# HEY AEGIS, THIS IS THAAD CALLING: THE JOINT INTEGRATION OF MISSILE DEFENSE

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Ronald Reagan's Star Wars speech on 23 March 1983, announced to the world the Strategic Defense Initiative (SDI) where an umbrella technology would protect the United States from Intercontinental and Submarine Launched Ballistic Missiles. SDI has evolved into the Joint Integrated Air and Missile Defense wherein the U.S. Navy, Army, and Air Force have key architectures and missile defense capabilities. With U.S. personnel stationed in 160 countries throughout the world, it is imperative for an integrated missile defense system to counter the ballistic missiles from theater to global ranges to maximize the defense of the United States and her allies. In the fiscally constrained Department of Defense, these high-demand yet low-density extremely expensive systems must be joint and integrated where possible to maximize their contribution to national defense. This study provides a qualitative DOTMLPF-based analysis of what gaps exist within Ballistic Missile Defense, which are causing limited joint integration.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

HEY AEGIS, THIS IS THADD CALLING: THE JOINT INTEGRATION OF MISSILE DEFENSE, by LCDR Christopher H. Chastain, 85 pages.

Ronald Reagan's Star Wars speech on 23 March 1983, announced to the world the Strategic Defense Initiative (SDI) where an umbrella technology would protect the United States from Intercontinental and Submarine Launched Ballistic Missiles. SDI has evolved into the Joint Integrated Air and Missile Defense wherein the U.S. Navy, Army, and Air Force have key architectures and missile defense capabilities. With U.S. personnel stationed in 160 countries throughout the world, it is imperative for an integrated missile defense system to counter the ballistic missiles from theater to global ranges to maximize the defense of the United States and her allies. In the fiscally constrained Department of Defense, these high-demand yet low-density extremely expensive systems must be joint and integrated where possible to maximize their contribution to national defense. This study provides a qualitative DOTMLPF-based analysis of what gaps exist within Ballistic Missile Defense, which are causing limited joint integration.

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TABLE OF CONTENTS

Page

# ACRONYMS

| | |
|---|---|
| AAMDC | Army Air Missile Defense Command |
| AOR | Area of Responsibility |
| BMD | Ballistic Missile Defense |
| BMDS | Ballistic Missile Defense System |
| CCMDs | Combatant Commands |
| DoD | Department of Defense |
| EKV | Exo-thermic Kill Vehicle |
| GAO | United States Government Accountability Office |
| GMD | Ground-based Midcourse Defense |
| IAMD | Integrated Air and Missile Defense |
| IBCS | IAMD Battle Command System |
| JCIDS | Joint Capabilities Integration Development System |
| JFCC IMD | Joint Functional Component Command, Integrated Missile Defense |
| JIAMDO | Joint Integrated Air and Missile Defense Organization |
| JIAMD JAT | Joint Integrated Air and Missile Defense (JIAMD) Governance Joint Analysis Team |
| JMETL | Joint Mission-Essential Task List |
| JROC | Joint Requirements Oversight Council |
| MAD | Mutually Assured Destruction |
| MDA | Missile Defense Agency |
| NASA | National Aeronautics and Space Administration |
| NDAA 2017 | National Defense Authorization Act for Fiscal Year 2017 |
| NMDA 1999 | National Missile Defense Act of 1999 |

| | |
|---|---|
| PATRIOT | Phased Array Tracking Radar Intercept On Target |
| PAC-3 | PATRIOT Advanced Capability-3 |
| SDI | Strategic Defense Initiative |
| TBMD | Theater Ballistic Missile Defense |
| THAAD | Terminal High Altitude Area Defense |
| US | United States of America |
| USSR | Union of Soviet Socialist Republics |
| USSTRATCOM | United States Strategic Command |

ILLUSTRATIONS

Page

TABLES

Page

# CHAPTER 1

# INTRODUCTION

## Overview

> What if free people could live secure in the knowledge that their security did not rest upon the threat of instant U.S. retaliation to deter a Soviet attack; that we could intercept and destroy strategic ballistic missiles before they reached our own soil or that of our allies?
>
> — President Ronald Reagan, *Strategic Defense Initiative (SDI)*

Ballistic Missile Defense (BMD) is a complex operation involving extreme engineering to destroy an offensive inflight missile by striking it with another missile to protect personnel, assets and population centers from a weapon systems launched from hundreds to thousands of miles from the intended target. The operational BMD system is composed of elements from the Department of the Army, Department of the Navy, and the Department of the Air Force. As Joint Publication 1, *Doctrine for the Armed Forces of the United States* defines joint in nature as "activities, operations, organizations, etc., in which elements of two or more Military Departments participate," Ballistic Missile Defense is clearly a joint operation as the ballistic missile threat exists in the air, land, sea, and space domains.[1]

Military operations are inherently dangerous. Combat forces are expected to go in harm's way to achieve national objectives. Military operations are dangerous not only from enemy action but also from complex and hazardous daily operations, such as live fire exercises, flight operations, ship anchoring, refueling, and movement of large pieces

[1] Joint Chiefs of Staff, Joint Publication 1, *Doctrine for Armed Forces of the United States* (Washington, DC: Government Printing Office, 2013), GL-8.

of equipment. These dangers cannot be mitigated, but the accepted risk can be minimized through rehearsals involving all participants. Practiced evolutions create smoothly communicating teams which can safely operate towards a common objective.

Today's military operate in a joint environment due to the range of modern weaponry being able to cross multiple domains. The joint environment adds to the existing complexity of military operations by introducing differences in service-based culture, leadership, command structures, interpretation of doctrine, verbal-based communication, and training. A commonly used term in the Army may have a different meaning in the Navy, Air Force, or Marines. This communication gap may have unwanted and potentially lethal consequences. It is imperative to overcome these differences in order to maximize U.S. combat effectiveness.

National Defense Authorization Act for Fiscal Year 2017 states "it is the policy of the United States to maintain and improve a robust layered missile defense system capable of defending the territory of the United States, allies, deployed forces, and capabilities against the developing and increasingly complex ballistic missile threat."[2]

There are 31 countries that currently possess ballistic missile technology. Nine of those countries (China, France, India, Israel, North Korea, Pakistan, Russia, the United Kingdom, and the United States) possess or are thought to possess nuclear weapons (see table 1). The United States has bases in 74 countries and forward deployed forces in another 86 countries of the 195 U.S. recognized countries to help ensure U.S. world-wide strategic interests and partnerships (see figure 1). In the fiscally constrained Department

[2] U.S. Congress, *National Defense Authorization Act for Fiscal Year 2017* (NDAA) (Washington, DC: Government Printing Office, 2017), 908.

of Defense (DoD), low-density and high-demand BMD assets must be joint and integrated where possible to maximize their contributions to a layered ballistic missile defense of the United States, its deployed forces, allies, and friends against all ranges of enemy ballistic missiles in all phases of flight.

