defense
JIAMDO	Joint Integrated Air and Missile Defense Organization (DoD)
MDA	Missile Defense Agency (DoD)
MDTF	Multi-Domain Task Force (U.S. Army)
MML	Multi-Missile Launcher (U.S. Army)
MSE	Missile Segment Enhancement (U.S. Army)
NIFC-CA	Naval Integrated Fire Control-Counter Air (U.S. Navy)
PAC (2/3)	Patriot Advanced Capabilities (U.S. Army)
THAAD	Theater High Altitude Area Defense (U.S. Army)
SDI	Strategic Defense Initiative

"Free people must voluntarily, through open debate and democratic means, meet the challenge that totalitarians pose by compulsion. It's up to us, in our time, to choose and choose wisely between the hard but necessary task of preserving peace and freedom and the temptation to ignore our duty and blindly hope for the best while the enemies of freedom grow stronger day by day."[1]

– President Ronald Reagan, Address to the Nation on Missile Defense

INTRODUCTION

Missile defense is a necessary investment in integrative diplomacy that requires a streamlined multi-domain strategic mission command platform to actively deter, offensively diminish, and defensively deny an aggressor's ability to coerce the United States. The Army's Integrated Battle Command System (IBCS) will integrate sensors, shooters and mission command with multiple defensive and counter-fire capabilities. The Navy's Cooperative Engagement Capability (CEC) and Naval Integrated Fire Control-Counter Air (NIFC-CA) is similarly designed. To maintain a position of advantage over the evolving air and missile threat, the Department of Defense requires a single joint fire control and sensor optimization platform immediately adaptable and capable of updating mission command functions across the battlespace to effectively counter anti-access and area denial (A2/AD) strategies in a multi-domain operating environment. By taking account of the re-emerging global threat since the end of the Cold War and fall of the Soviet Union in 1989, the United States can take immediate and long-lasting strategic measures to secure an integrated defense. The United States and its international partners need a stronger, integrated and synchronized missile defense strategy and mission command capability that will change the strategic calculus for countries like China, North Korea, Russia and Iran.

[1] Reagan, Ronald, "President Reagan's SDI Speech: Address to the Nation on Defense and National Security."

President Reagan's speech on March 23rd, 1983 underscored the time. A powerful Soviet Union, he argued, had the means to deliver nuclear ballistic missiles to the United States and the only resource to deter such an attack was a similar capability. Mutually assured destruction in the first nuclear age, the thought was, effectively deterred an unprovoked attack on our nation. But we had no defense. Like much of the public in the latter half of the 20th Century, President Regan believed in our ability to leverage technology to reduce the risk to human life. He proposed a synchronized anti-nuclear missile defense strategy, the Strategic Defense Initiative (SDI), informally referred to as 'Star Wars'. SDI was more than defending against a ballistic missile attack from space. It initiated a series of tasks that led to capabilities we employ today.[2]

The ultimate vision of intercepting ballistic missiles from the advantage of space is not yet fulfilled. However, more than 35-years after President Reagan's SDI speech, we presently employ space-based missile early warning with satellites that detect a missile in its initial boost phase.[3] With this information we warn affected areas of the inbound attack and cue available defense resources to provide them the best tactical advantage. Regional and theater air and missile defense such as the Patriot Advanced Capabilities (PAC-2 and 3) family of interceptors provide point defense against multiple regional air threats and missiles at the low terminal, or final phase of a ballistic missile's trajectory. Under operational testing now, the Army's newest PAC-3 Missile Segment Enhancement (MSE) will significantly increase the upper limits and speed of Patriot.[4] Terminal High Altitude Area Defense (THAAD) intercepts at the high

[2] Peoples, *Justifying Ballistic Missile Defence: Technology, Security and Culture*, 112:125–37.
[3] "Space-Based Early Warning: From MIDAS to DSP to SBIRS," https://nsarchive2.gwu.edu/NSAEBB/NSAEBB235/ (accessed February 5, 2018).
[4] "MDA - PATRIOT Advanced Capability-3 (PAC-3)," https://www.mda.mil/system/pac_3.html (accessed February 5, 2018).

terminal phase. The U.S. Navy's Aegis Ballistic Missile Defense (BMD) destroyer tracks its target with a Spy-1 radar deep in the early stages of flight and intercepts at the midcourse phase, just post-apogee as the missile begins its descent.[5] The United States also employs the strongest ground and sea-based radar systems on the planet, all to provide early warning and target information to shooters around the world.[6] More to President Reagan's vision, the Ground-based Midcourse Defense (GMD) program, with an extremely limited number of interceptors, protects the Continental United States from an intercontinental ballistic missile (ICBM) attack.[7] We share limited information with our international partners, many of which purchased U.S. integrated air and missile defense (IAMD) ships, sensors, weapons, communications architecture and interceptors.[8] Air and missile defense technology continues to evolve in response to the threat. This evolution, the result of over five decades of studying the air and missile threat, is far from complete. While there are many attempts to streamline and integrate mission command of these system, there is no single joint air and missile defense mission command platform.

Compared to threat systems such as ballistic and cruise missiles or unmanned aerial systems, air and missile defense is prohibitively expensive. Research and development, testing, lengthy acquisition processes, continuous software upgrades, intercept missile technology, force structure, facilities, communication architectures, regionally forward deployed capabilities, and homeland defense systems, as President Reagan admitted in his speech, cost tax-payers amid a growing deficit and cuts in other vital domestic programs. In light of emerging regional and

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[5] "MDA - Aegis Ballistic Missile Defense," https://www.mda.mil/system/aegis_bmd.html (accessed February 5, 2018).

[6] "Sea-Based X-Band Radar-1 (SBX-1)," http://www.naval-technology.com/projects/sea-based-x-band-radar-1-sbx-1/ (accessed February 7, 2018).

[7] "Ground-Based Midcourse Defense (GMD) System," https://missilethreat.csis.org/system/gmd/ (accessed February 2, 2018).

intercontinental threats, the 2018 National Defense Authorization Act approved a record $10.5 billion in federal funding for improved missile defense capability and capacity.[9] However, the compounded risk is mounting with continued threats of government shutdowns and without a Congressionally ratified federal budget. To understand this impact, we must first examine the threat.

[9] Thornberry, "Text - H.R.2810 - 115th Congress (2017-2018)," https://www.congress.gov/bill/115th-congress/house-bill/2810/text (accessed February 10, 2018).

CHAPTER 1: The Evolving and Expanding Air and Missile Threat

The changing global threat drives the desperate need to seek and apply new technologies, re-assess our array of air and missile defense forces, and re-focus our national security policy and strategy. Strategy is largely about organizing and prioritizing scarce resources to systematically address strategic national security objectives and goals. Understanding the full collection of regional, international and intercontinental air and missile threats comes first in aligning a proper strategy and integrating a standard JIAMD mission command capability.

North Korea

"A conflict in North Korea would be probably the worst kind of fighting in most people's lifetimes… The North Korean regime has hundreds of artillery cannons and rocket launchers within range of one of the most densely populated cities on Earth… This regime is a threat to the region, to Japan and South Korea and in the event of war they would bring danger to China and to Russia as well. But the bottom line is it would be a catastrophic war if this turns into… combat if we're not able to resolve this situation through diplomatic means."[10]

– Secretary of Defense James Mattis, May 28th, 2017
Televised interview, Face the Nation

At a Pentagon press briefing on May 19th, 2017, Secretary Mattis said "if this goes to a military solution, it's going to be tragic on an unbelievable scale." North Korea has maintained its threat against South Korea, Japan and U.S. Forces in Asia with its arsenal of short, medium and intermediate range ballistic missiles. These missiles can deliver weapons of mass destruction and high explosives. Added to North Korea's conventional artillery, they have an overwhelming capacity of force. Add, now, their long-range and developing ICBM capability, they can threaten the entire Pacific including Guam and Hawaii as well as the United States

[10] Hanham and Ji, "Advances in North Korea's Missile Program and What Comes Next," 9.

mainland.[11] Figure 1 illustrates North Korea's growing ballistic missile competency from 1984 to now. North Korea's continued efforts to weaponize a nuclear warhead on an ICBM capable of ranging the U.S., under the intemperate leadership of Kim Jong Un, is reminiscent of 1983 and a renewed effort to align missile defense strategy.

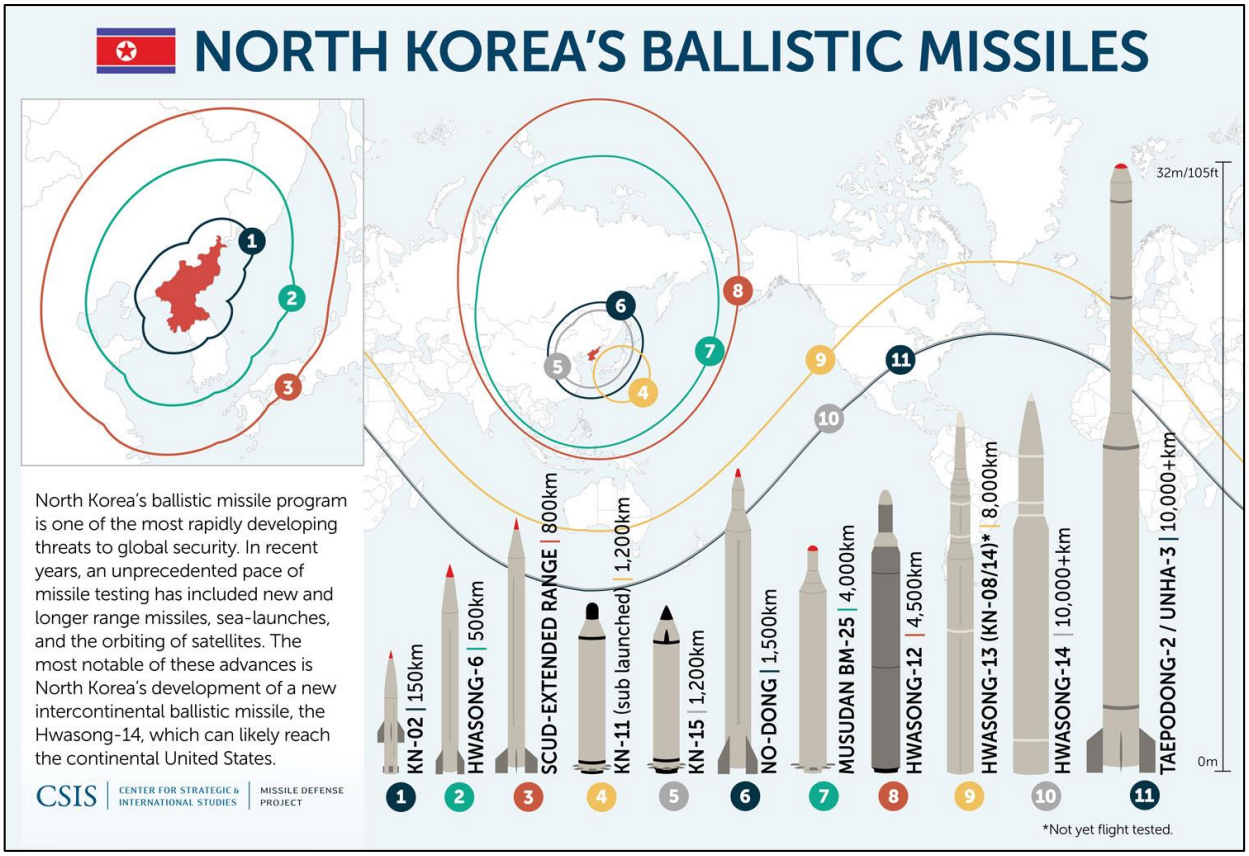

Figure 1: North Korea's Ballistic Missiles.[12] *Since early 1984, North Korea's ballistic missile program has expanded at an alarming rate. Under Kim Il Sung (leader between 1984 and 1994), Korea test-launched 15 ballistic missiles. Under Kim Jong Il between 1994 and 2011, the country fired 16. However, under its current leader, Kim Jong Un, North Korea has developed several new missiles and provocatively test-launched at least 122 and tested its nuclear capability in an underground facility.*[13]

[11] Hanham and Ji, 6; Dodge, "President Obama's Missile Defense Policy: A Misguided Legacy," 2. Hanham and Ji, "Advances in North Korea's Missile Program and What Comes Next," 6; Dodge, "President Obama's Missile Defense Policy: A Misguided Legacy," 2.

[12] "Missiles of North Korea," https://missilethreat.csis.org/country/dprk/ (accessed January 19, 2018).

[13] Hanham and Ji, "Advances in North Korea's Missile Program and What Comes Next," 9.

Iran

In the Middle East, the U.S., its Allies and partners face daily threat of short to medium range ballistic missiles from Iran. Iran continuously threatens Israel with its long-range missiles as it evades targeting by traversing ballistic missile operating areas with tractor-erector-launchers (TEL) dispersed throughout its territory.[14] TELs are capable of hiding, emerging on challenging terrain, firing, then hiding again before a military coalition can locate and destroy them.

Figure 2: Iran's Ballistic Missiles.[15] *Though largely regional, Iran's ballistic missile arsenal aims is to control U.S. partnerships through proxies such as the Houthi Rebels, Syria and even North Korea. Iran poses a significant threat throughout the Arabian Gulf and to deployed U.S. and partner-nation forces. (UNCLASSIFIED)*

Iran continues to challenge the United Nations Security Council and signatories of the Iran Nuclear deal with its ballistic missile tests, proxy wars and failure to submit to International

[14] Dodge, "President Obama's Missile Defense Policy: A Misguided Legacy," 9.
[15] "Missiles of Iran," https://missilethreat.csis.org/country/iran/ (accessed January 19, 2018).

Atomic Energy Agency (IAEA) inspections – now in question with U.S. President Trump's decision to withdrawal from the agreement. U.N. Security Council Resolution 1929 dictates that "Iran shall not undertake any activity related to ballistic missiles capable of delivering nuclear weapons, including launches using ballistic missile technology."[16] Iran's history of lying about its nuclear capability and ballistic missile aspirations to the IAEA and the U.N., as well as its covert cooperation with North Korea, Syria, Hamas, and Houthi Rebels in Yemen, underscore the need for a robust integrated air and missile defense program that can only be effective with a synchronized and advanced JIAMD mission command capability.[17]

Figure 3: Iran's Proxy War Against Saudi Arabia.[18] *U.S. Ambassador to the United Nations, Nikki Haley, briefs the evidence against Iran that it is in violation of U.N. Security Council Resolution 1929 and the Iran nuclear agreement by fueling proxy wars against its enemies, most recently by supplying ballistic missiles to Houthi Rebels in Yemen. Houthis have launched several ballistic missiles into Saudi Arabian airspace, some of which Saudi Arabian air defense forces have neutralized with its U.S.-supplied Patriot missile system. (UNCLASSIFIED)*

[16] Dodge, "President Obama's Missile Defense Policy: A Misguided Legacy," 3.
[17] Karako, *A Missile Defense Agenda*, 69:29.
[18] "Nikki Haley Presents Evidence Claiming Iran's Ties to Houthi Missile Strike," https://www.usnews.com/news/politics/articles/2017-12-14/nikki-haley-presents-evidence-claiming-irans-ties-to-houthi-missile-strike (accessed January 19, 2018).

China, Russia and Mutual Vulnerability

China and Russia both maintain and continue to develop their ballistic missile, cruise missile, and manned and unmanned aerial system programs. Their capabilities threaten the U.S., Europe, the Pacific and each other. Recent aggression by both countries and continued long-range ballistic missile modernization illustrates their collective anti-U.S. strategy.[19] Russia maintains the second-largest nuclear force in the world and it views the deployment of U.S. and North Atlantic Treaty Organization (NATO) air and missile defense systems as highly destabilizing.[20] China and Russia demonstrate a belief that U.S. and NATO missile defenses, though not their own, undermine nuclear deterrent capabilities. Russia and China claim that the U.S. ballistic missile defense system (BMDS) is an effort to escape 'mutual vulnerability'. China also believes that BMD systems could be used in an offensive role. This is a primary reason China is exploring its own missile defense capability.[21]

China's focus on modernization and development while aggressively expanding its military capacity beyond territorial waters in the South China Sea are concerning Southeast Asia nations such as the Philippines and Vietnam. In an effort to control their sovereignty and trade, China is leveraging its Navy and ballistic missile program to deny freedom of navigation and access within the first island chain from the Philippines to Taiwan.