Table 1. Nations Possessing Ballistic Missiles

| Country | SRBM <1000km | MRBM 1000-3000km | IRBM 3000-5500km | ICBM 5500+km | SLBM |
|---|---|---|---|---|---|
| **Afghanistan** | X | | | | |
| **Armenia** | X | | | | |
| **Bahrain** | X | | | | |
| **Belarus** | X | | | | |
| **China** | X | X | X | X | X |
| **Egypt** | X | | | | |
| **France** | | | | | X |
| **Georgia** | X | | | | |
| **Greece** | X | | | | |
| **India** | X | X | X | X | X |
| **Iran** | X | X | | | |
| **Iraq** | X | | | | |
| **Israel** | X | X | X | | |
| **Kazakhstan** | X | | | | |
| **Libya** | X | | | | |
| **North Korea** | X | X | | X | |
| **Pakistan** | X | X | | | |
| **Romania** | X | | | | |
| **Russia** | X | X | X | X | X |
| **Saudi Arabia** | | X | | | |
| **Slovakia** | X | | | | |
| **South Korea** | X | | | | |
| **Syria** | X | | | | |
| **Taiwan** | X | | | | |
| **Turkey** | X | | | | |
| **Turkmenistan** | X | | | | |
| **United Arab Emirates** | X | | | | |
| **United Kingdom** | | | | | X |
| **United States** | X | | | X | X |
| **Vietnam** | X | | | | |
| **Yemen** | X | | | | |

*Source:* Created by author using information from Arms Control Association, "Worldwide Ballistic Missile Inventories," accessed 16 October 2016, https://www.armscontrol.org/factsheets/missiles.

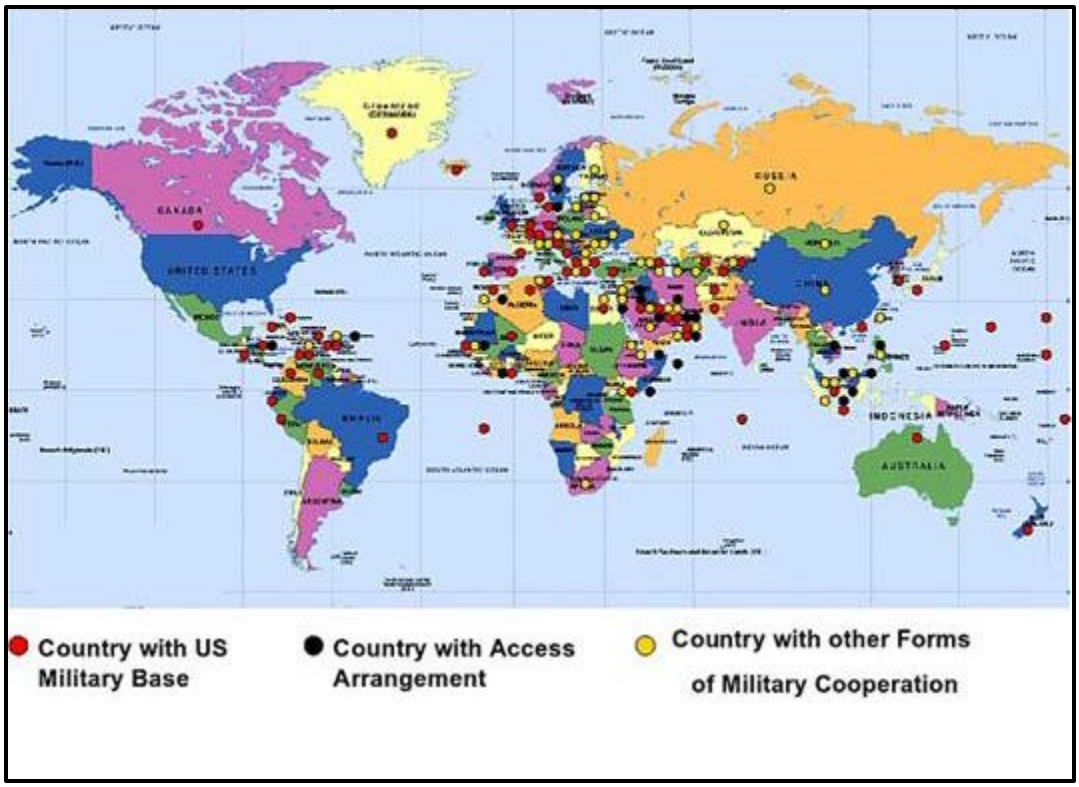


Figure 1. U.S. Military Presence Overseas

*Source:* The Millennium Report, "America's Humanitarian War Against the World," accessed 16 October 2016, http://themillenniumreport.com/2016/08/americas-humanitarian-war-against-the-world/.

## Primary Research Question

This study will investigate within the doctrine, organizations, training, materials, leadership and education, personnel, and facilities (DOTMLPF) construct to research and perform an analysis to answer the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense?

## Secondary Research Questions

To answer the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense, several secondary questions must be defined and answered. The secondary research questions will help outline the doctrine, organizations, training, materials, leadership and education, personnel, and facilities aspects of BMD. Secondary questions to be answered in this thesis are:

1. What current Ballistic Missile Defense doctrine exists and to what extent is it integrated?
2. What organizations and commands comprise Ballistic Missile Defense and to what extent is the organizational manning jointly optimized at the operational level?
3. What institutionalized joint Ballistic Missile Defense training exists within the various services' training pipelines prior to operational execution?
4. What material components comprise Ballistic Missile Defense systems for each service and whether/how these systems integrate between services?
5. To what extent is Ballistic Missile Defense leadership educated to maximize the joint integration of their systems?
6. To what extent are Ballistic Missile Defense assets deployed at the operational level manned jointly to maximize experience and overcome service differences?
7. Do joint facilities for Ballistic Missile Defense exist?

These secondary questions will not only build a picture of current Ballistic Missile Defense system but help with understanding the mechanisms involved which are

necessary to create a joint integrated system. The aggregated findings will lead to answering the primary research question and developing conclusions and recommendations for future research.

It is not the intent of this study is to embarrass or discredit any service, command, agency, or BMD program, but rather to show that a synergistic joint integrated BMD is stronger than the summation of the individual BMD systems working independently. The hope of this study is to encourage discussions amongst BMD stakeholders and promote efforts to become joint and integrated to produce a BMD system capable of providing maximum protection against ballistic missile threats.

## Assumptions

There are a number of assumptions to discuss in order to frame research as it applies to the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense? These are ideas or concepts that the researcher assumes to be true and therefore form the basis of this research. As nonscientific truths are individually biased and differ from person to person, assumptions used in this study will be defined and presented. First, this study assumes BMD systems are capable of becoming one joint integrated system. The next assumption is that the published capabilities of each system are accurate and factual. The third assumption is that a joint integrated BMD is stronger than individual service BMD systems working independent of other systems. The final assumption is that BMD stakeholders and entities are willing to work towards a joint integrated BMD.

## The Threat

> Given the goals of rogue states and terrorists, the United States can no longer solely rely on a reactive posture as we have in the past. The inability to deter a potential attacker, the immediacy of today's threats, and the magnitude of potential harm that could be caused by our adversaries' choice of weapons, do not permit that option. We cannot let our enemies strike first.[3]

The reign of terror of the Ballistic Missile Age began when Nazi Germany launched the first V-2 rocket against London on 8 September 1944, from Wassenaar in the Netherlands against London. Realization of a high explosive weapon delivery system able to strike deep within a country from hundreds to thousands of miles away changed warfare forever. The threat was immediately recognized and methods to defend against a ballistic missile attack began. Payload options of high explosives, chemicals, biological, or nuclear weapons increase the lethality of the ballistic missile from hundreds of deaths to potentially millions. Limited point-defense antiballistic missile defense batteries were created in order to defend key cities and assets. As the nuclear arms race began between the United States and USSR, and thousands of ballistic missiles were produced, the limited point-defense yielded to the theory of Mutually Assured Destruction (MAD). MAD is the cold war game of nuclear brinksmanship in which a first launch is deterred by threat of massive retaliation in which neither participant has any hope for survival.

But what if there was a missile shield that protected against an incoming attack? In 1983, President Ronald Reagan reinvigorated the concept of missile defense within the U.S. population psyche when he proposed the Strategic Defense Initiative (SDI). Strategic Defense Initiative's premise was to develop a system capable of destroying a Soviet ballistic missile before it reached U.S. territory. In theory, this negates the

[3] Bush, *National Security Strategy*.

mutually of MAD theory. The newly created Strategic Defense Initiative's Innovative Sciences and Technology Office began to cultivate the brightest and most innovative scientists to meet the SDI challenge much like NASA had done to meet President Kennedy's moon landing challenge of the 1960s. Due to budgetary concerns, yet-to-be-invented technology, and the Strategic Arm Limitations Treaty (SALT) and the Anti-Ballistic Missile Defense (ABM) treaty, ideas were born but little came to fruition. The two world super powers continued to observe the tenants of MAD and cautiously stared at each other across the ballistic missile table. Ballistic missile technology, like all new technology, began to slowly proliferate into other countries. With the United States and USSR possessing overwhelming military power, these other ballistic missile states were held in check. MAD theory is based upon a rational nation state recognizing the futility of a first strike. The next major doctrinal shift to occur in global policy came in December 1991, when the world watched in amazement as the symbol of Communist Power, Soviet Union's flag bearing the star, hammer, and sickle, was lowered from the Kremlin and the tricolor flag of an independent Russian state took its place above Moscow's capital. With this changing of the guard, the United States found itself as the world guardian, involved in conflicts with countries which would have been seen as trivial a decade before. Ballistic missile-capable countries like Iran and North Korea do not respect international conventions and their governments do not behave in a predictable manner. These nations are labeled as rogue nations and, when armed with ballistic missile technology, threaten world-wide security.

Invention of ballistic missiles makes it possible to deliver a lethal attack from great distances by having the weapon power itself through launch and letting it take a

ballistic, gravitational path to its target. Ballistic missiles are divided into four classifications based on their ranges with a fifth based solely on submarine launched variant. Short Range Ballistic Missiles (SRBM) have a range of less than 1,000 kilometers. Medium Range Ballistic Missiles (MRBM) can range 1,000-3,000 kilometers. Intermediate Range Ballistic Missiles (IRBM) range 3,000-5,500 kilometers. Intercontinental Ballistic Missile range is 5,500+ kilometers. Submarine Launched Ballistic Missiles (SLBM) are not constrained by range as the nature of the mobility of a submarine through international waters makes the range of a SLBM irrelevant.

## Definitions and Terms

The following key definitions and terms provide fidelity and clarity when used in the context of this thesis. They provide a common understanding of certain concepts presented to the reader.

Aegis: A ship-based combat system that can detect, track, target, and engage air, surface, and subsurface threats, including ballistic missiles on some modified ships.[4]

Ballistic Missile: Any missile which does not rely upon aerodynamic surfaces to produce lift and consequently follows a ballistic trajectory when thrust is terminated.[5]

Common Tactical Picture: An accurate and complete display of relevant tactical data that integrates tactical information from the multi-tactical data link network, ground network, intelligence network, and sensor networks. Also called CTP.[6]

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[4] Joint Chiefs of Staff (JCS), Joint Publication (JP) 1-02, *DOD Dictionary of Military and Associated Terms* (Washington, DC: Government Printing Office, 2017), accessed 14 May 2017, http://dtic.mil/doctrine/new_pubs/dictionary.pdf, 4.

[5] Ibid., 25.

Ground-Based Midcourse Defense: A surface-to-air ballistic missile defense system for exo-atmospheric midcourse phase interception of long-range ballistic missiles using the ground-based interceptors. Also called GMD.[7]

Integrated Air and Missile Defense: The integration of capabilities and overlapping operations to defend the homeland and United States national interests, protect the joint force, and enable freedom of action by negating an adversary's ability to create adverse effects from their air and missile capabilities. Also called IAMD.[8]

Joint: Connotes activities, operations, organizations, etc., in which elements of two or more Military Departments participate.[9]

Missile Defense: Defensive measures designed to destroy attacking enemy missiles, or to nullify or reduce the effectiveness of such attack.[10]

Operation: A sequence of tactical actions with a common purpose or unifying theme. A military action or the carrying out of a strategic, operational, tactical, service, training, or administrative military mission.[11]

Operational Approach: A description of the broad actions the force must take to transform current conditions into those desired at end state.[12]

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[6] JCS, JP 1-02, 50.

[7] Ibid., 117.

[8] Ibid., 34.

[9] Ibid., 143.

[10] Ibid., 179.

[11] Ibid., 200.

[12] Ibid.

Operational Characteristics: Those military characteristics that pertain primarily to the functions to be performed by equipment, either alone or in conjunction with other equipment; e.g., for electronic equipment, operational characteristics include such items as frequency coverage, channeling, type of modulation, and character of emission.[13]

PATRIOT (Phased Array Tracking Radar Intercept On Target): A point and limited area defense surface-to-air missile system capable of intercepting aircraft and theater missiles, including short-, medium-, and intermediate-range ballistic missiles in the terminal phase.[14]

Strategic Direction: The processes and products by which the President, Secretary of Defense, and Chairman of the Joint Chiefs of Staff provide strategic guidance to the Joint Staff, combatant commands, Services, and combat support agencies.[15]

Strategy: A prudent idea or set of ideas for employing the instruments of national power in a synchronized and integrated fashion to achieve theater, national, and/or multinational objectives.[16]

Tactical Data Link: A Joint Staff-approved, standardized communication link suitable for transmission of digital information. Tactical digital information links interface two or more command and control or weapons systems via a single or multiple

[13] JCS, JP 1-02, 200.

[14] Ibid., 207.

[15] Ibid., 259.

[16] Ibid., 260.

network architecture and multiple communication media for exchange of tactical information. Also called TDL.[17]

Theater: The geographical area for which a commander of a geographic combatant command has been assigned responsibility.[18]

Theater of War: Defined by the President, Secretary of Defense, or the geographic combatant commander as the area of air, land, and water that is, or may become, directly involved in the conduct of major operations and campaigns involving combat.[19]

Theater Event System: Architecture for reporting ballistic missile events, composed of three independent processing and reporting elements: the joint tactical ground stations, tactical detection and reporting, and the space-based infrared system mission control station. Also called TES.[20]

Theater Strategy: An overarching construct outlining a combatant commander's vision for integrating and synchronizing military activities and operations with the other instruments of national power in order to achieve national strategic objectives.[21]

Terminal Phase: That portion of the flight of a ballistic missile that begins when the warhead or payload reenters the atmosphere and ends when the warhead or payload detonates, releases its submunitions, or impacts.[22]

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[17] JCS, JP 1-02, 266.