In 1990, China employed a few dozen short-range missiles primarily intended to maintain control over Taiwan. By 2015, China maintained more than 1,000, adding medium and intermediate-range capacity. China's development of its anti-ship ballistic missile will degrade U.S. and Allied deterrence, free trade in the South China Sea and Southeast Asian nations'

[19] Dodge, "President Obama's Missile Defense Policy: A Misguided Legacy," 9.
[20] Garcia, "Strategic Stability in the Twenty-First Century: The Challenge of the Second Nuclear Age and the Logic of Stability Interdependence," 13.
[21] Garcia, 358.

sovereignty. China's development of its intermediate-range missile program is another reason Russia has fielded its ground launched cruise missile, in violation of the Intermediate-Range Nuclear Forces (INF) Treaty.[22] This clearly impacts stability in East Asia and Europe.

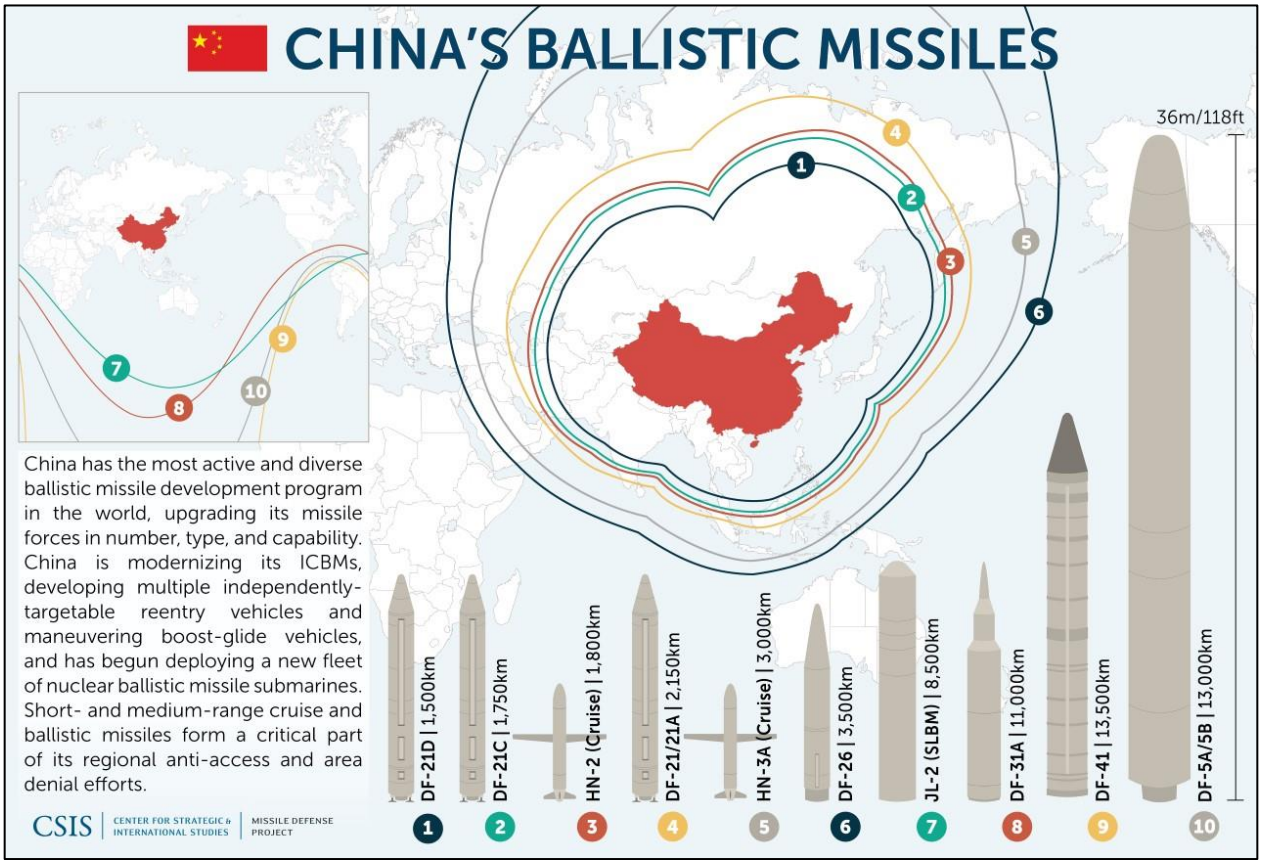

Figure 4: China's Ballistic Missiles.[23] *(UNCLASSIFIED)*

President Reagan and Mikhail Gorbachev signed the INF Treaty in 1987, another measure of Regan's vision for stability and security. Senator John McCain (Republican-Arizona) argued that Russia's cruise missile poses "a significant military threat to U.S. Forces in Europe and our NATO Allies," and that the U.S. must "take immediate action to enhance our deterrent posture in Europe and protect our Allies."[24] In July 2014, the Obama Administration notified Congress that Russia was violating the treaty when it began testing the missile. Russia

[22] Garcia, 356–58.
[23] "Missiles of China," https://missilethreat.csis.org/country/china/ (accessed January 19, 2018).
[24] Atlas and Tennis, "Russia Advances Banned Cruise Missile," 36.

created two battalions with this capability. One was placed at an operational base in December 2016.[25]

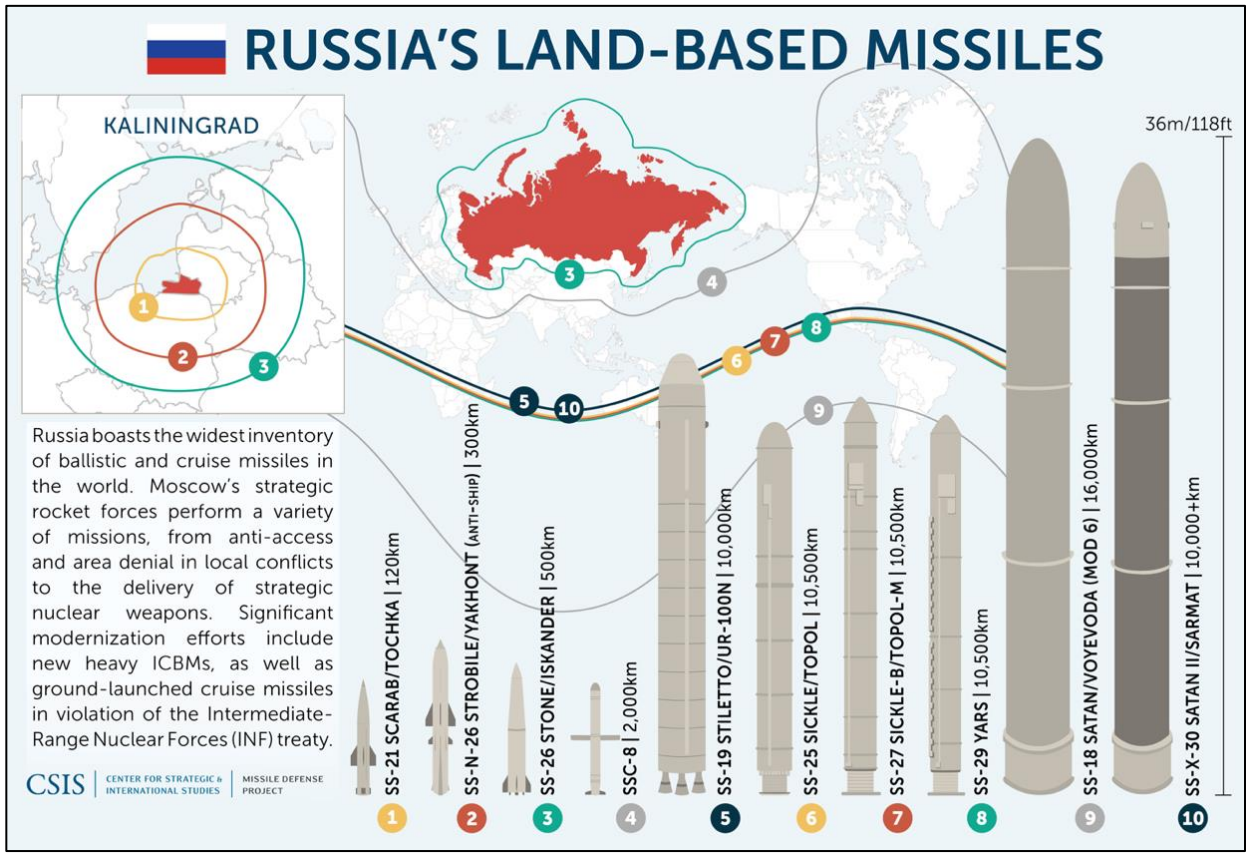

Figure 5: Russia's Land-based missiles.[26] *Not depicted is Russia's sea and air-launched missile capacity. With conventional and unmanned nuclear submarines, Russia can strike nearly anywhere in the world with little to no notice. (UNCLASSIFIED)*

Russia continues its aggressive stance in Europe as it pursues to negate U.S. national security agreements and relationships in the Middle East. Russia maintains a formidable ICBM capability and continues to modernize its ballistic missile and nuclear technology. In another violation of the INF Treaty, Russia routinely threatens NATO allies with nuclear retaliation for cooperating with U.S. missile defense strategy. With its newest capability, an unmanned nuclear submarine can launch a 100 mega-ton or cobalt armed ballistic missile as it threatens coastal

[25] Atlas and Tennis, 41.
[26] "Missiles of Russia," https://missilethreat.csis.org/country/russia/ (accessed January 19, 2018).

areas with no notice of a strike.[27] What makes an unmanned sub-surface vehicle so dangerous is the length of time it can remain hidden without a need to surface to refuel, resupply or return a human crew to its home station, making it very difficult to track.[28] Consider the threat from a submarine, needing no food or water, capable of lurking indefinitely within range of the United States coastline. This game-changer destabilizes the concept of mutual vulnerability and requires a sound global air and missile defense strategy.

CHAPTER 2: Redefining the Missile Defense Mission Command Ethos

Today's leaders recognize the imperative to enable multi-domain joint mission command. For air and missile defense, this imperative garners significant interest. "Missile threats respect no domain."[29] Our adversaries deliver air and missile threats through the air and space, over land and sea, and by their navies, armies and air forces. Yet, U.S. air and missile defense systems are limited in their ability to jointly detect, track, assess and neutralize these threats because they lack critical interoperable components. For example, the Army's Patriot system is a closed air and missile defense architecture. Its fire control system must use an organic Patriot radar to command on-site, or directly remote-netted launchers. As a result, when a battery has limited interceptors, it will only fire within its limitations rather than selecting the best possible interceptor from another Patriot battery – or better, an inter-service platform such as Aegis BMD. And while the Information Coordination Central (ICC), the battalion level fire control, can command a second Patriot battery to engage a target, that battery must be in precisely the right location and use its organic radar to track the threat and lead its interceptor to the target.

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[27] Dodge, "President Obama's Missile Defense Policy: A Misguided Legacy," 5.
[28] Insinna, "Russia's Nuclear Underwater Drone Is Real and in the Nuclear Posture Review," https://www.defensenews.com/space/2018/01/12/russias-nuclear-underwater-drone-is-real-and-in-the-nuclear-posture-review/ (accessed February 5, 2018).
[29] Stone, "Synchronized, Simultaneous Combat," 2.

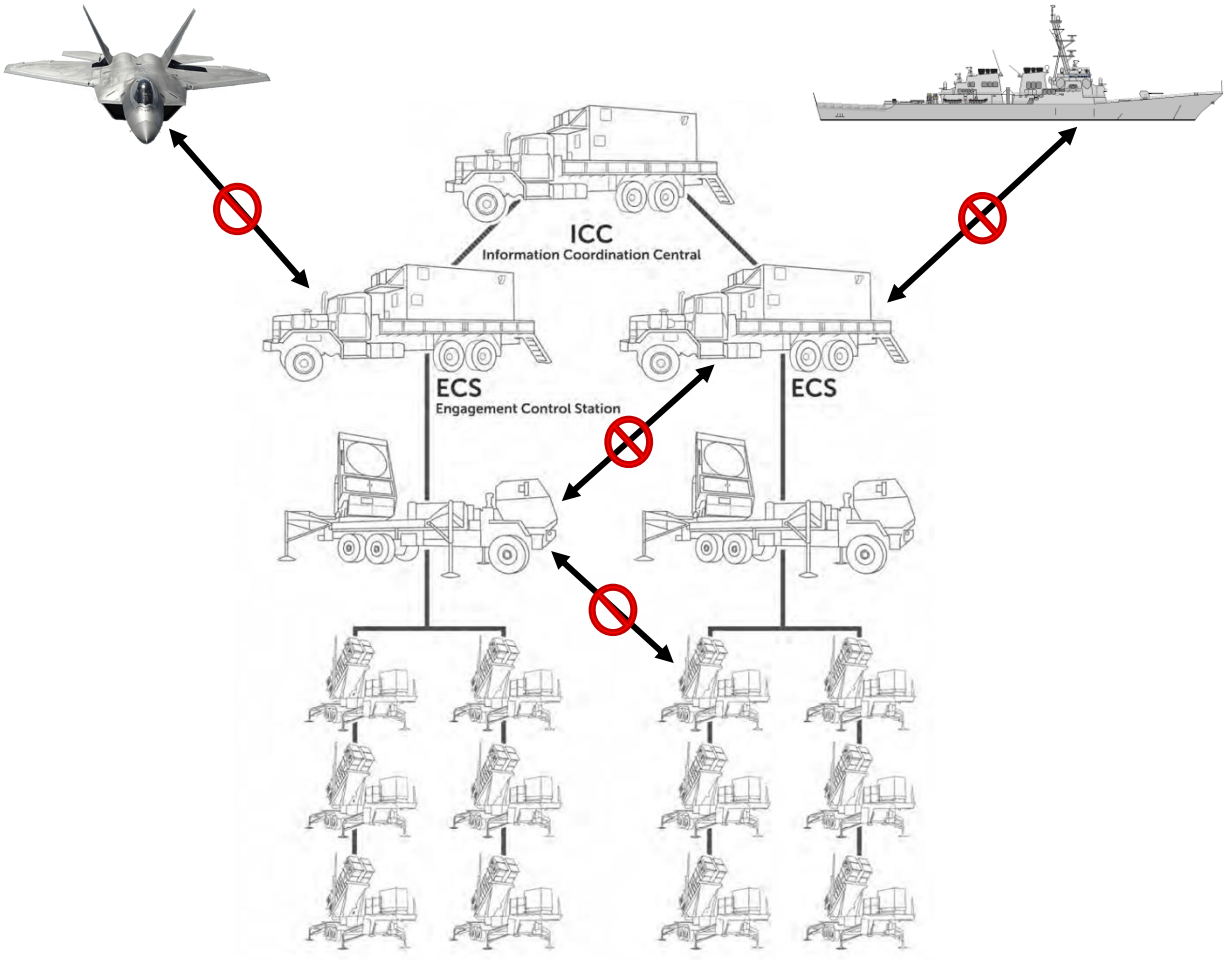

Figure 6: Closed Networks. *The Army's Patriot missile system, until the introduction of its Integrated Battle Command System (IBCS), has operated solely in a 'stovepipe', or closed architecture that requires a battery with organic radar, fire control, launchers and interceptors to prosecute air and missile engagements. Terminal High Altitude Area Defense (THAAD) operates in a similar manner.* [30]

This mode of operating presents several potential single points of failure. For example, if the only Patriot radar in a battery ceases to operate, the entire set of interceptors is largely unusable. Either the battery fixes its radar, replaces it by delivering an off-site radar to the fire unit, or it redistributes interceptors; all of which are time consuming and expensive remedies that

[30] Karako and Wes Rumbaugh, "Distributed Defense: New Operational Concepts for Integrated Air and Missile Defense.," 11.

pose considerable tactical risk. The Army has addressed this issue to a degree, but only if the launchers of the non-mission capable battery are within the forward view of a second battery that can attain remote-control – and still, with many limiting factors. The operational risk a Joint Fore Commander assumes increases when he or she must distribute the batteries over a wide area in order to protect numerous and divergent critical assets. Stove-piped air and missile defense platforms are a symptom of a larger joint mission command problem.