[18] Ibid., 275.

[19] Ibid.

[20] Ibid.

[21] Ibid., 276.

[22] Ibid., 273.

Track Correlation: Correlating track information for identification purposes using all available data.[23]

Tracking: Precise and continuous position-finding of targets by radar, optical, or other means.[24]

## Limitations and Delimitations

This study is unclassified. The following aspects of data collection, research and analysis will be limited due to their classification residing at a higher level: communication systems, technical parameters, fire control systems, and operating procedures. Despite the unclassified nature of this thesis, there exists a danger of aggregated classification due to the collection of this information in one location.

Requests to military school houses for specific course curriculums hold no legal authority and therefore the researcher is held to what is voluntarily provided.

This research will not explore individual operational commands employing BMD systems.

This study will be delimited in scope to set the boundaries and direct the focal point of the thesis to successfully tested U.S. Ballistic Missile Defense technology and assets and therefore will not discuss any integration of allied BMD technology.

## Conclusion

Ballistic Missile Defense assets are deployed in an extremely complex environment, occupied by all military services. History is littered with lethal friendly fire

[23] JCS, JP 1-02, 279.

[24] Ibid., 270.

incidents which could have been prevented if more attention had been paid to the coordination of joint operations. Unfortunately, Missile Defense has its own example of what happens when joint coordination does not occur with the prime example of the 2 April 2003 incident where two PATRIOT interceptors downed an F/A-18C, killing Navy pilot LT Nathan White as he was returning from a mission over Iraq. The incident was attributed to inexperienced U.S. troops operating in a joint environment in which they relied too heavily on the autonomous mode for self-defense.[25] All DOTMLPF aspects of BMD must be joint and integrated to operate and to produce a synergistic sum of the parts, which is greater than the individual components.

[25] Lester Haines, "Patriot Missile: Friend or Foe? RAF Tornado Downed, Questions Unanswered," *The Register*, 2004, accessed 4 March 2017, http://www.theregister.co.uk/2004/05/20/patriot_missile/.

# CHAPTER 2

# LITERATURE REVIEW

## Introduction

Determining the answer to the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense, requires a literature review to lay the foundation for the parameters of this study. A Joint Concept links strategic guidance to the development and employment of future joint force capabilities and serve as "engines for transformation" that may ultimately lead to doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) and policy changes.[26] This chapter will discuss how the literature answers to the following secondary research questions:

1. What is current Ballistic Missile Defense doctrine exists and to what extent is it integrated?
2. What organizations and commands compromise Ballistic Missile Defense and to what extent is the organizational manning jointly optimized at the operational level?
3. What institutionalized joint Ballistic Missile Defense training exists within the various services' training pipelines prior to operational execution?
4. What material components comprise Ballistic Missile Defense systems for each service and whether/how these systems integrate between services?

[26] Director, Joint Staff, Chairman of the Joint Chiefs of Staff Instruction 3010.02C, Subject: Guidance for Development and Implementation of Joint Concepts. Joint Chiefs of Staff, Washington, DC, 15 January 2012, A-1.

5. To what extent is Ballistic Missile Defense leadership educated to maximize the joint integration of their systems?
6. To what extent are Ballistic Missile Defense assets deployed at the operational level manned jointly to maximize experience and overcome service differences?
7. Do joint facilities for Ballistic Missile Defense exist?

Systematically and sequentially finding answers to the secondary research questions will support and inform the conclusion to the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense?

## Doctrine

Doctrine is composed of fundamental principles and overarching guidance by which military forces guide their actions in support of national objectives. As U.S. doctrine is a nested concept derived and informed from strategy, research begins with the Goldwater-Nichols Reorganization Act, then to a review of the National Security Strategies and Congressional missile defense acts (to include the National Security Presidential Directive on BMD), drilling down into the National Military Strategies, to finally come to rest in the Joint Publications.

The Goldwater-Nichols Defense Reorganization Act is the single most important document in the joint world as it reorganized the chain of command to eliminate inter-service rivalries and competing forms of doctrine. Goldwater-Nichols set the stage for the modern concept of Network Centric Warfare, on which an integrated BMD is totally dependent. The chain of command is now designated as from the President to the Secretary of Defense to the Combatant Commanders. This limits the service chiefs to the

administrative controls of manning, training and equipping their forces. The operational control of the services in a theater now belongs solely to the respective combatant commander. Goldwater-Nichols also established the primacy of joint doctrine above all other service doctrine. The Goldwater-Nichols Defense Reorganization Act requires the President to submit his strategy in the form of the *National Security Strategy* (NSS) to Congress.

The NSS sets principles and priorities to safeguard national interests. Within the first section of the 2015 NSS, Ballistic Missile Defense is specifically named as a key component to strengthen National Security and National Defense. Ballistic Missile Defense's role is crucial in combating the persistent threat of terrorism by preventing a rogue nation from launching and striking the homeland with a ballistic missile. By removing the effectiveness of ballistic missiles, BMD prevents conflict and the spread and use of Weapons of Mass Destruction.

Further clarification of national BMD strategy can be found in the National Missile Defense Act of 1999, National Security Presidential Directive-23 (NSPD-23), and the National Defense Authorization Act for Fiscal Year 2017. The National Missile Defense Act of 1999 (NMDA 1999) declares that "it is U.S. policy to: deploy as soon as technologically possible a National Missile Defense (NMD) system capable of defending U.S. territory against limited ballistic missile attack (whether accidental, unauthorized, or deliberate)."[27] This act created the appropriations and established the sense of urgency necessary to begin the development of BMD.

[27] U.S. Congress, *National Missile Defense Act of 1999* (NMDA) (Washington, DC: Government Printing Office, 1999), 1.

On 16 December 2002 President George W. Bush issued National Security Presidential Directive (NSPD-23) which defined national policy on ballistic missile defense in response to changes in the post 9/11 security environment. NSPD-23 is the single most important document for BMD as it lay the foundation for today's BMD and describes why and how missile defense was to be developed. The below quotation is a direct quotation from NSPD-23. The bolded text is present in the original document and connotes the areas President George W. Bush wanted to emphasize:

> As the events of September 11 demonstrated, the security environment is more complex and less predictable than in the past. We face growing threats from weapons of mass destruction (WMD) in the hands of states or non-state actors, threats that range from terrorism to ballistic missiles intended to intimidate and coerce us by holding the U.S. and our friends and allies hostage to WMD attack.
>
> Hostile states, including those that sponsor terrorism, are investing large resources to develop and acquire ballistic missiles of increasing range and sophistication that could be used against the United States and our friends and allies. These same states have chemical, biological, and/or nuclear weapons programs. In fact, one of the factors that make long-range ballistic missiles attractive as a delivery vehicle for weapons of mass destruction is that the United States and our allies lack effective defenses against this threat.
>
> The contemporary and emerging missile threat from hostile states is fundamentally different from that of the Cold War and requires a different approach to deterrence and new tools for defense. The strategic logic of the past may not apply to these new threats, and we cannot be wholly dependent on our capability to deter them. Compared to the Soviet Union, their leaderships often are more risk prone. These are leaders that also see WMD as weapons of choice, not of last resort. Weapons of mass destruction are their most lethal means to compensate for our conventional strength and to allow them to pursue their objectives through force, coercion, and intimidation.
>
> Deterring these threats will be difficult. There are no mutual understandings or reliable lines of communication with these states. Moreover, the dynamics of deterrence are different than in the Cold War when we sought to keep the Soviet Union from expanding outward. What our new adversaries seek is to keep us out of their region, leaving them free to support terrorism and to pursue aggression against their neighbors. By their own calculations, these leaders may believe they can do this by holding a few of our cities hostage. Our adversaries seek enough destructive capability to blackmail us from coming to the assistance of our friends

who would then become the victims of aggression. In recognition of these new threats, I have directed that the United States must make progress in fielding a new triad composed of long-range conventional and nuclear strike capabilities, missile defenses, and a robust industrial and research development infrastructure.

Some states, such as North Korea, are aggressively pursuing the development of weapons of mass destruction and long-range missiles as a means of coercing the United States and our allies. To deter such threats, we must devalue missiles as tools of extortion and aggression, undermining the confidence of our adversaries that threatening a missile attack would succeed in blackmailing us. In this way, although missile defenses are not a replacement for an offensive response capability, they are an added and critical dimension of contemporary deterrence. Missile defenses will also help to assure allies and friends, and to dissuade countries from pursuing ballistic missiles in the first instance by undermining their military utility.

Finally, history teaches that, despite our best efforts, there will be military surprises, failures of diplomacy, intelligence, and deterrence. Missile defenses help provide protection against such events.

Missile Defense Program

Upon taking office, I directed the Secretary of Defense to examine the full range of available technologies and basing modes for missile defenses that could protect the United States, our deployed forces, and our friends and allies. As I have previously directed, our policy is to develop and deploy, at the earliest possible date, ballistic missile defenses drawing on the best technologies available.

The Administration has also eliminated the artificial distinction between "national" and "theater" missile defenses.

The defenses we will develop and deploy must be capable of not only defending the United States and our deployed forces, but also friends and allies;

The distinction between theater and national defenses was largely a product of the ABM Treaty and is outmoded. For example, some of the systems we are pursuing, such as boost-phase defenses, are intended to be capable of intercepting missiles of all ranges, blurring the distinction between theater and national defenses; and

The terms "theater" and "national" are interchangeable depending on the circumstances, and thus are not a meaningful means of categorizing missile defenses. For example, some of the systems being pursued by the United States to protect deployed forces are capable of defending the entire national territory of some friends and allies, thereby meeting the definition of a "national" missile defense system.

Building on previous missile defense work, over the past year and a half, the Defense Department has pursued a robust research, development, testing, and evaluation program designed to develop layered defenses capable of intercepting missiles of varying ranges in all phases of flight. The testing regimen employed has become increasingly stressing, and the results of recent tests have been impressive.

Fielding Missile Defenses

In light of the changed security environment and progress made to date in our development efforts, the United States plans to begin deployment of a set of missile defense capabilities in 2004. These capabilities will serve as a starting point for fielding improved and expanded missile defense capabilities later.

The Defense Department plans to employ an evolutionary approach to the development and deployment of missile defenses to improve our defenses over time. The United States will not have a final, fixed missile defense architecture. Rather, we will deploy an initial set of capabilities that will evolve to meet the changing threat and to take advantage of technological developments. The composition of missile defenses, to include the number and location of systems deployed, will change over time.

In August 2002, the Secretary of Defense proposed an evolutionary way ahead for the deployment of missile defenses. The capabilities planned for operational use in 2004 and 2005 will include ground-based interceptors, sea-based interceptors, additional Patriot (PAC-3) units, and sensors based on land, at sea, and in space. In addition, the United States will seek permission respectively from the U.K. and Denmark to upgrade early-warning radars in Fylingdales and Thule, Greenland as part of our capability.

Under the approach presented by the Secretary of Defense, these capabilities may be improved through additional measures such as:

Deployment of additional ground- and sea-based interceptors, and Patriot (PAC-3) units;

Initial deployment of the THAAD and Airborne Laser systems;

Development of a family of boost-phase and midcourse hit-to-kill interceptors based on sea-, air-, and ground-based platforms;

Enhanced sensor capabilities; and

Development and testing of space-based defenses."[28]

The current scope of what the U.S. BMD system is to defend is defined in section 1665 of the National Defense Authorization Act for Fiscal Year 2017 (NDAA 2017). NDAA 2017 amends NMDA 1999 the BMD defended area to include U.S. allies, and U.S. deployed forces as well as the originally NMDA stated U.S. territory.[29]

The National Military Strategy (NMS) is a derivative of the NSS and describes military force employment to protect and advance national interests described in the NSS. In the NMS, the U.S. Armed Forces' purpose is stated as to defend the homeland, build security globally, and project power and win decisively. The NMS recognizes the need to optimize joint integration in order to meet the military objectives of deterrence, denial, and the defeat of U.S. adversaries. 2015 NMS is important to BMD as it specifically has the following two paragraphs dedicated to the ballistic missile threat emanating from Iran and North Korea.

> Iran also poses strategic challenges to the international community. It is pursuing nuclear and missile delivery technologies despite repeated United Nations Security Council resolutions demanding that it cease such efforts. It is a state-sponsor of terrorism that has undermined stability in many nations, including Israel, Lebanon, Iraq, Syria, and Yemen. Iran's actions have destabilized the region and brought misery to countless people while denying the Iranian people the prospect of a prosperous future.
>
> North Korea's pursuit of nuclear weapons and ballistic missile technologies also contradicts repeated demands by the international community to cease such efforts. These capabilities directly threaten its neighbors, especially the

[28] U.S. President, National Security Presidential Directive-23, Subject: National Policy on Ballistic Missile Defense, The White House, Washington, DC, 2002, accessed 1 May 2017, https://fas.org/irp/offdocs/nspd/nspd-23.htm.

[29] U.S. Congress, NDAA, 908.

> Republic of Korea and Japan. In time, they will threaten the U.S. homeland as well.[30]

Iran's development of extended range ballistic missiles poses a threat to U.S. allies throughout the Middle East and Europe. North Korea has directly threatened U.S. allies around the Pacific Rim and continues development of missiles that may ultimately threaten the United States directly. Together, these two rogue nations justify a fully integrated global missile defense capability.

Joint Publications are written by the Joint Staff to provide a bridge between policy and doctrine. The basic tenet of U.S. military doctrine is by creating a joint environment where the synergistic sum of the parts is greater than the individual components. Research began in Joint Publication 1 (JP 1), *Doctrine for the Armed Forces of the United States* and followed BMD operations to JP 3-01, *Countering Air and Missile Threats*, JP 3-31, *Command and Control for Joint Land Operations*, and JP 3-32 *Command and Control for Joint Maritime Operations*.

Joint Publication 1, *Doctrine for the Armed Forces of the United States* serves as the overarching doctrine for the U.S. military. It describes how the military will conduct joint operations. JP1 seeks to build a broad framework in which multiple services will interact. JP 1 declares joint doctrine takes precedence over individual Services' doctrine. JP 1refers the reader to JP 3-01 for further doctrine concerning missile defense.