As Chairman, Joint Chiefs of Staff, General Martin Dempsey published a JIAMD Vision for 2020 in December 2013. This document articulates the imperative to integrate all U.S. and international partner IAMD into a single, seamless capability. The 2020 vision identifies four constants that will shape the DoD's approach to JIAMD. The "evolving global security environment" acknowledges ballistic, cruise and hypersonic missile technology. "Expanding battlespace" deepens the need to operate in a multi-domain environment from the theater to the homeland. "An era of declining defense budgets" will remain imbalance against global JIAMD demand. "Increasing Allied and partner appetite" for JIAMD underscores worldwide concern and places a high premium on defensive capabilities. The JIAMD Vision 2020 argues for 'horizontal integration' of existing and future capabilities, to include coordination with JIAMD partner nations and directs increased efforts to fuse the following capabilities.[31]

1. Incorporate, fuse, exploit, and leverage every bit of information available regardless of source or classification, and distribute it as needed to U.S. Forces and selected partners.[32]
2. Make interdependent Joint and Combined force employment the baseline.

[31] Dempsey, Martin E., "Joint Air & Missile Defense: Vision 2020," 1.
[32] Dempsey, Martin E., 4–5. Points 1-6 are directly cited.

3. Target development, modernization, fielding, and science and technology efforts to meet specific gaps in IAMD capabilities, all the while stressing affordability and interoperability.
4. Focus passive defense efforts on addressing potential capability and capacity shortfalls in air and missile defense.
5. Establish and pursue policies to leverage partner contributions.
6. Create an awareness of the IAMD mission and the benefits of its proper utilization across the Department of Defense.

General Dempsey laid a framework for JIAMD collaboration across the services and encouraged interoperability among U.S. and partner nation IAMD systems. "The effectiveness with which we field competent Joint IAMD capabilities will help prevent catastrophic attacks on the U.S. Homeland; secure the U.S. economy and the global economic system; and build secure, confident, and reliable allies and partners."[33] In 2013, while the Navy sped past its review of CEC/NIFC-CA and the Army sought AIAMD/IBCS, senior military leadership acknowledged and authorized the sort of systems integration outlined in this paper. Further, General Dempsey recognized the necessity for international integration and sharing data and information to combine JIAMD efforts into a single whole. Yet, the more advanced we make our systems, the seeming less joint and combined they become.

There are many organizations within the DoD that fuel the confusion of how the United States should coordinate JIAMD fires. Each military service retains its own acquisition and procurement authority, although the Missile Defense Agency is charged to help synchronize efforts. In January 2002, the Secretary of Defense reorganized the Ballistic Missile Defense

[33] Dempsey, Martin E., 5.

Organization (BMDO) into the Missile Defense Agency (MDA).[34] This change charged MDA with the responsibility and authority to manage missile defense programs from acquisition to integration.

President Trump's proposed 2019 budget includes $12.9 billion for missile defense, which includes an annual allocation of $9.9 billion for MDA and $3 billion to modernize military service IAMD. This request largely focuses on managing, updating and maintaining existing programs and increasing capacity for programs such as Ground-based Midcourse Defense by adding 20 interceptors. But extra funding, if approved, does not address air and missile defense integration, modernizing mission command or programs that further support the National Security Strategy and National Defense Strategy.[35] While the budget does fund at least one discrimination radar in Hawaii for homeland defense, it fails to recognize the growing mission command flaws in U.S. JIAMD infrastructure as we continue to add capacity.

$1.5 billion of the 2019 request would fund Patriot modernization, of which, $1.1 billion will add the Patriot Missile Segment Enhancement (MSE) interceptor to close the high-terminal phase gap between Patriot and THAAD. The Army requested a total of $2 billion more each year to support its IAMD missions.[36] Air and Missile Defense is one of the Army's top six modernization priorities. Closely related to IAMD capabilities and capacity growth, the Army's number one effort is to integrate Long Range Precision Fires, a surface-to-surface strike capability to complement multi-domain battle requirements. Within IAMD, the Army plans to

[34] McConnell and Jordan, "Naval Integrated Fire Control - Counter Air Capability-Based System of Systems Engineering," 3.
[35] Karako, Tom and Wess Rumbaugh, "Trump's 2019 Missile Defense Budget: Choosing Capacity over Capability," 2.
[36] Sydney J. Freedberg, "Missile Defense Vs. China, Russia: Decentralize, Disperse, & Hide."

spend the most, $3.2 billion between 2020 and 2024, on its new Maneuver SHORAD capability and $2 billion on integrated air and missile defense battle command.[37]

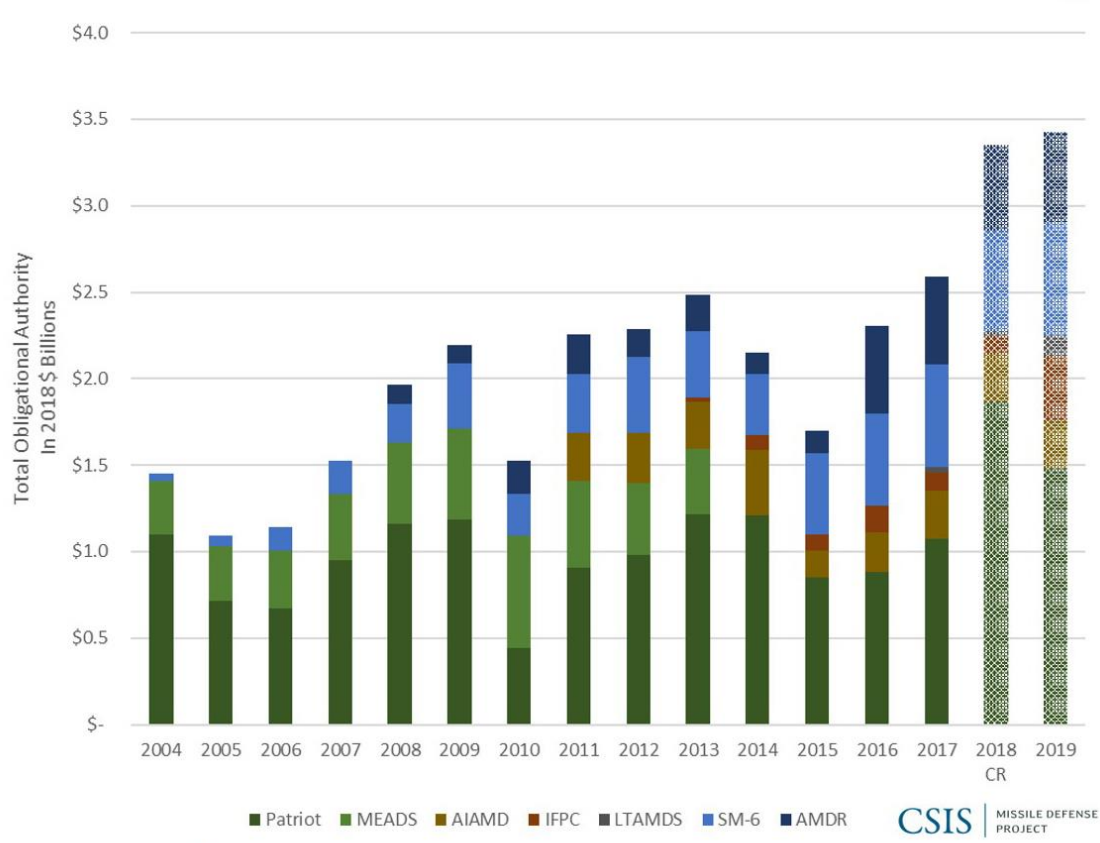

Figure 7: The Cost of JIAMD. *Funding for IAMD capabilities illustrated by year and system. (UNCLASSIFIED)*

What there is little focus on funding JIAMD mission command, the Army and Navy lead individual programs and the Air Force seems to participate at limited scope and frequency. JIAMD mission command could help the DoD in saving millions, if not billions, in wasted research, development and procurement of separate platforms.

[37] Sydney J. Freedberg.

CHAPTER 3: Current DoD IAMD Mission Command Systems for Comparison

The DoD's primary JIAMD sensor, shooter and interceptor capabilities all leverage separate and distinct mission command and control platforms. In decades of air and missile defense development, the DoD and its services have attempted to merge mission command capabilities. The goal has been to achieve interoperability between platforms in order to expand U.S. JIAMD versatility. Since President Reagan's SDI speech in 1983, this joint effort continues to elude the U.S., even as it develops and modernizes the latest in air and missile defense technologies. In order to focus upon, and commit to, a single multi-domain capable JIAMD mission command structure and platform, one must first investigate these efforts.

Command and Control, Battle Management, and Communications (C2BMC)

The Missile Defense Agency's C2BMC intends to synchronize the multi-layered missile defense system with sensors and operators.[38] The ballistic missile defense system (BMDS) includes multiple complex systems and platforms from space-based early warning to sophisticated ground and air sensors, to lethal defensive weapons. "The C2BMC system receives, processes, and displays tracking and status data from these elements so that commanders at various locations have the same integrated operating picture and can make coordinated decisions about deploying weapons." MDA's intent with C2BMC is to leverage the most effective sensor and weapon to counter ballistic missile threats.

Developed by Lockheed Martin and Northrup Grumman, C2BMC includes three mission areas designed to address JIAMD requirements: command and control (C2), battle management, and communications. Within these mission areas, C2BMC is designed to assist operators in

[38] "Command and Control, Battle Management, and Communications (C2BMC)," 1.

planning sensor management, net sensors to detect, identify, track and discriminate threats, achieve situational awareness, pair sensors and shooters for threat engagement, and to control communications networks to manage and distribute data.[39] C2BMC has come a long way since MDA began to leverage its capability prior to 2007. Hundreds of millions in federal MDA funding in the last decade have produced considerable, though mixed, results.

MDA conducted a JIAMD test in September 2013 at the Reagan Test Site on Kwajalein Atoll in the Pacific. Aegis BMD and THAAD, coordinated through C2BMC destroyed two medium range ballistic missile targets. Using an AN/TPY-2 radar in forward based mode, C2BMC cued DDG 74, the USS Decatur, which operated Aegis BMD software build 3.6.1. Decatur's system successfully correlated, tracked and killed its assigned target with a Standard Missile-3 Block IA interceptor. C2BMC also passed digital track information to a THAAD battery. Using its own organic AN/TPY-2 radar, THAAD successfully intercepted its target. It is important to note, however, that both intercepts, while cued via C2BMC, were prosecuted by each individual weapon systems mission command platforms. C2BMC did not serve as the complete mission command capability from early warning to intercept, but it did enhance the JIAMD experience.[40]

During a comprehensive assessment of the European Phased Adaptive Approach (EPAA), in which the United States develops a regional missile defense capability in support of NATO strategic objectives, the Government Accounting Office reported to Congress that MDA struggled 'to develop the tools needed to successfully assess regional missile defense performance' and that MDA had not been able to conduct 'formal system-level end-to-end simulations' as it had planned. GAO concluded that, without this data, MDA declared technical

[39] "Command and Control, Battle Management, and Communications (C2BMC)," 1.
[40] "Command and Control, Battle Management, and Communications (C2BMC)," 2–4.

capabilities it may not have validated in support of EPAA.[41] C2BMC was key to EPAA's success. The GAO report validates that C2BMC software updates prior to 2014 lacked the ability to fully control JIAMD fires.

MDA seeks to fully integrate U.S. and NATO missile defense in Europe. There are many systems to ingrate from space-based early warning, to forward based Army TPY-2 radars, to a second Aegis Ashore BMD site. C2BMC's latest updates endeavor to synchronize a single JIAMD mission command platform. According to former MDA Director, Vice Admiral J.D. Syring during his testimony to the Senate Appropriations Committee Subcommittee on Defense in April 2016, "…upgrades are further enhanced by spiral upgrades to the C2BMC network [which will enable the] engage-on-remote capability and extend defensive coverage for NATO Europe."[42] C2BMC's success as a complete end-to-end multi-domain JIAMD mission command platform remains in question after more than a decade of development.

U.S. Army Integrated Battle Command System (IBCS)

Senior leaders in the Department of Defense seek to integrate the complex IAMD platforms that comprise regional and strategic air and missile defense. The Army's effort to detach organic sensors and shooters and to share digital fire control data is the Integrated Battle Command System, or IBCS. IBCS supports a greater Army effort known as Army Integrated Air and Missile Defense (AIAMD). AIAMD is as much a doctrinal approach, a tactical process and a culture shift, as it is a technical solution. AIAMD intends to stitch together the various components of Army IAMD platforms from command, control, computers, communication and

[41] Office, "Regional Missile Defense," 25.
[42] "CASE STUDY."

intelligence (C4I) to fire control, intercepts and launchers in order to extend capability and increase a commander's span of control within the battlespace.

Since their creation, Army IAMD systems such as Patriot or THAAD require a collective battery of organic launchers, a dedicated fire control system and sensor, tied to a hierarchical digital communications network to prosecute engagements. This inherently limits JIAMD operations. Even less, this limitation all but forces the Army and each service to plan and fight differently and separately. Until recently, a Patriot system could not engage using the radar data of another. A THAAD battery is unable to engage using a Patriot sensor. No Army IAMD system has the ability to directly infuse fire control quality data from Aegis. And none of these systems have the ability to launch-on-remote or directly cue another.

The Army IAMD Project Office in the Program Executive Office for Missiles and Space, the Fires Center of Excellence and Northrup Grumman are jointly developing IBCS. The Army envisions IBCS to enable warfighters to leverage any sensor on the battlefield and to align the optimum shooter, whether SHORAD, Patriot or THAAD, with the most capable interceptor against a threat.[43] Northrup Grumman advertises IBCS to provide commanders with real-time situational understanding to "use composite track data from multiple sensors to gain a single, integrated air picture." IBCS is designed to "acquire, assign, engage and kill incoming threat systems" and "select the best available weapon for the threat". In theory, IBCS will finally revolutionize the way the Army integrates its air and missile defense systems within a joint and open architecture network.