JP 3-01, *Countering Air and Missile Threats* is the joint publication that describes Integrated Air and Missile Defense doctrine of Ballistic Missile Defense. The Joint Staff recognized the airspace above a battlefield is congested and therefore must have specific

[30] Joint Chiefs of Staff, *National Military Strategy 2015* (Washington, DC: Government Printing Office, 2015).

doctrine describing how multiple service will coordinate the use of the same airspace. JP 3-01 defines the Geographical Combatant Commanders (GCCs) and their corresponding Joint Force Commanders responsibilities for BMD and designates tasking authority of the BMD assets. JP 3-01 calls out the need for joint planning by emphasizing the short timeline in which to conduct BMD, and establishes key roles in order combat the ballistic missile threat. It establishes the GCC under ballistic missile attack as the supported commander for BMD in their respective AOR and how processes linking sensors to decision makers to fire control nodes that cross AOR boundaries will require coordination between neighboring GCCs to enable multiple engagement opportunities which impacts asset protection decisions, target selection, shot doctrine, and reserves in a larger global context. Coordination between GCCs has command and control implications that transcend regional decisions and strategies. JP 3-01 refers the reader to JP 3-31 and JP 3-32 for further clarification on BMD command and control in a land (JP 3-31) and maritime (JP 3-32) environments. JP 3-01 recognizes that ballistic missile threats can cross GCC Areas of Responsibilities boundaries and refers to the Unified Command Plan (UCP) directing for CDRUSSTRATCOM to be responsible for synchronizing the planning for global missile defense with all GCCs and subordinate JFCs coordinating their BMD planning and support with USSTRATCOM JFCC-IMD.

JP 3-31, *Command and Control for Joint Land Operations* gives the doctrine for joint land operations and land control operations to establish local military superiority in land operational areas. JP 3-31 further refines the roles and responsibilities of land forces to ensure missile defense operations are “planned, coordinated, and synchronized to

effectively counter air and missile threats."[31] JP 3-31designates Operational Control (OPCON) and Tactical Control (TACON) for missile defense assets.

JP 3-32, *Command and Control for Joint Maritime Operations* provides doctrine for the command and control of joint maritime operations across the range of military operations. JP 3-32 establishes doctrine necessary for subordinate maritime commanders to execute operations independently through mission command and command by negation constructs. JP 3-32 addresses the possibility for naval assets to engage in cross AOR BMD events and reaffirms the GCC for the effected AOR retains responsibility and authority for BMD.

## Organizations

Within this study Organizations will refer to military commands and agencies which are stakeholders in the development and employment of theater ballistic missile defense. Organizations included within this study will include JIAMDO, JIAMD Governance JAT, MDA, USSTRATCOM, JFCC IMD and SMDC/ARSTRAT.

As a part of the Joint Staff, Joint Integrated Air and Missile Defense Organization (JIAMDO) supports the Chairman of the Joint Chiefs of Staff, through the Director for Resources, Force Structure, and Assessments (J8), in his responsibility to coordinate development of Joint Air and Missile Defense requirements and capabilities. JIAMDO facilitates collaboration between Services, Combatant Commands (CCMDs), and Agencies to identify existing and emerging capabilities. When the capability gap has been identified as a material deficiency, JIAMDO places the requirement into the Joint

[31] Joint Chiefs of Staff, Joint Publication 3-31, *Command and Control for Joint Land Operations* (Washington, DC: Government Printing Office, 2013), IV-22.

Capabilities Integration Development System (JCIDS) which is overseen by the Joint Requirements Oversight Council (JROC). Additionally, in 2008 the Joint Integrated Air and Missile Defense (JIAMD) Governance Joint Analysis Team (JAT) was establish to manage the Air and Missile Defense portfolio by providing oversight and direction for efforts to integrate applicable sensors, weapons systems, and weapons capabilities across the Department of Defense. The JIAMD Governance JAT duties include budgeting, systems architecture definition, testing, System of Systems integration, and acquisition planning and execution that support both Homeland and Theater IAMD and provides recommendations for appropriate linkages with the lead policy and capability development entities to best harmonize DoD processes that ultimately result in fielding of systems for warfighters.

The Missile Defense Agency (MDA), as an acquisition agency, is charged with developing and providing warfighters with an integrated missile defense solution to meet this requirement. The organization was born as the Strategic Defense Initiative's Innovative Sciences and Technology Office in 1983, renamed the Ballistic Missile Defense Organization in 1993 and re-christened as the Missile Defense Agency in 2002. MDA is answerable to the JROC and audited by the United States Government Accountability Office (GAO). MDA's mission is to manage, direct, and execute the development of the BMDS in accordance with NSPD-23 and to achieve Department of Defense priorities to:

a. Defend the United States, deployed forces, allies, and friends from ballistic missile attacks of all ranges in all phases of flight.

b. Develop and deploy, as directed, a layered BMDS.

c. Enable the fielding of elements of the BMDS as soon as practicable.

d. Provide capability in blocks, improving the effectiveness of fielded capability by inserting new technologies as they become available.[32]

MDA philosophy on developing joint interoperability architecture is to begin with existing legacy systems and use the information gained for the design of future systems. MDA Joint Service Systems Engineering Team (JSSET) is the specific MDA entity that coordinates the work on the architectures. This team serves as a joint acquisition effort to build the future framework for the near-term joint track management capability and long-term joint IAMD capabilities.

Unified Command Plan (UCP) assigns United States Strategic Command (USSTRATCOM) missile defense responsibilities of synchronizing operational missile defense planning, security cooperation activities, global force management for missile defense capabilities, conducting global ballistic missile defense operations support, asset management, alternate execution authority, and joint BMD training. Two USSTRATCOM component commands, Joint Functional Component Command, Integrated Missile Defense (JFCC IMD) and U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (SMDC/ARSTRAT) fulfill these UCP requirements. JFCC IMD serves as the Warfighter's advocate to MDA, ensuring MDA's compliance with warfighter requirements. JFCC IMD is co-located with MDA in the MDIOC at Schriever AFB. SMDC/ARSTRAT conducts space and missile defense operations and provides planning, integration, control and coordination of Army forces and capabilities in support of U.S. Strategic Command missions (strategic deterrence, integrated missile defense, and space operations) and serves as the Army force

[32] Missile Defense Agency, "Mission Statement," accessed 16 October 2016, https://www.mda.mil.

modernization proponent for space, high altitude and global missile defense. ARSTRAT is co-located with MDA headquarters at Redstone Arsenal, Alabama.

## Training

Training refers to efforts that prepares individual members and commanders to perform required military duties and functions. Curriculum provided by the U.S. Naval Surface Warfare Center Dahlgren Division and the U.S. Army Fires Center of Excellence showed officer and enlisted students are taught the fundamentals of their individual weapon systems. They are provided with a 2-hour briefing over the capabilities and limitations of their sister-service systems during system indoctrination phase of training. At the U.S. Army Fires Center of Excellence schoolhouse, the Aegis BMD capability and limitation briefing is taught by a Navy Aegis officer. At the U.S. Naval Surface Warfare Center Dahlgren Division schoolhouse, the THAAD and PATRIOT capability and limitation briefing is taught by a Navy schoolhouse instructor. There are not any joint BMD training courses offered at the Army or Navy missile defense school houses.