However, developing an IAMD mission command system to co-operate among older platforms that use differing computer languages, created and supported by multiple defense

[43] "Integrated Air and Missile Defense Battle Command System (IBCS)."

industry partners from Lockheed Martin to Raytheon, complicates an already arduous process. Though nearly eight years into development, IBCS has three successful tests to speak of. During one such test, IBCS fused the track data from a Sentinel Radar against an MQM-107 drone target, simulated as a cruise missile. Only the Sentinel could detect and track this low-flying target. The IBCS-enabled battalion headquarters alerted to this threat as it launched a PAC-3 interceptor from the best available Patriot system in the network.[44]

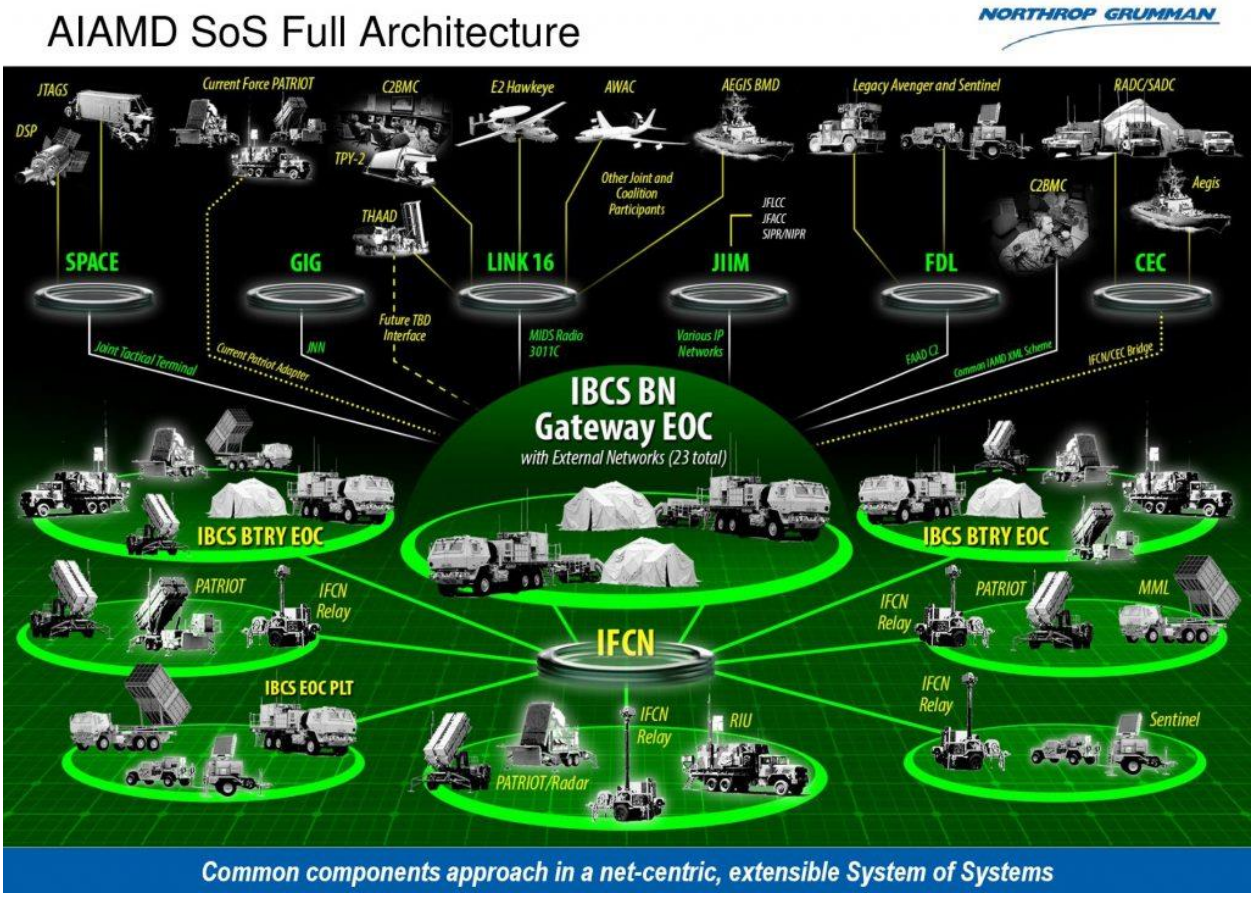

Figure 8: The Army's Integrated Battle Command System architecture. (UNCLASSIFIED)[45]

Early-on, IBCS struggled to process and track aerial threats without a catastrophic breakdown. Now, however, IBCS is reaching a stride that will ultimately enable the Army to fully develop its

[44] "Integrated Air and Missile Defense Battle Command System (IBCS)."
[45] Mahon, Fran, "Support IBCS, Best Missile Defense C2 We've Got."

endstate capability by tying together all Army IAMD assets such as the new multi-mission launcher (MML). MML is a contributing element of the Army's Indirect Fire Protection Capability (IFPC), Increment 2-I that will offer a host of new interceptor options to operators when connected through IBCS.[46] Since its first successful flight test in May 2015 and its first engage-on-remote and multi-tier engagement successes that and the following year, the 3d Battalion, 43d Air Defense Artillery has tested IBCS in a fully employed tactical environment and continues to aid developers in refining the system. While IBCS appears promising for the Army, it is not a joint system and much work is left to integrate JIAMD fires. In order to share data in a distributed defense network among multiple Army systems that were designed separately, IBCS software is extremely complex and continues to suffer significant delays.[47]

Figure 9: *The Army's Multi-Mission Launcher (MML) fires an AIM-9X Sidewinder interceptor on an Integrated Battle Command System (IBCS) enabled fire control network. (UNCLASSIFIED)*[48]

[46] Osborn, "The U.S. Army's New Missile Launcher Has a Super Game Changing Trick Up Its Sleeve."
[47] Sydney J. Freedberg, "Missile Defense Vs. China, Russia: Decentralize, Disperse, & Hide."
[48] Osborn, "The U.S. Army's New Missile Launcher Has a Super Game Changing Trick Up Its Sleeve."

Cooperative Engagement Capability and Naval Integrated Fire Control-Counter Air

Distributed defense is not a new concept. The Department of Defense and U.S. Navy recognized a need to distribute its maritime offensive and defense capabilities in the early 1990s.[49] The Navy created a systems engineering working group that developed requirements for a single Navy mission command platform. The Cooperative Engagement Capability (CEC) began as the backbone for the Navy's open network to pair any sensor with any shooter. In 2010, the Navy reviewed its process for developing a system of systems (SoS) and the manner in which it assessed the future operating environment in 1996. The Navy initiated CEC when then Under Secretary of Defense for Acquisition and Technology, Paul Kaminski, and the Vice Chairman of the Joint Chiefs of Staff, Admiral W.A. Owens, issued guidance to consider the emerging cruise missile threat in DoD programs.[50] This guidance began a process to develop capabilities to support the Overland Cruise Missile Defense (OCMD) SoS. Intended as a joint effort, this program include the Army's cruise missile sensor aerostat, later named the Joint Land Attack Cruise Missile Defense Elevated Netter Sensor, or JLENS.[51] OCMD also include the Navy's E-2C and Air Force's E-3 early warning aircraft as well as advanced interceptor seeker technologies. From 1996 to present, CEC was to combine service capabilities to form a virtual targeting and defense platform that leveraged ground and air sensors to create an over-the-horizon (OTH) network. This network would allow shooters to see beyond organic limitations, select the best available targeting platform with the most capable interceptor, and apply a standard fire control algorithm to calculate a successful engagement. In 2002, DoD renamed

[49] Sydney J. Freedberg, "Missile Defense Vs. China, Russia: Decentralize, Disperse, & Hide."
[50] McConnell and Jordan, "Naval Integrated Fire Control - Counter Air Capability-Based System of Systems Engineering," 1.
[51] The Army's JLENS aerostat broke free during testing over Maryland in 2015 and the Army later ended the program in 2017, however MDA is researching additional elevated sensor capabilities.

CEC to the Naval Integrated Fire Control-Counter Air (NIFC-CA), which expanded the programs OTH emphasis.

The Department of Defense directed the Navy's Program Executive Officer for Integrated Warfare Systems (PEO-IWS) to establish a systems engineering office that would integrate systems development and acquisition across the DoD with the NIFC-CA capability. Its purpose was to oversee a capabilities-based acquisition plan that would update and procure systems capable of integrating with NIFC-CA. DoD's intent was to resolve issues created by systems with distinctly separate and proprietary or 'single use' mission command systems. Integrated fire control (IFC) compliant combat systems became a Navy priority in order to extend the range of active-seeker missiles that were limited by organic sensors. NIFC-CA established three 'kill chains': 'From-the-Air (FTA),' 'From-the-Sea (FTS),' and 'From-the-Land (FTL).' Each kill chain is designed to leveraged a specific set of joint SoS capabilities to include sensors, sensor networks, weapons control and active missiles, both offensive and defensive.[52] This laid the groundwork for NIFC-CA's success as a JIAMD mission command system.

NIFC-CA's success is due largely to its systems engineering approach. PEO-IWS and the NIFC-CA Project Office fully realized a collaborative government and industry systems engineering integration and test team (SEI&T) in 2006. A cohort of NIFC-CA personnel, government technology laboratories, academia and industry partners comprised a team responsible for integrating SoS component systems. For example, the team integrated the Aegis combat system, designed in the 1970s, by combining multiple sensors within the original CEC network and Aegis platform organic sensors. This enabled an OTH engagement with an SM-6

[52] McConnell and Jordan, "Naval Integrated Fire Control - Counter Air Capability-Based System of Systems Engineering," 3.

interceptor where the Aegis combat system controlled the missile until it passed over the horizon. NIFC-CA maintained the SM-6 flight, completing the engagement beyond the line-of-sight of the Aegis radar.[53] This not only demonstrates a single mission command capability, but also maximizes the interceptor's range. Without NIFC-CA's use of any sensor, the Aegis combat system would not have engaged. The Navy's engineering systems approach enabled key developments in capability and integration.

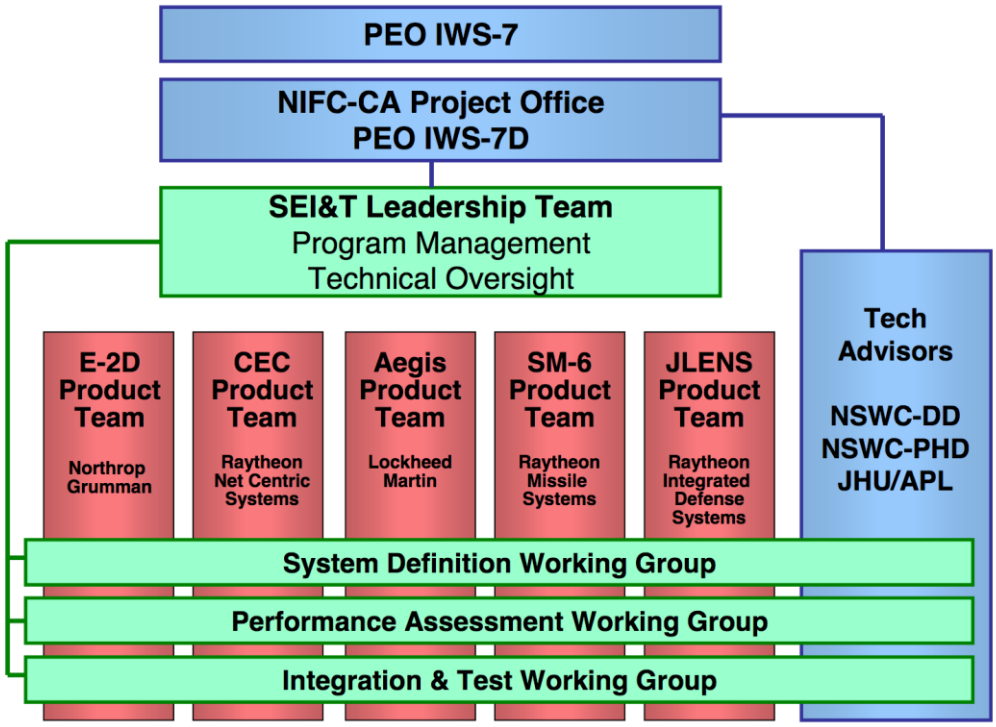

Figure 10: NIFC-CA systems engineering approach and SoS management. (UNCLASSIFIED)[54]

Engineering teams applied the same principles to distribute NIFC-CA kill chains as they established standards for new systems and quickly evolved existing platforms. The Aegis combat system, for example, was redesigned to be sensor agnostic so that it would not default to

[53] McConnell and Jordan, 5.
[54] McConnell and Jordan, 4.

its organic SPY-1 radar data but prioritize weapons computing algorithms to the best available covariance data from any sensor in the network.[55] This illustrates that any IAMD system language and computing capabilities can be revised to uncouple its own organic sensor-shooter platforms and not only be sensor agnostic, but military service independent.

CEC, and now NIFC-CA is inherently joint as a mission command system that could do more to integrate all JIAMD platforms. A single system, as advertised by C2BMC, NIFC-CA could be the easier and less costly solution. Its success is not limited to 2006. Most notably, the F-35C is designed to channel its sensor data through the E-2D on the CEC/NIFC-CA open network. Any sensor or shooter on the network would benefit from such data.[56] In September 2016, Lockheed Martin, the F-35 developer, used a ground-based NIFC-CA network to pass targeting data to an Aegis combat system for a SM-6 engagement. A high-flying B-2 bomber could report a missile launch over the horizon, and through NIFC-CA, cue the best available mid-course shooter for early engagement. Cueing at this speed and efficiency will significantly reduce the radar resources used to search assigned airspace, thereby increasing the range and abilities of each organic sensor platform. With every air platform reporting directly through NIFC-CA, shooters using NIFC-CA could achieve greater confidence in the location and classification of friendly airborne assets. A complete network of joint service platforms, to include IBCS could further mitigate fratricide risk. And it ultimately conserves interceptors and opens their entire battlespace kinematic range with advanced OTH targeting.[57]

JIAMD is but a single function of NIFC-CA. By networking every sensor from ground to space, the Navy is attempting to design less costly bombs that will not need expensive on-

[55] McConnell and Jordan, 8.
[56] McConnell and Jordan, 6.
[57] McConnell and Jordan, 9.

board guidance and computing systems to hit their targets. By connecting munitions to the network, the Aegis combat system can guide the bomb to its target using the same OTH NIFC-CA capability.[58] If successful, the DoD could concentrate on developing longer range weapons by lightening their payload. Passing the weapons control from one forward sensor to another on the network could also achieve the long-range precision capability the DoD has be looking for. And by utilizing the same data network among sensors and defensive and offensive weapons, joint systems may achieve the ability to deliver long-range precision counter-fires against an enemy launch point while simultaneously neutralizing enemy ballistic missiles – all prosecuted by the same weapons control or JIAMD platform. Once attained, imagine a multi-domain JIAMD mission command capability that adds the computing power of artificial intelligence in a CEC environment to calculate sensor data and targeting decisions beyond the speed of existing weapons control computers. That would clearly put the U.S. ahead of its competitors and adversaries.

CHAPTER 4: Infusing Intelligent Agent in Joint Missile Defense Mission Command

Artificial intelligence technologies are appearing in nearly every aspect of our lives. Companies like Google, Amazon and Apple are attempting to enrich our tech experience with automated virtual assistants that help us keep track of our daily activities, search for information or by automatically ordering household supplies when we are running low. Artificial intelligence is also in use for military applications. The United States Army and Department of Veterans Affairs have used a form of AI called predictive analytics to help determine the root causes of service member and veteran suicide. A team of researchers across the country are

[58] "NIFC-CA Advances Could Allow The Navy To Use Cheaper Weapons."

working to help the Army and VA prevent suicide by better understanding risk factors.[59] If AI can do all this and more, it will also enable a stronger multi-domain JIAMD mission command platform by achieving optimum joint and international interoperability, enhancing planning, and providing commanders with decision support information and data.

The Journal of Strategic Studies published an article in 2016 entitled, *"Strategy in the Age of Artificial Intelligence."* The Authors argued that AI will disrupt global power balances with its ability to impact human decision making. In their explanation of applying AI technologies to decision making, the authors separate AI into two categories: modular AI and general AI. Modular AI narrowly focus on a specific expertise, or domain, and learns by practicing to improve performance. Conversely, general AI uses knowledge in a flexible way to address a wide variety of abstract problems. Like a golfer who perfects his swing after years of practice, modular AI can perfect its ability to perform specific tasks based on data available to it.[60] Modular forms of artificial intelligence can perform specific military tasks to aid commanders in making decisions.

The U.S. Army Mission Command Center of Excellence (MCCoE) wants to leverage AI as a "true assistant that aids in understanding the operational environment while supporting the operations process."[61] The Army's Operating Concept looks to AI to aid in the deployment of autonomous and semi-autonomous systems that have the ability to learn. Much of the Army's interest in AI has been to provide autonomous vehicles on the battlefield that can evacuate combat casualties or deliver ammunition in the heat of a firefight without risk additional lives. However, MCCoE is developing a means to sort through mounds of data to create algorithms

[59] Linehan, "The VA Is Using Advanced Technology To Predict Which Veterans Are At Risk Of Suicide."
[60] Ayoub and Payne, "Strategy in the Age of Artificial Intelligence," 795.
[61] Hern, "Google's Go-Playing AI Still Undefeated with Victory over World Number One."

that support decision making. Through these algorithms and a modular AI's ability to learn from the operational environment, commanders would be able to leverage information otherwise unavailable to them and make split-second combat decisions while mitigating risk. "An effective future AI will give humans back the time to conduct higher cognitive load functions of gaining understanding and applying knowledge to problem solving."[62]

A key mode of making decisions on the battlefield is understanding strategy. Commanders use strategy to determine the best courses of action available against a specific adversarial threat. Strategy is the exercise of judgment when one has imperfect knowledge in a complex or dynamic situation.[63] Commanders are typically forced to make decisions without fully understanding causality or having an awareness of limits. In JIAMD systems, we use computer software, pre-programmed algorithms, to help operators understand what they are seeing. These algorithms aid tacticians in making decisions – how to classify a threat, whether to engage, and when to engage. Operators generally trust these algorithms, but only after they enter a significant amount of data to finalize the manner in which they wish the system to operate and perform its mission.

As humans, we have limits to assess and mitigate risk. Our minds take cognitive shortcuts. We reason emotionally, shaping our recall and impacting our decisions. This emotion shapes our tolerance for risk – such as when anger imbalances humans to be more certain and anxiety pushes us towards uncertainty. The human dimension to understanding strategy is affected by cognitive load, stress, the pressures of time, fatigue, emotional distraction and blood sugar levels.[64] Combat stress for a decision maker can be exacerbated by the weight of life-and-

[62] Mingus and Dilly, *On Warfare and Watson: Invest Now to Win With Artifi Cial Intelligence*, 67:35.
[63] Ayoub and Payne, "Strategy in the Age of Artificial Intelligence," 797.
[64] Ayoub and Payne, 798.

death decisions, significant lack of sleep and the cognitive overload of applying doctrine against a technical threat analysis as made in the air and missile defense specialty. Modular AI could mitigate these human uncertainties and reduce stress on decision makers, allowing them to make better informed decisions.

> Modular AI is not directly subject to physical factors like fatigue, and can be constructed so as to take account of those other psychological dimensions of strategy. Among many other human tendencies, a modular AI does not feel the pressure to escalate in response to a challenge to its esteem; does not become more risk-loving if it perceives itself to be in a domain of losses; does not employ 'mindguards' to isolate dissenting opinion; and does not deploy spurious analogies of past events without systematically considering the parallels. Finally, a modular AI is able to process information and reach decision sequentially and via parallel process at speeds that are orders of magnitude faster than humans.[65]

Machine learning systems are nested with a hierarchical pattern recognition capability that allows them to sift through the deepest depths of data, determine risks and rewards for an infinite number of decisions and outcomes, and recommend the best, most advantageous options to commanders.[66]

Applying Modular AI to JIAMD Strategy

There are many key tasks of JIAMD decision making for which a commander is responsible for. Developing commander's intent for how he or she determines is the best way to employ strategy begins with knowledge of joint system performance data from radar theory to

[65] Ayoub and Payne, 799.
[66] Ayoub and Payne, 800.

fires solution computing and interceptors. Planners and commanders make a career out of understanding this information, but a modular AI could master it, thus allowing the commander to select the optimum solution that uses the least amount of resources and mitigates the most operational and tactical risk. Google's DeepMind tackled Atari games from the 1980s and played numerous times until it developed the most efficient way to win.[67] Its revision AI, AlphaGo, beat the world's foremost champion in the Asian strategy board game Go with ease.[68] And of course the most famous early use of natural language is IBM's Watson when it defeated several Jeopardy game show champions in the popular trivia contest.[69]

Figure 11: Watson, IBM's artificial intelligence super computer, takes on top Jeopardy game show contestants in 2011 as a demonstration of Artificial Intelligence machine learning capability. (UNCLASSIFIED)[70]

Deep machine learning can leverage overwhelming amounts of information and come out on top while achieving an efficient calculation of risk versus reward. Just as Watson consumes massive

[67] Ayoub and Payne, 802.
[68] Hern, "Google's Go-Playing AI Still Undefeated with Victory over World Number One."
[69] Ayoub and Payne, "Strategy in the Age of Artificial Intelligence," 801.
[70] Hickman, "Why IBM's Watson Supercomputer Can't Speak Slang."

volumes of data to recommend a medical diagnosis with accuracy, a military AI could pull from countless after-action reports, threat information, system performance data, and calculated human interface strategies to reduce risk on the battlefield and recommend appropriate decisions.[71]

For example, an AI enabled JIAMD mission command platform may not only be able to calculate the best location for an Aegis BMD ship to loiter as it protects the fleet, but by accounting for how the adversary operates at night, and how the fleet maneuvers, it may be able to recommend the best loiter and ship maneuvering plan over a period of time. Further, this AI could balance such planning recommendations across the entire JIAMD force – THAAD, Patriot, and airborne and space-based sensors. Consider a missile defense plan informed by countless connections deep in the data that allows a commander to know exactly at what time to assume the greatest risk, such as when to conduct preventative radar maintenance or when to perform an assigned mission that limits the ship's BMD capability.

Firing doctrine, or how many and of what type of interceptors to launch against a threat – is elusive to many commanders and planners because of the amount of data necessary to make such decisions. Based on performance data and a limited algorithmic approach, it is generally acceptable for a deployed regional missile defense platform to fire two interceptors at a target. This increases the probability that the enemy warhead will be destroyed in the engagement. Countries like Iran, Russia, China and North Korea employ sophisticated counter measures intended to confuse missile defense radars and interceptors. Two interceptors for every threat will quickly exhaust interceptor inventory. But a strategy platform within the JIAMD AI could inform firing doctrine of a Patriot battery based precisely on how the threat missile is acting and

[71] Ayoub and Payne, "Strategy in the Age of Artificial Intelligence," 804.

the level of protection assigned to the asset the battery is protecting. Further, based on information about the enemy, its missile operating areas, terrain, how the enemy views its high value targets, the AI could recommend a sophisticated interceptor distribution plan between batteries to mitigate the possibility of a single unit firing all its interceptors before resupply, or having to reduce engagements due to a drastic decrease in inventory – known as 'low missile procedures'. And, armed with this data, the AI could recommend re-distribution among batteries based on how the air battle unfolds.

A machine's ability to 'see' data and patterns will enable it to identify enemy signatures such as radar jamming or offensive cyber attacks, landmarks such as mountains in front of a ground radar, and friendly coalition aircraft that it must protect.[72] A singular JIAMD mission command platform, enabled by intelligent agent functions, could manage the joint sensor network via NIFC-CA and IBCS to maximize anti-jamming protocols. While the enemy attempts to jam one sensor, the system immediately selects another and recommends frequency diversity measures, a change in sensor placement or emissions countermeasures. With its knowledge of enemy missile countermeasures, the AI can assist operators in discriminating between debris and the actual warhead to further conserve interceptors. It can recommend readiness or alert state changes based on strategic intelligence and adversary doctrine to maximize crew effectiveness and maintenance readiness. It could match the most effective air battle crew – based on training and certification results and its knowledge of enemy ballistic missile trends – with an adjacent THAAD or Aegis BMD capability to maximize multi-layered JIAMD. It could allow any unit to maintain a passive radar search – where it is not emitting

[72] Ayoub and Payne, 804.

radar waves, thus safeguarding against radar seeking threats – by understanding friendly and enemy aircraft patterns.

The IBM Corporation's Watson and Stream programs are working with NATO to integrate C4ISR and an offensive and defensive kill chain. The program integrates data and analytics to support military tactical intelligence, threat prediction and prevention, and other related situational awareness tasks. By leveraging a shared set of components for similar military functions, Watson can rapidly "connect, fuse, and analyze varying sources, types and volumes of data to identify and respond to potential threats, often in real time."[73] IBM provides a baseline data processing platform to support a battle management system. "The core component is a platform for providing in-line analytics to process streaming data, so that much of the work of identifying and confirming targets, determining appropriate actions, and assigning resources for engagement is performed automatically…" The operator, a human 'on the loop', reviews this process and confirms various actions. The operator maintains constant authority to override any AI action. This AI-enabled process allows the operator to focus on the most critical functions and priority tasks. IBM has expanded this capability to a theater level situational awareness capability where Watson can read regional and societal events to build predictive models and recommended solution. An AI can detect nuances in social media and public domain data to detect patterns.[74] This is a useful function of AI predictive analytics within the cyber domain. Watson also emerges in maritime domain awareness models to automate intelligence feedback in real-time across all data streams. It can match "streaming sources such as full motion video (FMV), still imagery, social media, and hyperspectral imagery (HIS) against additional, more static intelligence based on persisted [human intelligence sources]. By fusing

[73] "C4ISR and Kill Chain Integration - IBM Point of View," 2.
[74] "C4ISR and Kill Chain Integration - IBM Point of View," 6.

this data with an operational overlay, it can predict developments and suggest several ranges of responses for a commander to consider while rapidly disseminating analyses.[75] A JIAMD AI platform can apply this approach similarly in developing a commander's situational awareness and recommending planning and engagement decisions in a rapidly evolving air and missile battle. By leveraging an IBCS or NIFC-CA network, the AI can live in a three-dimensional tactical cloud over the sensors and weapon systems while simultaneously reacting to electronic warfare and cyber attacks.

Intelligent agent functions can broadly automate a JIAMD mission command capability by fusing sensor, intelligence and weapons platform data in a singularly streamed joint network. It can flawlessly select and share data with international partners while protecting national security. An AI can compute at an exponentially higher quality and recommend a decision solution far more quickly that a staff or commander can assess, understand and decide. The technology to integrate AI with a JIAMD mission command capability exists today. It is in use today. And judging from the developing all-source capabilities of our potential adversaries and competitors, joint AI-enabled IAMD mission command is a critical development the U.S. cannot afford to miss. "Modular AI will shift the balance of power radically in favor of its possessor…"[76]

[75] "C4ISR and Kill Chain Integration - IBM Point of View," 6–9.
[76] Ayoub and Payne, "Strategy in the Age of Artificial Intelligence," 808.

CHAPTER 5: The Case for JIAMD in a Multi-Domain Environment

"I think China probably poses the greatest threat to our nation by about 2025…I look out to 2025, and I look at the demographics and the economic situation, I think China probably poses the greatest threat." China is "focused on limiting our ability to project power and weakening our alliances in the Pacific."[77]

– General Joseph Dunford, The 19th Chairman of the Joint Chiefs of Staff

An Illustration: China's Anti-Access and Area Denial in the South China Sea

General Dunford's comments to the Senate Armed Services Committee on September 26th, 2017 illustrate a growing concern that China's military expansion threatens global and regional security. The United States and its regional partners in Asia must synthesize their shared economic and security interests in the region to address these threats. North Korea's unashamed ballistic missile technology testing and threats of nuclear destruction, combined with China's military modernization and efforts to claim portions of the South China Sea threaten decades of peace and stability in Asia.

The evolving political and policy environment between the U.S., the Philippines and China requires a long-term, sustainable counter anti-access and area denial (A2/AD) response to deter further Chinese military and unlawful economic advancement in the South China Sea. South China Sea and East Asia security is critical to global economic and strategic stability. Economic success since the end of World War II has provided China opportunities to amass considerable strategic power by expanding its military capacity and modernizing its capabilities with new technologies, doctrine and training.[78] China leverages this power to limit access and

[77] Joseph Hincks, "China Will Be Next Big Threat to U.S., General Dunford Says," Washington Post, September 27, 2017, http://www.washingtonpost.com/.
[78] Raine and Le Mière, *Regional Disorder: The South China Sea Disputes*, 436–437.:10.

deny freedom of navigation and maneuver in the South China Sea. For decades, China has overtly asserted a sea denial campaign that allows it to freely access precious resources and control its neighbors without the full consequence of the international community.

None of the many diplomatic, litigation and economic efforts over the years to dissuade China's development in the South China Sea have been successful. China is also leveraging its own complex and effective diplomatic, economic, information and military strategies.[79]

Vital to regional and global economic interests, the South China Sea is a thoroughfare of trade and commerce. As the easiest route between the Indian and West Pacific Oceans, the South China Sea carries half the world's sea vessel cargo. The U.S. moves one-fifth of the 5.3 trillion dollars in trade through the Sea annually, more than one trillion U.S. dollars. Eighty percent of China's crude oil imports are delivered by way of the South China Sea. South China Sea traffic accounts for 66 percent of South Korea's and 60 percent of Japan's and Taiwan's energy resources. The Middle East and Africa supply much of East Asia's oil through the South China Sea, making it an international hot-spot of activity and economic interest.

The U.S. and China differ on freedom of navigation rights within the economic exclusion zone (EEZ) of another country. At issue is China's claim of nearly all the South China Sea. China calls it the Nine Dash Line. The Nine Dash Line encompasses two million square miles of international waters. Encounters between Chinese paramilitary, Vietnam and Philippines patrols occur regularly. In 2009, China attempted to exclude military activities within its Nine Dash Line and its 200-nautical mile EEZ. Few countries share this expectation within their own EEZs.[80] Disputes extend beyond the South China Sea. In the East China Sea, China and Japan dispute ownership over the Senkaku Islands.

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[79] Raine and Le Mière, 436–437.:60.
[80] Haddick, *Fire on Water: China, America, and the Future of the Pacific*, 18.

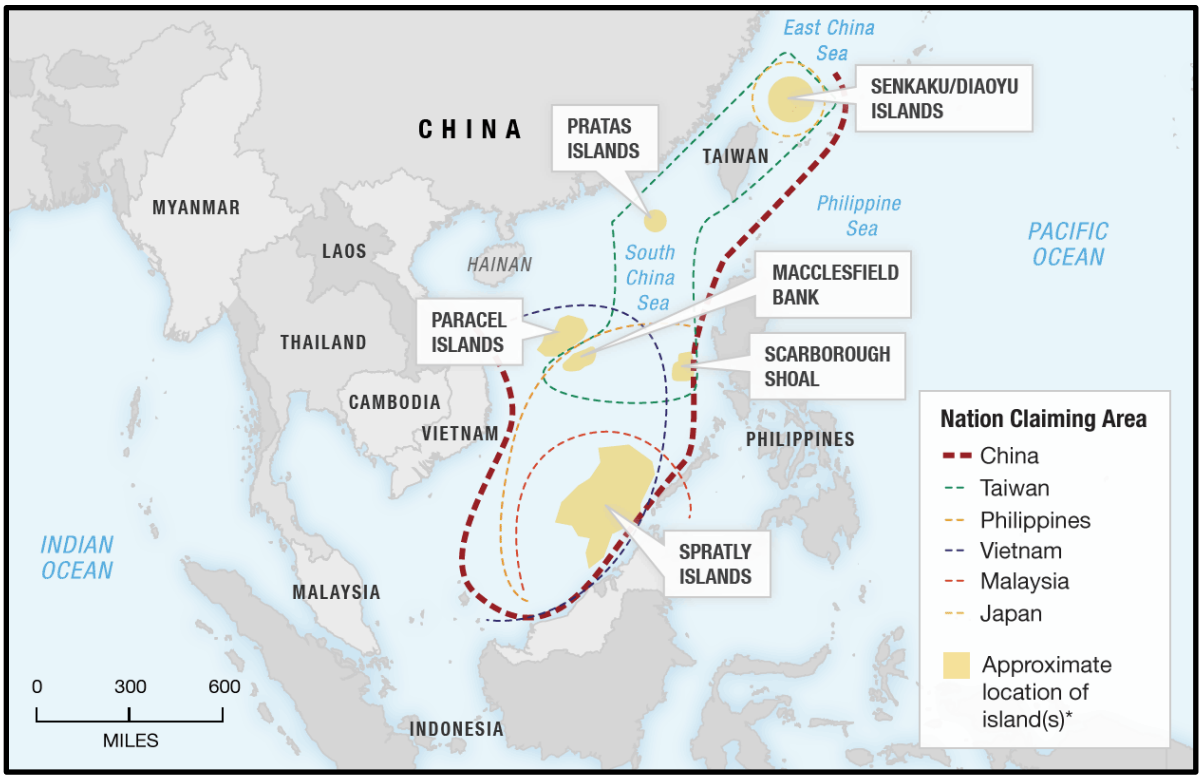

Figure 12: China's 'Nine-Dash Line' shown here in a dashed red line encompasses the entire South China Sea. (UNCLASSIFIED)[81]

In 2010, a Chinese fishing boat rammed a Japanese Coast Guard vessel, a tactic sanctioned by China's ruling communist party. Protests in both countries led to a weeks-long trade disruption. In 2013, Japan claimed that a Chinese warship locked-on a Japanese naval vessel with its fire control system. Chinese state-run newspapers urged China to claim sovereignty over Okinawa, home to 1.3 million Japanese citizens and more than 27,000 U.S. troops. Also in 2013, China declared an air defense identification zone (ADIZ) over a large portion of the East China Sea. China's ADIZ overlaps South Korea and Japan, covering the disputed Senkaku Islands and has triggered increased air patrols by China and Japan.[82] China's activities within its Nine Dash Line seek to limit freedom of navigation for commercial trade and resource mining vessels and are