Limited joint operator-level training has been accomplished through three MDA live fire flight tests of FTI-01, FTO-01, and FTO-02 Event 2a. The live fire tests "provide the warfighters confidence in the execution of their integrated air and missile defense plans and the opportunity to refine operational doctrine and tactics, techniques and procedures."[33]

[33] U.S. Congress, *Unclassified Version of Vice Admiral James D. Syring, USN, Director Missile Defense Agency before the Senate appropriations Committee* (Washington, DC: Government Printing Office, 2014).

FTI-01Summary: Flight Test Integrated (FTI-01) demonstrated regional BMDS regional/theater, integrated operations ability to defend a ballistic missile attack of up to five near-simultaneous threats in an operationally relevant scenario. FTI-01 was an integrated, system-level, live-fire event to be conducted at U.S. Army Kwajalein Atoll (USAKA)/Reagan Test Site (RTS) on 26 October 2012. It demonstrated interoperability among the three currently-fielded TBMD weapons platforms: Aegis BMD, THAAD, and PAC-3. Other assets, including AN/TPY-2 Forward-Based Mode (FBM) and Command, Control, Battle Management, and Communications (C2BMC) contributed essential interoperability capabilities to FTI-01. Representative threats in FTI-01 included three ballistic missiles and two air-breathing (cruise missile) targets (ABTs). Targets were flown at multiple ranges and trajectories in an operationally realistic scenario.

FTO-01 Summary: Flight Test Operational-01 (FTO-01), demonstrated integrated, layered, regional missile defense capabilities to defeat a raid of two threat-representative medium-range ballistic missiles in a combined live-fire operational test. The test stressed the ability of the Aegis BMD and THAAD weapon systems to function in a layered defense architecture and defeat a raid of two near-simultaneous ballistic missile targets. FTO-01 was an integrated, system-level, live-fire event to be conducted at U.S. Army Kwajalein Atoll (USAKA)/Reagan Test Site (RTS) on 10 September 2013.

FTO-02 Event 2a Summary: Flight Test Operational-02 Event 2a, was complex operational flight test of the BMDS demonstrating a layered defense architecture. FTO-02 Event 2a conducted in the vicinity of Wake Island and surrounding areas of the western Pacific Ocean on 1 November 2015. The test included Aegis BMD and THAAD weapon systems to negate two ballistic missile threats while Aegis BMD simultaneously

conducted an anti-air warfare operation. This highly complex operational test of the BMDS required all elements to work together in an integrated layered defense design to detect, track, discriminate, engage, and negate the ballistic missile threats.

## Materials

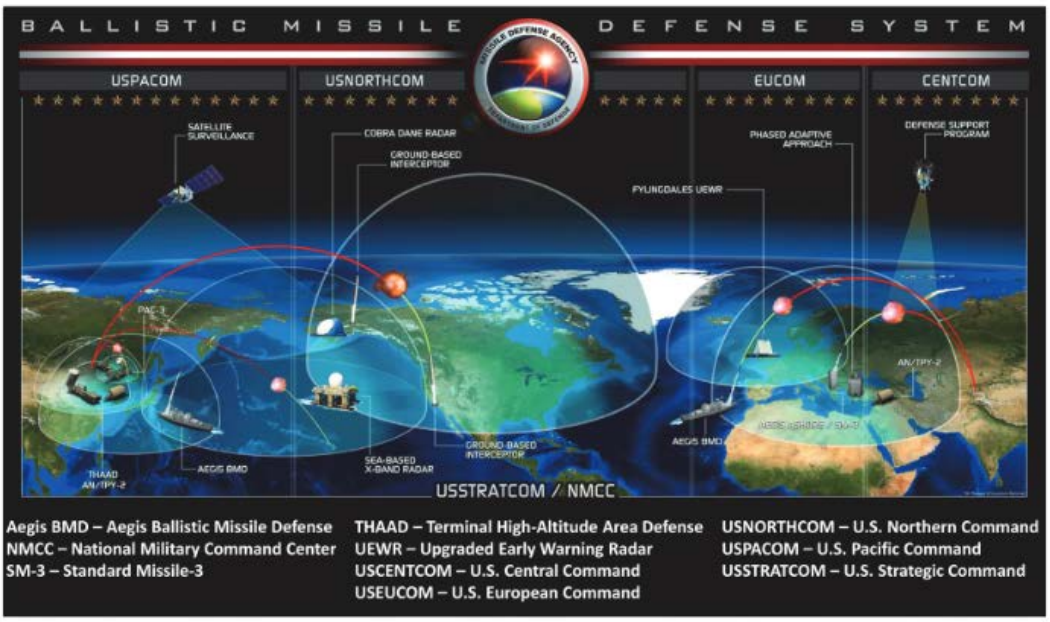


Figure 2. Ballistic Missile Defense System

*Source:* Missile Defense Agency, "Ballistic Missile Defense System," accessed 16 October 2016, https://www.mda.mil.