[81] http://www.npr.org/news/graphics/2016/07/map-south-china-sea-line-624.png
[82] Haddick, *Fire on Water: China, America, and the Future of the Pacific*, 16–17.

designed to limit international military freedom of maneuver.[83] To preserve free commercial traffic, the U.S. and Japan maintain a sea power presence in the East and South China Seas.[84]

To protect its economic advancement and Nine Dash Line, China will attempt to form a security barrier, cementing its regional hegemonic aspirations. It will seek to weaken its neighbors through military power or diplomatic coercion.[85] To better understand just how threatening China's activities are to its neighbors in the South China Sea, we need only look to recent headlines. "China has completed major construction of military infrastructure on artificial islands it has built in the South China Sea," which offers China the ability to "deploy combat planes and other military hardware there at any time." The Pentagon added that "China's continued construction in the South China Sea is part of a growing body of evidence that they continue to take unilateral actions which are increasing tensions in the region and are counterproductive to the overall peaceful resolution of disputes.[86] A Chinese military presence on Scarborough Shoal, for example, would directly threaten Luzon and the Philippines mainland by finalizing a military capability between the Spratlys, Paracels and Scarborough, effectively limiting access to the South China Sea.[87] China dedicated its Southern Fleet's 120 combatant vessels to deny freedom of navigation and maneuver. It regularly dispatches its coast guard to enforce its expanding interests. The Peoples Liberation Army (PLA) Air Force has inserted J-11 Shenyang jet fighters at a constructed airfield on the Paracel Islands and anti-ship cruise missiles on Woody Island. China's recent construction on the Spratly Islands include reinforced military

[83] Wuthnow, "Beyond Imposing Costs: Recalibrating U.S. Strategy in the South China Sea," 128.
[84] Raine and Le Mière, *Regional Disorder: The South China Sea Disputes*, 436–437.:15.
[85] Haddick, *Fire on Water: China, America, and the Future of the Pacific*, 16.
[86] "Phil's Stock World: Is War Between U.S. And China Brewing In The South China Sea?"
[87] Wuthnow, "Beyond Imposing Costs: Recalibrating U.S. Strategy in the South China Sea," 128.

hangars, runways and air defense batteries. China employs routine naval patrols to limit observation of these sites and initiated combat air patrols in July 2016.[88]

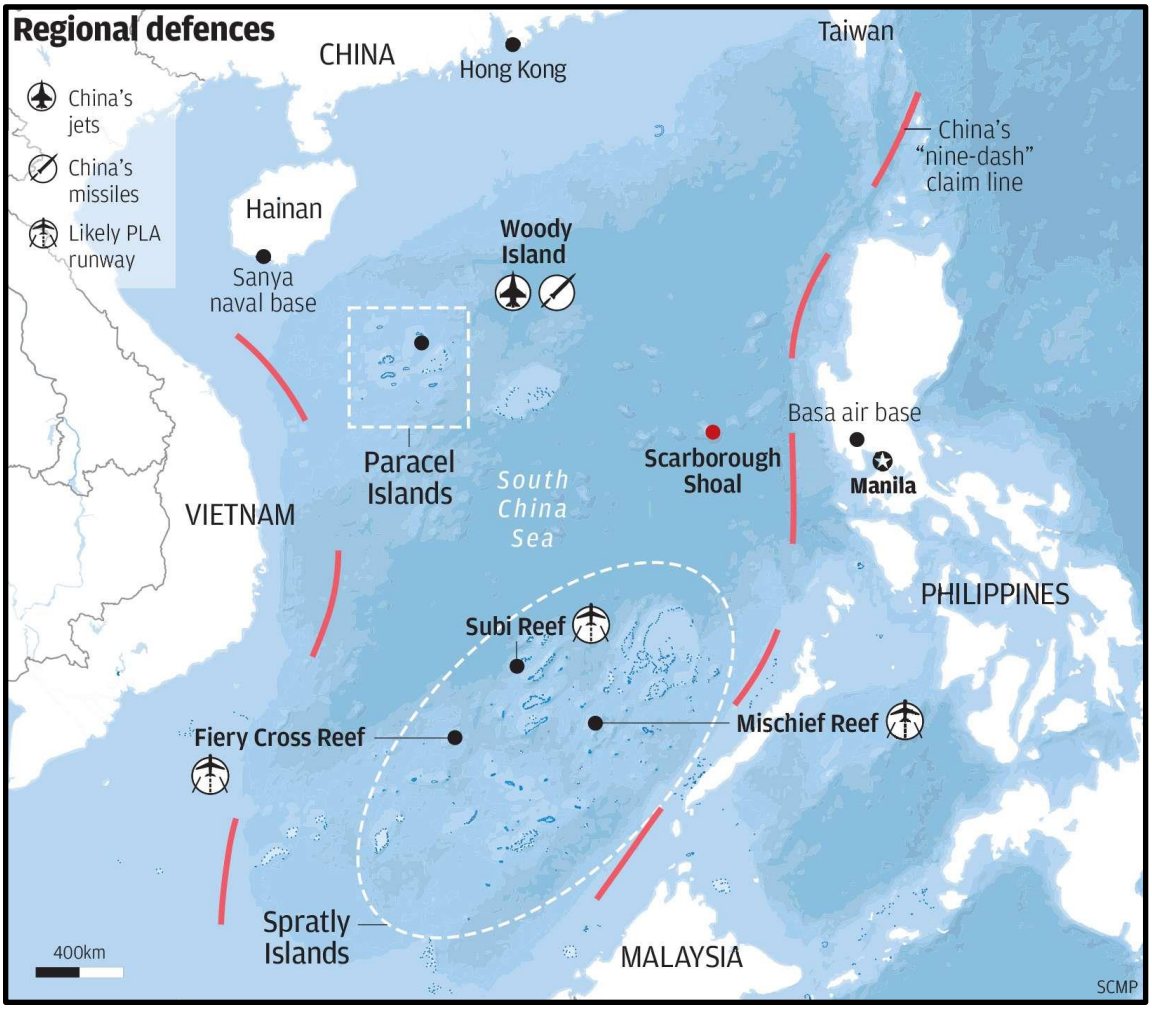

Figure 13: China's Anti-Access / Area Denial buildup in the South China Sea (UNCLASSIFIED)[89]

As a result of China's hostile actions in the South China Sea, neighboring nations have responded with their own buildup. Indonesia initiated military deployments to its Natuna Island.[90] Vietnam placed rocket launchers and began its own land reclamation program in the

[88] Wuthnow, 128.
[89] http://www.scmp.com/sites/default/files/images/methode/2016/04/25/5283a5fc-0a2c-11e6-99cd-3469e7fd8aa2_image_hires.jpg
[90] "Indonesia to Boost Defense around Natuna Islands after Sea Ruling." Asia Times. http://www.atimes.com/article/indonesia-to-boost-defense-around-natuna-islands-after-sea-ruling/

South China Sea.[91] China's expansion is only the beginning as it threatens the region with advanced military capabilities and lays a national strategy to control the waters, land and airspace within the Nine Dash Line.

China's quest is not all about its economy. In its South China Sea occupation, China's desired endstate is twofold: to protect its natural resource interests and to dissuade global action or attack by the U.S. and Japan. Observing lessons from World War II, China recognizes the importance of access into the West Pacific through the Luzon Strait between North Philippines and Taiwan. Conversely, the strait is critical to U.S. and international trade access into the South China Sea. China's control of the Luzon Strait will deny air and maritime access between the first and second island chains.[92] The First Island Chain, closest to China, extends from the southern portion of the Kamchatka Peninsula through the Japanese Islands, Taiwan, the Philippines, Malaysia, Brunei and Singapore. The Second Island Chain, as an outer perimeter, extends from Japan through Guam to the Marianas and Micronesia to Northern Papua New Guinea.[93] With its emerging military reach, limiting access inside the First Island Chain enables China to deny freedom of maneuver within the Second Island Chain. China feels it must limit access through the Strait with a strong military capability to counter the U.S., Japan and South Korea, all likely to come to the aid of Taiwan and the Philippines.[94] By occupying the Paracel Islands, China excludes its use and controls the approach to its strategic submarine base at Yulin. Control of the Spratly Islands allows China to closely observe sea traffic and base its anti-ship

[91] Holmes, "Vietnam Sends Rocket Launchers to the South China Sea."
[92] Friedberg, *Beyond Air-Sea Battle: The Debate over US Military Strategy in Asia*, 444.:53.
[93] Tangredi, *Anti-Access Warfare: Countering A2/AD Strategies*, 164.
[94] Raine and Le Mière, *Regional Disorder: The South China Sea Disputes*, 436–437.:66–67.

ballistic missiles, intelligence resources, communications capabilities and command and control assets to support its strategic endstate.[95]

Anti-access and area denial are not Chinese terms. In fact, even the U.S. Navy, which coined the term A2/AD in 2010 has determined it to be too broad and is now focusing its doctrine on countering specific threats. However, the other services, particularly the Army, continue to utilize the term to illustrate Chinese and Russian capabilities by countering A2/AD in multi-domain operational environments. Leveraging modernized capabilities to create a contested environment has made its way into Chinese strategy and doctrine. China A2/AD is a strategic framework controlled by its central government as a means to project national power regionally with global impacts.[96] Anti-access measures prevent and degrade an adversary's ability to enter an operational area, such as the South China Sea or inside the First Island Chain. Area denial limits freedom of maneuver. A2/AD capabilities typically include long range precision fires such as ballistic missiles, air platforms and anti-maritime tactics. More recently, China A2/AD incorporates significant offensive cyber and frequency jamming.[97] China's modernization includes cruise missiles, ballistic missiles, air-to-air missiles, all with improved range, accuracy and lethality. It's added contested operations to its doctrine and trains regularly. Further modernization of its submarine force, aircraft, sea mining, anti-satellite and offensive cyberspace capabilities enable China to limit power projection in East Asia.[98] China's A2/AD strategy will not reach its strategic endstate without this modernized military power.

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[95] Raine and Le Mière, *Regional Disorder: The South China Sea Disputes*, 436–437.:65–66.
[96] Johnson, "Washington's Perceptions and Misperceptions of Beijing's Anti-Access Area-Denial (A2-AD) 'Strategy': Implications for Military Escalation Control and Strategic Stability," 274.
[97] Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?*, no. 1820:75.
[98] Eirik Torsvoll, "Deterring Conflict with China: A Comparison of the Air-Sea Battle Concept, Offshore Control, and Deterrence by Denial," 38.

The PLA began to intensively modernize its military decades ago, applying a substantial amount of China's gross domestic product as an outcome of its budding economy. Based on open source, free and unrestricted information, China's capabilities remain mysterious to the public, but its A2/AD development on its homeland and in the South China Sea are indisputable.[99] China is increasingly employing A2/AD measures across all operational domains: air, land, maritime, space and cyberspace (to include electromagnetic operations, or electronic warfare).[100] The country's superior Naval power threatens its neighbors with whom it contests South China Sea rights.

China, as is its ally North Korea, is focusing significant resources to advance its intermediate and long-range missile strike capabilities to maintain a strategic deterrence advantage.[101] Multiple studies conclude that China's ballistic missile capabilities remain its center of gravity and could preclude U.S. and partner nation action against China, risking grave harm to Taiwan and the Philippines.[102] China has achieved significant growth in its maritime and land-based missiles and sensors to extend its A2/AD screen beyond the First and Second Island Chains.[103] One of China's latest ballistic missile advancements, the DF-21D, dubbed the 'carrier killer' delivers a maneuverable re-entry vehicle, its warhead, over 1,500 kilometers to attack large surface ships and is designed specifically to counter U.S. and Japanese aircraft carriers.[104] The DF-21C and DH-10 cruise missile with a very effective and accurate range pose

[99] Tangredi, *Anti-Access Warfare: Countering A2/AD Strategies*, 165.
[100] Johnson, "Washington's Perceptions and Misperceptions of Beijing's Anti-Access Area-Denial (A2-AD) 'Strategy': Implications for Military Escalation Control and Strategic Stability," 274.
[101] Johnson, 274.
[102] Yoshihara and Holmes, *Red Star over the Pacific: China's Rise and the Challenge to U.S. Maritime Strategy*, 104.
[103] Handberg, "The Symbolic Politics of Ballistic Missile Defense: Seeking the Perfect Defense in an Imperfect World," 77.
[104] Erickson, *Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategies*, 10.

significant threat to the Philippines.[105] China's air defenses include the Russian made S-400 'Triumf' with a 250-nautical mile engagement range and the older, but upgraded S-300, originally commissioned in 1979.[106] Combined with its over-the-horizon radars, state of the art satellites for oceanic surveillance, targeting platforms and command, control, computer, communications, intelligence, surveillance and reconnaissance (C4ISR) platforms, China is finalizing its A2/AD strategy.[107] To counter such a threat, the Philippines will need passive and active air and missile defense, anti-ship weapons, and long range precision fires, but would lack the necessary capacity to repel a Chinese attack without a multi-lateral deterrence and defense strategy.

China has the largest naval force among all Asian countries and employs an integrated A2/AD maritime strategy which enables it to contest freedom of navigation in the South China Sea. In recent years, China has employed an increasingly complex application of maritime strength.[108] By coordinating and controlling its naval power with its law enforcement and maritime militia, China has imposed its will on the commercial industry and still avoids effective international responses.[109] In 2009, a Chinese naval warship, two coast guard vessels and three militia trawlers surrounded the U.S. Naval Surveillance Ship Impeccable in international waters. In a coordinated attack controlled at the highest levels of the Chinese ruling party, the militia trawler attempted to retrieve Impeccable's towed sonar array with a grappling hook.[110] In another incident, the Philippines Navy observed twelve Chinese trawlers netting tons of

[105] Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?*, no. 1820:85.
[106] Tangredi, *Anti-Access Warfare: Countering A2/AD Strategies*, 164.
[107] Erickson, *Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategies*, 81.
[108] Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?*, no. 1820:73.
[109] Erickson, *Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategies*, 119.
[110] Erickson, 121.

endangered species near Scarborough Shoal and boarded two of the trawlers. The trawlers quickly radioed for help. China's coast guard immediately responded by sealing the Shoal's lagoon while the militia blocked Filipino fisherman from fishing in the area. Recognizing its militia's strategic importance, China purchases steel hull trawlers for its 'fishermen', capable of ramming and damaging larger vessels.[111] The militia routinely harasses U.S. and Japanese maritime forces as they operate in international waters. China's A2/AD military capabilities, combined with its integrated maritime sea control efforts, require a swift international multi-lateral response.

A Case for Multi-Lateral, Multi-Domain Deterrence

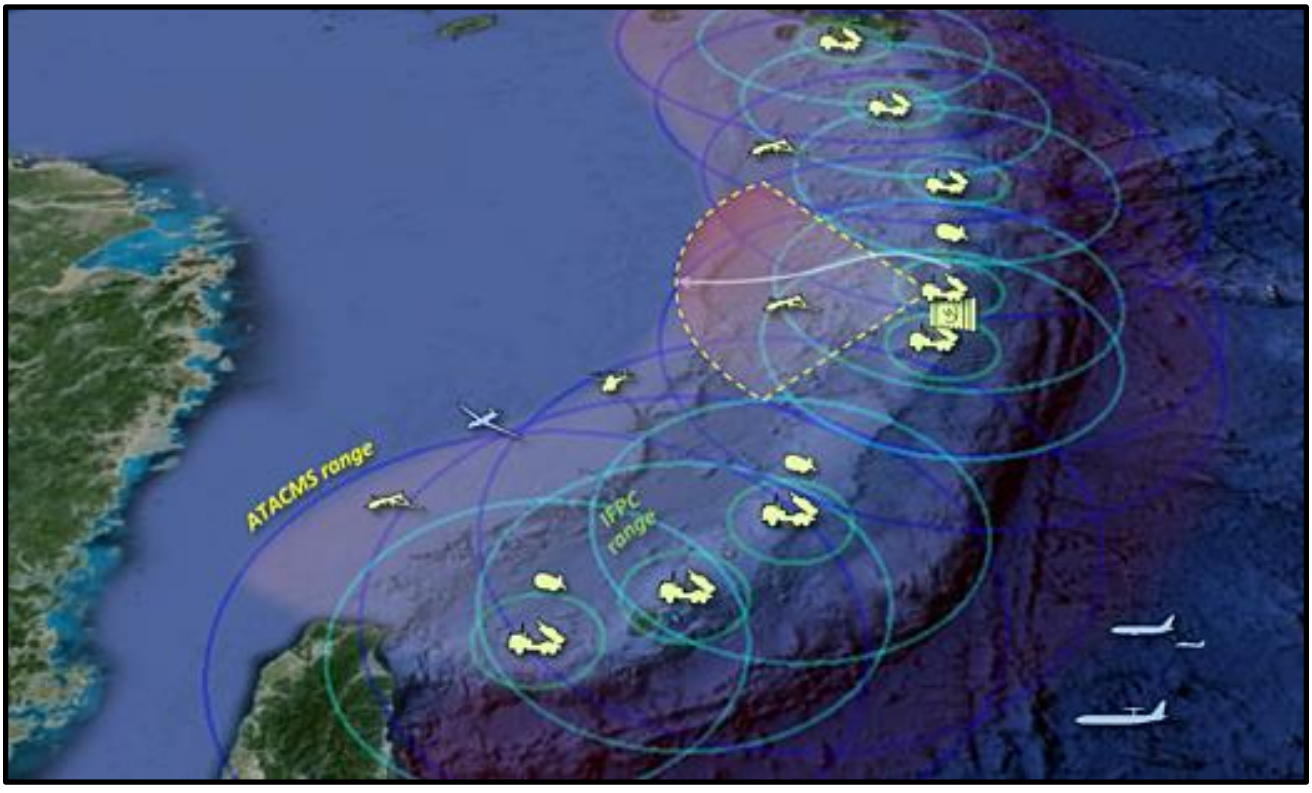

Figure 14: Notional deterrence package in the Luzon Strait. (UNCLASSIFIED)[112]

[111] Erickson, 124.
[112] http://www.islandbreath.org/2017Year/02/170220ring.png

The lack of a comprehensive U.S., Philippines and Southeast Asia partner strategy to dissuade China's A2/AD campaign risks regional and global security. A JIAMD array of sensors, defensive and offensive weapons and mission command capabilities is the critical ingredient to addressing an A2/AD problem in a multi-domain operating environment. Before 1992, American presence offered an effective deterrence against external attacks on the Philippines. Estimates reveal the Philippines saved over seven billion U.S. dollars between 1980 and 1990 in external security costs. In the early 1990s, the Philippines attempted a large-scale military modernization, but this effort only addressed counter drug, insurgency and terrorism; leaving an external security void for China to exploit after it expelled U.S. forces in 1992. In 1996, the Philippines discovered Chinese military infrastructure on Mischief Reef, just 130-miles west of the Island of Palawan. Inadequate maritime and air forces led the Philippines to seek a rededicated alliance with the U.S.[113] Philippines' shortfalls may necessitate a significant U.S. response in support of the 1951 Mutual Defense Treaty. China's A2/AD strategy necessitates a strategically located deterrent option to maintain access within the First Island Chain.[114] The bi-lateral U.S.-Philippines Enhanced Defense Cooperation Agreement is designed to augment the Treaty by establishing a long-term modernization plan, developing maritime security and expanding humanitarian assistance over several years.[115] However, EDCA and the Treaty fall short of providing for the defense of the Philippines.

A sustainable multi-lateral deterrence will empower an effective diplomatic strategy. ASEAN and Asian foreign policy analysts argue that a U.S. backed, Philippines led multi-lateral

[113] De Castro, "Philippine Strategic Culture: Continuity in the Face of Changing Regional Dynamics," 253–56.
[114] Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?*, no. 1820:46.
[115] "What Is the Enhanced Defense Cooperation Agreement? The Philippine Star, http://www.philstar.com/.

power will deter China's hostile actions in the South China Sea.[116] The U.S. deterred Russia in the Cold War and more recently Iranian aggression with combat air, maritime power and missile defense. Ballistic missile defense threatens to degrade aggressive deterrent arsenals such as China's anti-ship, ballistic and cruise missiles in the South China Sea.[117] Synchronized with an effective air and maritime projection, the deployment of the U.S. Patriot air and missile defense system across the Arabian Gulf beginning in 2006 has effectively deterred Iranian ballistic missile aggression. In a scenario that sees China's forcible annexation of Taiwan, its A2/AD strategy will significantly limit U.S. and partner intervention if military power is not already inside the First Island Chain. Philippines expulsion of the U.S. and its recent realignment with China leaves ASEAN and the U.S. little influence from Central to South Asia.[118] The RAND Corporation recommends deterrence over an attack on China's A2/AD. A 2017 RAND study concluded that the U.S. should invest in multi-domain counter-A2/AD capabilities such as mobile land-based missiles, integrated air and missile defense, increasing high demand weapons capacity and force structure, and increasing munitions capacities. Another RAND study recommends rapid fielding of the Army's Indirect Fire Protection Capability (IFPC), Increment 2-I and its newest Integrated Battle Command System (IBCS) to "complicate efforts to attack air bases or to suppress artillery fires and change China's calculus on the outcome of a future conflict."[119] RAND contends that a key element of deterrence is strengthening regional partnerships and supporting Southeast Asian nation capacity.[120] Deterrence will give the less advantaged Asian nations the bargaining power they need to enforce arbitration decisions and

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[116] Yoshihara and Holmes, *Red Star over the Pacific: China's Rise and the Challenge to U.S. Maritime Strategy*, 9.
[117] Steff, *Strategic Thinking, Deterrence and the US Ballistic Missile Defense Project: From Truman to Obama*, 32–33.
[118] Tangredi, *Anti-Access Warfare: Countering A2/AD Strategies*, 166.
[119] Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?*, no. 1820:132.
[120] Gompert, Cevallos, and Garafola, *War with China: Thinking through the Unthinkable*.

will provide for their defense early to mitigate cost and loss to Southeast Asian and global economies.

Employing power in the Pacific may be viewed by China as threatening and antagonistic. This, some argue, will lead China to vacate trade and economic development initiatives with the Philippines and others. China strongly opposed the deployment of the THAAD in South Korea and it expelled the Lotte Group, the supermarket chain that supplied land for the battery. China is also limiting tourism flights to South Korea.[121] In the case of THAAD, China is reacting, though it appears, for now, South Korea is unconcerned.

"The opportunity would be an Army Air and Missile Defense force that could truly change the balance…and indeed change the Chinese calculus on the overall outcome of the conflict, it might help avoid these conflicts in the first place."[122]

– Counter A2/AD RAND Corporation Study, 2017

The Army's Answer to Counter A2/AD with Multi-Domain Fires

The Army's six modernization priorities all serve to improve and increase multi-domain battle survivability and lethality. Addressing a mostly Army audience, U.S. Pacific Commander, Admiral Harry Harris said, "before I leave PACOM I'd like to see the Army's land forces conduct exercises to sink a ship [and] shoot down a missile and the aircraft that fired the missile near simultaneously in a complex environment for our joint and combined forces while operating [in the electromagnetic] and other domains."[123] The Army is taking this challenge seriously. General David Perkins, the U.S. Army Training and Doctrine Commander added, "if we constrain ourselves (to two domains), the enemy can fracture us…what we have to do is come up

[121] Taylor, "Why China Is so Mad about THAAD, a Missile Defense System Aimed at Deterring North Korea."
[122] Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?*, no. 1820:134.
[123] "'Multi-Domain Battle' Concept To Increase Integration Across Services, Domains."

with a very difficult-to-fracture concept."[124] The Army is introducing its Multi-Domain Battle (MDB) operating concept and organizing itself to meet Admiral Harris' goal with a new Multi-Domain Task Force (MDTF) and making its force structure multi-domain capable. The be multi-domain capable, a unit will function across several domains. In the case of the MDTF, it will operate in all five: air, land, maritime, space and cyberspace.

In an open article in Military Review, General Perkins writes that the nature of war will remain unchanged, however, the U.S. must better understand the strategic and future context of conflict.[125] This improved understanding leads the Army to make significant changes in how it fights on the battlefield and how it views its role in multi-domain environments. The Army's priorities included multi-purpose munitions to reach deep into enemy territory, next-generation combat vehicles that are smaller with increased maneuverability and optionally manned depending on the mission, future vertical lift to evacuate casualties at increased distance, a hardened network to increase speed and flow of information and data, air and missile defense to protect the joint maneuver force (including ships), and improved Soldier lethality to enhanced the squad's ability to overmatch the enemy on the ground.[126]

Task-organized force structure will bring these capabilities under a single command and staff, which will require the ability to seamlessly control the task force in support of the joint maneuver plan. General Mark A. Milley, the Army Chief of Staff, envisions the MDTF to be small and agile with a primary mission to counter A2/AD strategies posed by competitors such as Russia and China. The MDTF will contain Army capabilities likes long range artillery, IAMD, maneuver, cyber and electromagnetic operations, space, specialized communications and

[124] "'Multi-Domain Battle' Concept To Increase Integration Across Services, Domains."
[125] Perkins, David G., "Multi-Domain Battle: The Advent of Twenty-First Century War," 11.
[126] Perkins, David G., 11–12.

intelligence.[127] It will access a robust ISR network and coordinate across the services to enable joint freedom of maneuver. It will be an Army organization with sister-service representation. Its mission will make it inherently joint and it will require a joint mission command capability. While there is nothing easy about multi-domain mission command, the concept is not unlike controlling JIAMD fires.

This incremental reorganization is not unlike the birth of the Army Brigade Combat team that combines the abilities of various functions to project battlefield power in a single, cohesive tactical organization. While U.S. Pacific Command and U.S. Army Pacific test the MDTF concept with a pilot program led by the 17th Field Artillery Brigade, the Army will experiment with the functions and capabilities in the MDTF design and determine how best to organize the future MDTF on the battlefield. To be effective, it will require a new approach to multi-function mission command.

CHAPTER 6: Assessing the Multi-Agency, Command & Service Organizational Divide

Not a single entity exists within the DoD to exercise full authority in meeting air and missile threats. The JIAMD divide begins with a culture of service and agency compartmentalization of integrated air and missile defense. Reorganizing the joint and service structures will better streamline and integrate a JIAMD mission command system of systems. There are two inherently separate focuses for IAMD. The first is the service and joint Title X responsibility to research, develop and provide capability. The second is the operational responsibility to allocated and command IAMD platforms on the battlefield. These components

[127] Freedburg, Sydney J. Jr., "New Army Unit To Test Tactics."

generally work to serve the same need, to detect and neutralize air and missile threats. However, they do so in culturally and organizationally different ways that often-times conflict.

The military services retain most acquisition, test, procurement and modernization authorities in order to integrate their systems within the respective service. The Army, responsible for ground-based IAMD, oversees programs like Patriot, operation of active THAAD batteries (however the program falls to MDA), IFPC and the re-emerging maneuver short range air defense, recently termed MSHORAD. The Air Force is lead for the Joint Strike Fighter program and for a time led research and development for the airborne laser before the program ended. The Navy has Aegis BMD and the Standard Missile (SM) family of interceptors along with its accompanying SPY-1 radar and other maritime ISR platforms. As previously discussed, each of the services employ distinctly separate mission command platforms that largely do not communicate, share data, or integrate IAMD efforts. What is largely needed is a DoD-wide, joint integrating authority.

In 2005, the Unified Command Plan assigned U.S. Strategic Command with the long-standing task as integrated missile defense "global synchronizer" where it maintained the responsibility to assist in global resource allocation through a series of processes. STRATCOM organized itself in to functions and established the Joint Functional Component Command for Integrated Missile Defense (JFCC-IMD). The Army's Space and Missile Defense Command commander is assigned as the JFCC-IMD commander because he is also designated as the Army Strategic Command commander. JFCC-IMD's mission is to synchronize BMD requirements and operations across the combatant commands (CCMD). JFCC-IMD's charter continues to expand to address cruise missiles and hypersonic weapons. Later, in 2008, USSTRATCOM added to its responsibilities as the Air and Missile Defense Integrating Authority for the entire

Department of Defense. This task was to "provide a collaborative means for combatant commands, military departments, and defense agencies to identify and assess desired AMD capabilities and characteristics, examine the operational risks associated with capability gaps and redundancies, and review possible solutions and implementation timelines to support programmatic and milestone decisions."[128] This new responsibility leveraged the Joint Integrated Air and Missile Defense Organization (JIAMDO) within the J8 of the Joint Staff in Washington, D.C. The Chairman of the Joint Chiefs established JIAMDO to address the unique requirements of JIAMD. JIAMDO was initially assigned responsibility "to develop and integrate sensors, weapons, command and control systems, and the concepts to employ them in the air and missile defense mission area."[129] JIAMDO primarily served the Chairman on joint force structure and capabilities recommendations, but it also assisted USTRATCOM as the Joint Staff advocate for warfighter capabilities requirements. While JIAMDOs designation has adjusted recently, it continues to provide valuable JIAMD analyses and recommendations for DoD leaders and the military departments. USSTRATCOM and its subordinate JFCC-IMD exercise little, if any, command over IAMD warfighting organizations and systems. JIAMDO also has minimal to no authority to force joint integration.

The combatant commands, such as U.S. Central and U.S. Pacific Commands, perform functions as the Joint Force Commander (JFC) that determines how and what their assigned IAMD platforms will protect. They delegate various IAMD authorities to the Joint Force Air Component Commander (JFACC), which also typically serves as the Area Air Defense Commander (AADC). The JFACC and AADC further delegate authorities to the Deputy AADC

[128] Almodovar, Gabriel et al., "Joint Integrated Air and Missile Defense: Simplifying an Increasingly Complex Problem," 81.
[129] Almodovar, Gabriel et al., 81.

and one or more Regional/Sector Air Defense Commanders (R/SADC). The Army Air Defense Commander usually serves as the DAADC with his or her staff responsible for IAMD planning and coordination, however, it is doctrinally acceptable for the DAADC to be a maritime commander. The R/SADC is an Air Force commander who coordinates airspace functions. The Army general, the DAADC as his joint responsibility, also serves the senior Army commander as the Theater Air and Missile Defense Coordinator (TAAMDCOORD) and as the senior ground air and missile defense commander. The Navy typically fills a position in the Air and Space Operations Cell (AOC) known as the Senior Air Defense Officer. Air Defense in this sense is understood to include counter-air functions such as targeting. And within this hierarchy of leaders and staffs, the Airspace Control Authority exercises operational control of all airspace within an assigned area.[130] Multiple leaders wearing multiple hats that often-times conflict with each other and confuse subordinate leaders and organizational relationships. While their authorities are at least clearly limited to operational and tactical functions, inter-service responsibilities lead them to make very different recommendations within their own military departments.

The Missile Defense Agency is designated by the Secretary of Defense as the IAMD Technical Authority (TA) in 2013. This designation leaves MDA to oversee joint service IAMD capability, engineering and integration. MDA can "create and recommend system standards, modifications and other joint technical requirements" to address capability gaps and integrate IAMD across the services. MDA retains control over certain programs still in the development stage, such as the AN/TPY-2 X-Band Radar, even though it's in use as a forward deployed early warning sensor and as the organic radar in the seven existing Army THAAD batteries. This is

[130] "Countering Air & Missile Threats: Joint Publication 3-01," 34–39.

another program that MDA has not yet fully released to the Army. MDA also has no authority to carry out its recommendations and requires substantial support from the services in order to meet its goals of integrating IAMD. MDA is a key contributor to the JIAMD interoperability focus, but it remains a participant among many in a larger IAMD community.

Without a deliberative and single authority, it is nearly impossible to fully realize joint IAMD capabilities. This culture fuels the multi-agency, service and command divide. It is why the services seek to generate solutions internally and miss opportunities to achieve joint interoperability. The strategic and operational levels of joint air and missile defense misunderstanding stand in the way of integration and progress. The U.S. fails to employ a JIAMD mission command platform because there is no leader who demands it, and no one with the authority to achieve it.

CHAPTER 7: Recommendations & Conclusion

The threat analysis in this paper includes limited open source information for a basic but harrowing understanding of what the U.S. and its Allies and global international partners are up against. It is deliberately a very simplistic representation. Even so, the task before us is daunting and many in our nation's military and governmental officers are working hard to realign U.S. missile defense strategy while improving JIAMD capabilities and capacity. Here are some recommendations:

A fully joint IAMD mission command capability, enabled by artificial intelligence (AI), will increase our pace of planning, employing, making decisions, arraying interceptors for optimal success and preventing fratricide. The multi-lateral missile defense alliance will prosecute the air battle of the future at an inconceivable pace. Many see AI technology as far reaching into the future, however, AI is already proving useful in current military applications.[131] A joint fire control capability with a single common operating picture, that assists commanders and staffs in determining the precise and correct tactical moves to win the strategic fight should be an immediate and primary focus. Single, service-only structured solutions hamper our ability to plan, coordinate JIAMD fires, and lead a coalition. The DoD intended the Cooperative Engagement Capability to be the joint solution. The Naval Integrated Fire Control-Counter Air should be the basis for this capability and tactical network. Command and Control, Battle Management and Communications (C2BMC) has improved considerably, it does not have the full tactical mission command suite of functions necessary to directly control fires, though it does integrate existing sensor and fire control platforms. As the C2BMC proponent, the Missile

[131] Button, "Artificial Intelligence and the Military," https://www.rand.org/blog/2017/09/artificial-intelligence-and-the-military.html (accessed February 12, 2018).

Defense Agency should assume responsibility to evolve its capabilities to operate in tactical field environments and merge CEC/NIFC-CA and IBCS into a single, open architecture network. U.S. Strategic Command's Joint Function Component Command for Integrated Missile Defense should retain authority for determining system parameters. The DoD should immediately reach out to industry partners with an opportunity to showcase their JIAMD mission command research and development. Companies like Raytheon and IBM can combine the NIFC-CA and Watson with profound impact. IBM's Stream and Watson work with NATO IAMD and C4ISR is impressive and the DoD should capitalize on NATO's investment. Further, a JIAMD AI can assist by resolving technical limitations of interceptors by designing low-cost interceptors against specific threats. The AI can then recommend optimum interceptor load-out in a multi-mission launcher or on an Aegis BMD platform.

The Department of Defense should bridge the JIAMD organizational and cultural divide by simplifying organizational structure, roles and responsibilities. Visions and memoranda signed by senior leaders are not sufficient to solve this problem. A complete review and restructure is in order, but will only occur at the direction of the Secretary of Defense.

Joint: Too many organizations at the DoD, Joint and combined levels confuse an already arduous system of budgeters, developers, testers, implementors, leaders, operators, and systems. JIAMDO, MDA, USSTRATCOM, JFCC-IMC, the CCMDs and their various IAMD offices, the services and their cultures all contribute to this confusion. The DoD, led by JIAMDO, should assess and revise the Department's military and civilian JIAMD organizational structure.

U.S. Army: Systems within the JIAMD network like Patriot, THAAD, Aegis and their sensors are inherently strategic. The U.S. Army Forces Command (FORSCOM) is no longer

equipped to understand and manage Army Air and Missile Defense organizations. USTRATCOM should assume training and readiness authority (TRA) of all Army air and missile defense through the US Army Strategic Command (Army Space and Missile Defense Command). The regionally aligned 1-Star Army Air and Missile Defense Commands (AAMDC) should remain CCMD organizations and assume mission command of forward employed JIAMD assets. An Army 2-Star CONUS IAMD Command, aligned under U.S. ARSTRAT, should assume direct TRA to prepare units for deployment. This will streamline the deployment and allocation process that USSTRATCOM leads through JFCC-IMD, which is commanded by the SMDC/ARSTRAT commander.

U.S. Navy: The Navy began its endeavor for a joint mission command system of systems in 1996 but lost its way over time. NIFC-CA, while it carries a uniquely joint capability, does not reach out to joint systems unless those systems can benefit maritime operations. The MDA should resume systems engineering efforts between the Navy, Air Force and Army departments to consolidate JIAMD mission command efforts. The Navy can share its lessons in developing a superior system and open architecture while also, and finally, contributing to a joint integrated air and missile defense effort. The Navy is the last hold-out in joint and integrated AMD fires. Its CEC vision for pairing any sensor to any shooter should break through the Naval maritime operations culture and include all shooters and joint mission command of those shooters. If the U.S. Pacific Command wants the Army to support multi-domain operations, then it must likewise adopt a joint multi-domain architecture that all services can leverage.

U.S. Air Force: Generally designated as the Area Air Defense Commander (AADC), the Joint Functional Component Commander (JFACC) typical fails to understand the maintenance and readiness issues of a deployed JIAMD system. These systems were not designed to be

deployed perpetually as they have been since 1990. Aging, they require significant and sustained maintenance readiness when deployed. Their air battle crews require sustainment training and certification. These systems cannot sustain high operational tempos indefinitely without planned periods of preventive maintenance and crew proficiency. More so, the U.S. Air Force should commit significant Title X interest and resources to JIAMD considering most ground-based IAMD is designated to protect deployed airbases. A JIAMD mission command platform, enabled by intelligent agent, can balance operational requirements against valid threat assessments to recommend mitigated periods of risk in which to perform readiness functions.

The Army, at a minimum, should continue its work to address IAMD force structure and organizational reorganization. A pure Patriot battalion, consisting of only the Patriot missile intercept system, should be a thing of the past. Multi-mission capabilities will quickly force us to disperse in order to maintain survivability. U.S. Army IAMD should task organize forward deployed and ready forces into smaller, more agile capabilities with greater capacity. This includes the need to protect purely missile defense capabilities from manned and unmanned air or cruise missile attack. While the Army continues to implement its plan to field the Integrated Battle Command System (IBCS), it is falling behind on its ability to fight with agility across the multi-domain battlespace. In 2004, the Army introduced the AMD battalion concept that integrated an Avenger (Stinger missile) battery with a Patriot battalion. This provided the battalion with 360-degree AMD protection. As the Army active component began to phase out the Avenger program, before its 2017 decision to re-stablish divisional SHORAD, it vacated the concept of AMD battalions. THAAD batteries have no formally assigned mission command headquarters but require substantial battalion commander and staff support. Remerging

SHORAD capabilities should not automatically assume they require unique SHORAD battalion headquarters. With IBCS, the Army can easily task organize THAAD, Patriot, SHORAD, multiple sensor platforms and the Multi-Domain Task Force under a single mission command. The Army's approach must be functional, determined only by the assigned mission.

Guard from separating air defense and missile defense missions and cultures. It is common among certain experts to separate air defense and missile defense missions, sensors and weapon systems into two or more capabilities. This was a mistake prior to 2004 and it would be a grave misjudgment now. It is true, there are a few systems that are specific to these missions. However, Patriot, Aegis, and developing future systems such as directed energy like lasers and microwaves serve more than a single mission area.[132] They communicate, share data, and cross-train troops with similar specialties. These systems must work seamlessly, across joint capabilities, to address multiple layers of threats. In order to achieve cross-domain synergy, IAMD should remain a single mission area.

Continue to balance missile defense with conventional long-range precision strike and emerging technologies as a priority for funding, testing, acquisition, and fielding. The Chief of Staff of the Army's six priorities include long-range precision strike and air and missile defense[133]. As the U.S. continues to seek new weapons technologies and test the laws of physics

[132] "MDA - Advanced Technology," https://www.mda.mil/system/advanced_technology.html (accessed February 12, 2018).
[133] Judson, "The Army Is Creating a Modernization Command to Keep Projects on Track," https://www.defensenews.com/digital-show-dailies/ausa/2017/10/09/the-army-is-creating-a-new-modernization-command-to-keep-projects-on-track/ (accessed 10 February 2018).

with capabilities such as the hypersonic glide vehicle or the Navy's rail gun[134], it is vital to employ these systems quickly, even if only in limited locations and organizations. This will keep us ahead of our competitors and increase their risk calculous.

Establish strong multi-lateral IAMD alliances. With an ever-increasing global air and ballistic missile threat, it's become gravely necessary to synchronize our international alliances. Year after year we deploy more sensors, defense systems and U.S. Troops to address this threat. U.S. defense industry is selling these systems at increasing rates. All of this capability forward requires much coordination and support. We need to cultivate a renewed relationship with the Philippines to prepare potential positioning for missile defense and long-range precision strike capability. A multi-lateral missile defense alliance among the Philippines, Japan, South Korea, Australia, New Zealand, and the U.S. would forge an impenetrable presence to maintain access and freedom of maneuver in the South China Sea. Cooperation among the Gulf Cooperation Council to include Kuwait, Saudi Arabia, Bahrain, Qatar and the United Arab Emirates (U.A.E) – all which either own, are buying or host U.S. IAMD systems[135] – would allow for an integrated defense design, communications architecture and threat-focused interceptor laydown.

Immediately enact new authorities to address missile defense foreign disclosure issues. After decades of selling U.S. systems to international partners, missile defense professionals share an understandable frustration that the U.S. lacks national policies and authorities to share radar data, to place completely integrated defenses. The collective missile defense mission risks

[134] Keck, "The U.S. Navy's Ultimate Weapon," http://nationalinterest.org/blog/the-buzz/the-us-navys-ultimate-weapon-hypersonic-missiles-fired-23148 (accessed February 12, 2018).
[135] "Major Arms Sales | The Official Home of the Defense Security Cooperation Agency," (accessed February 10, 2018).

considerable interceptor wastage – a scarce resource already – when overlapping systems are unable to digitally coordinate air and missile engagements.

Seek regional, multi-lateral IAMD defense treaties. Refine the 1951 U.S. – Philippines Mutual Defense Treaty into a multi-national defense organization that combines the efforts of ASEAN, components of the Enhanced Defense Cooperation Agreement (EDCA) and bi-lateral visiting forces agreements across East Asia. China's fear of multi-lateral defense pacts will deter its hostile behaviors. Simultaneous diplomatic efforts should seek to maintain trade and economic agreements between each nation and China.

Establish state of the art multi-lateral, multi-domain counter-A2/AD center of excellence on Luzon in the Philippines and in Europe. Using Luzon as an example, resourced with all members of ASEAN, backed by U.S. expertise and capacity, this center will establish the foothold of deterrence. Capabilities should include over-the-horizon maritime radar, missile warning, active air and missile defense, unmanned aerial surveillance and communication systems, defensive cyber and anti-jamming assets and additional infrastructure to surge long range precision strike platforms, mission command, increased intelligence, surveillance and reconnaissance (C4ISR) platforms, and air and maritime basing to include a submerged maritime port. In 2008, the 11th Air Defense Artillery Brigade drafted a concept to establish a multi-lateral air and missile defense center of excellence in the United Arab Emirates. As members of the Integrated Air and Missile Defense Center of Excellence (IAMDCoE), the U.S. and Gulf Cooperation Council, collectively deter Iranian ballistic missile aggression. This center leverages U.S. missile defense expertise to strengthen each country's defensive posture. Today,

the IAMDCoE operates a robust training, equipping and strategy platform. UAE, Saudi Arabia, Kuwait and Qatar are all improving their defensive capabilities. Since 2006, the U.S. has employed a sustained and formidable deterrence against Iran that ultimately led Iran's leaders to the negotiating table regarding its nuclear capability. ***In Asia, this center must address all five domains: air, land, maritime, space and cyberspace.*** Placing this CoE in the hands of the Philippines mitigates ASEAN concerns of an unintended U.S. or Japan incident with China. By providing U.S. expertise and capability, the Philippines may soon be able to re-align itself with friendly East Asian partners rather than China. All members of ASEAN may feel better prepared to diplomatically confront China's actions in the South China Sea. This center might also employ the following opportunities:

- Serve as an international integrated multi-domain training center.
- Test and Apply new weapons technologies such as radars, directed energy, defensive cyber and anti-jamming, hypersonic glide vehicles, low cost interceptors, and sub-surface unmanned capabilities for detection and deterrence.
- Offer a multi-lateral defense mission command center to include international law enforcement capabilities and an intelligence fusion center to track and correlate Chinese, pirating and terror organization actions.
- Add pre-positioned equipment to deter, and if necessary, act against Chinese aggression and attempts to control the Strait of Luzon.

Fully redesign authorities to enhance information sharing and interoperability with U.S. partners. Foreign disclosure policies and proprietary industry rules severely limit bi-lateral and multi-lateral capability. Militaries from several nations have the technology and

relationships to guard information while they share it but lack the authorities to work together. These antiquated policies do not consider new technologies, interoperability and relationships. In many cases, the U.S. cannot share information with a partner nation to which it sold a U.S. weapon system. Japan currently owns both the Navy's Aegis and the Army's Patriot but are not authorized to directly link radar and fire control data. This severely limits multi-lateral operations and risks grave harm to national security.

Finally, insert the Army's Multi-Domain Task Force (MDTF) headquarters to support Philippines efforts and serve as the lead for U.S. capability and proof of the MDB operating concept. The Army is piloting the first of these organizations in the Pacific. Once complete, PACOM and the Army should consider, with support of the Philippines, establishing a rotational presence of this capability. In a war with China, the U.S. lacks the ability to deploy necessary forces forward of the Second Island Chain before China employs a robust A2/AD campaign. The MDTF will be designed to operate in the land, air, space and cyberspace domains while supporting maritime freedom of maneuver. In various forums, Admiral Harry Harris, the U.S. Pacific Command Commander, has emphasized the Pacific's need to maintain access with air and missile defense while simultaneously sinking ships from the air, maritime and land domains.[136] The MDTF could fill an advise, assist and train role with international partners, bolster Philippines defenses as a deterrent and quickly transition to war in support of the Philippines in accordance with current and future treaties. A counter-A2/AD approach that credibly threatens China and poses such a cost that it vacates further militarization of the South China Sea must be part of a larger ASEAN and U.S. strategy.

[136] "Army's Multi-Domain Battle Gains Traction Across Services." Breaking Defense. https://breakingdefense.com/2017/03/armys-multi-domain-battle-gains-traction-across-services/

CONCLUSION

Nuclear defense was almost immediately conceived after the development of the Atom Bomb. American sentiment was that if American scientists fashioned the first nuclear age, the U.S. could build a defense against it. Post WWII, after the height of the industrial revolution, Americans had a high degree of confidence in American science and ingenuity.[137] In 1957, the United States recognized the missile technology gap after the Soviet Union placed the first satellite in orbit around the Earth. Space exploration rockets are not much different than ICBMs. A nation's space launch capability, in general, demonstrates its ICBM capability. North Korea launched its first satellite in December 2012.[138] Defense systems and systems that target another country's deterrent capabilities can all be viewed as destabilizing.[139] While a missile defense system will not provide 100 percent protection, it might, however, cause rational competitors such as China and Russia or less rational actors like Iran and North Korea to adjust their calculous on the development, employment and use of a nuclear and conventional ballistic missiles, cruise missiles, autonomous unmanned systems and hypersonic weapons. As these competitors and adversaries begin a new surge to gain and build greater capability and capacity in everything from threat air, short to long-range ballistic missiles, unmanned systems, and intercontinental ballistic missiles, the U.S. must meet the challenge of this generation with a global missile defense architecture and multi-domain responses to maintain a stable balance of power and to guard the freedoms and liberties of the oldest democracy in the world. Yet by flooding the multi-domain environment with new and upgraded end-user systems, the U.S. risks its strategic objectives by failing to merge networks and control disparate platforms. A Joint and

[137] Peoples, *Justifying Ballistic Missile Defence: Technology, Security and Culture*, 112:78–79.
[138] Dodge, "President Obama's Missile Defense Policy: A Misguided Legacy," 2.
[139] Garcia, "Strategic Stability in the Twenty-First Century: The Challenge of the Second Nuclear Age and the Logic of Stability Interdependence," 361.

fully integrated air and missile defense mission command capability that excels in multi-domain operations will be the key to enhanced global stability.

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