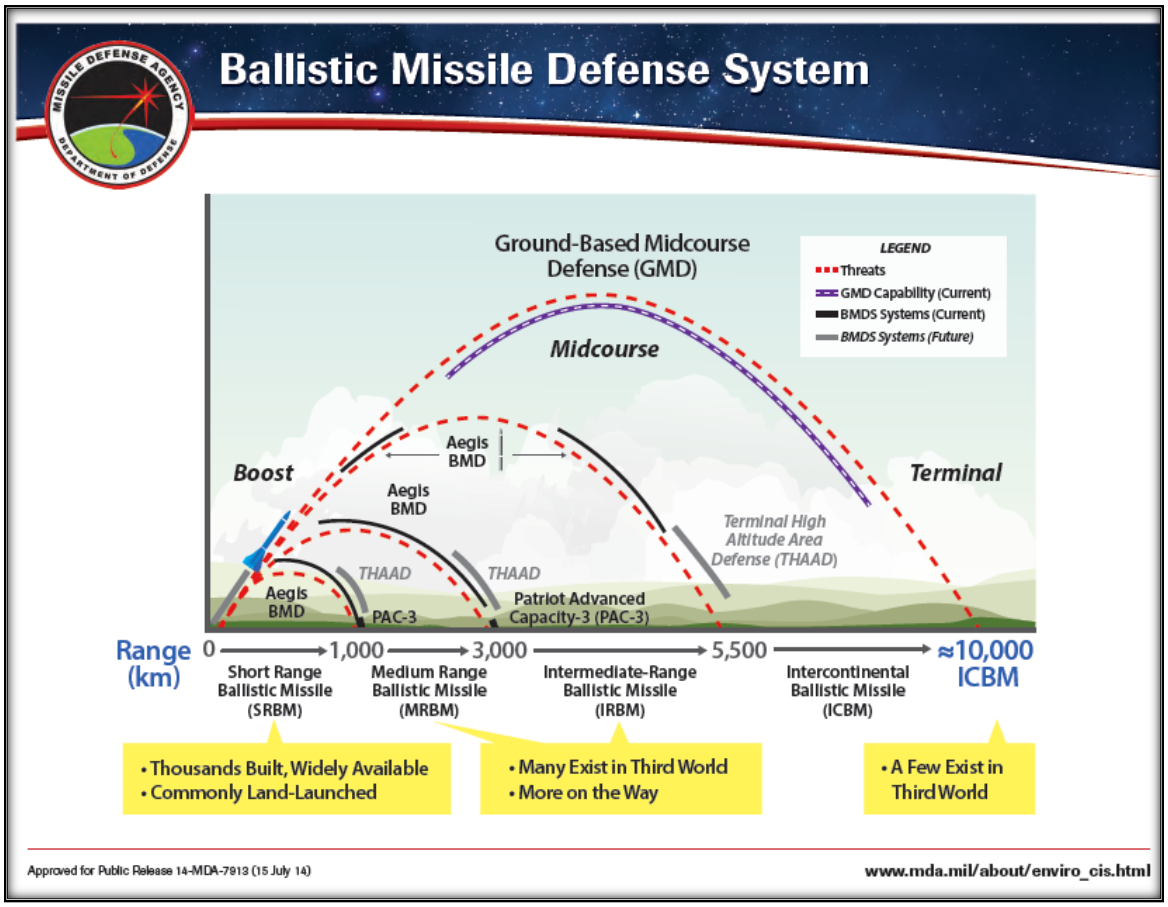


Figure 3. Ballistic Missile Defense System

*Source:*. Missile Defense Agency, "Ballistic Missile Defense System," accessed 16 October 2016, https://mda.mil/about/enviro_ois.html.

Table 2. Operational BMD Systems

| System | Link-16 Comms? | Sensor | Interceptor | Current Inventory | Total future Inventory | Interceptors per system | Range | Price per Missile |
|---|---|---|---|---|---|---|---|---|
| PAC-3 | Yes | AN/MPQ-65 | MIM-104F | 27 | ??? | 16 | 20-35km | $125,00 |
| THAAD | Yes | AN/TPY-2 | THAAD interceptor | 6 | 99 | 24 | 200km | $915,000 |
| Aegis BMD Ship | Yes | SPY-1 | | 33 | 80-97 | | | |
| | | | SM-2 Block IV RIM-66 | | | 0-36 | 70-170km | $400k |
| | | | SM-3 Block 1A (RIM-161) | | | 0-36 | 700-2,500km | $9-24 million |
| | | | SM-3 Block IIA (RIM-161) | | | 0-36 | 700-2,500km | $9-24 million |
| | | | SM-3 Block IIB (RIM-161) | | | 0-36 | 700-2,500km | $9-24 million |
| | | | SM-6 Dual I/II (RIM-174) | | | 0-36 | 240-460km | $500k |
| Aegis Ashore | Yes | SPY-1 | | 1 | 2 | | | |
| | | | SM-3 | | | 18 | 700-2,500km | $9-24 million |
| GMD | Yes | UEWR | GBI | 36 | 44 | | | $70-90 Million |

*Source:* Created by author.

Materials will refer to systems currently operating as the BMD. BMD systems are composed of highly technical equipment. For this study, it is assumed that the individual components of BMD can carry out the designed task and mission. It is important for the scope of this study not to get lost in the specifications of each system; instead, investigate

the technical possibility for joint integration of each system. Extensive research has been conducted using published information from the Missile Defense Agency, individual weapon system Program Executive Offices, and the websites of Lockheed Martin Corporation, Raytheon Corporation and Northrop Grumman. This research was required to understand the roles and capabilities each element of the BMD system was designed to perform. The operational Ballistic Missile Defense is comprised of the following sensor-shooter systems: the PAC-3, THAAD, Aegis BMD and GMD; and one overarching command and control system known as C2BMC. Each system was developed to provide a unique layer to ballistic missile defense. Aegis BMD is further divided in to the sea-going Aegis BMD ships and the fixed, land-based Aegis Ashore. Future capabilities which have been tested but not yet implemented within the operational force were include as well.

## PATRIOT

The current PATRIOT Weapon System used in BMD is the PATRIOT Advanced Capability-3 (PAC-3). The PATRIOT system has the distinction of being the only BMD system not produced and further developed by MDA, but by the U.S. Army. MDA only has the responsibility of overseeing the integration and interoperability of the PATRIOT system within BMD.

The PATRIOT missile system first gained fame during Desert Storm, as it was the first missile defense system deployed in combat operations. The Desert Storm PATRIOTS used a unitary warhead with a proximity fuse to destroy incoming ballistic missiles. Desert Storm PATRIOTS were a self-contained unit where the sensor was physically attached to the missile launcher via fiber optic cables, and provided the data

required necessary to engage an enemy IAMD threat using an Extended Range Interceptor (ERINT). Due to upgrades to the PATRIOT Weapons Control Computer and Data Link Terminal, the PAC-3 utilizes a Tactical Digital Information Link-J (TADIL-J or Link-16) to communicate between Weapons Control Computers and VHF or fiber optic cables to communicate with launchers.

Figure 4. PATRIOT

*Source:* Missile Defense Agency, "PAC-3 Radar System," accessed 4 February 2017, https://www.mda.mil/global/images/system/pac-3/p39.jpg; Missile Defense Agency, "PAC-3 System," accessed 4 February 2017, https://www.mda.mil/global/images/system/pac-3/dt5i102.jpg.

The PATRIOT PAC-3 is an entirely new missile, derived from the ERINT interceptor, which is intended to counter theater-class ballistic missile threats using hit-to-kill intercept. The PAC-3 missile is fired from the same launcher as earlier versions of PATRIOT, although eight of the smaller PAC-3 missiles are carried in each firing unit,

versus four each of the earlier versions. The PAC-3s organic sensor is a multifunctional phased array C-band radar (wavelength of 4-8 centimeters and a frequency of 4-8 gigahertz) known as the AN/MPQ-65. The AN/MPQ-65 has an operational range of 100 kilometers and is able to track more than one hundred potential targets, with the ability to actively simultaneously engage nine. The AN/MPQ-65 data is relayed to the engagement control station.

The engagement control station remotely provides missile prelaunch data and the fire command signal to the launching stations which points and launches the Patriot missile. The engagement control station also communicates with other Patriot batteries and the higher command headquarters via VHF and Link-16 data links. Link-16 communication, a military ultra-high frequency (UHF) tactical data exchange network used by NATO, allows for the yet-to-be-fielded Integrated Air and Missile Defense (IAMD) Battle Command System (IBCS). The IBCS utilizes sensors and interceptors from inorganic air defense systems to operate as an integrated fire control network IBCS allows any sensor, best shooter operations to optimize limited resources and facilitate flexible defense designs:

> The PAC-3 Missile uses a solid propellant rocket motor, aerodynamic controls, attitude control motors (ACMs) and inertial guidance to navigate. The missile flies to an intercept point specified prior to launch by its ground-based fire solution computer, which is embedded in the engagement control station. Target trajectory data can be updated during missile flyout by means of a radio frequency uplink/downlink. Shortly before arrival at the intercept point, the PAC-3 Missile's on board Ka band seeker acquires the target, selects the optimal aim point and terminal guidance is initiated. The ACMs, which are small, short duration solid

propellant rocket motors located in the missile forebody, fire explosively to refine the missile's course to assure body-to-body impact.[34]

The PAC-3 missile's main destructive power against a target is the kinetic energy of a direct impact, known as a hit-to-kill. However, as the PAC-3 is not solely intended for use in the BMD role, the PAC-3 is also equipped with a high-explosive fragmentary warhead to improve lethality against aircraft or cruise missiles. PAC-3 is globally-transportable via air, land and sea.

THAAD

Figure 5. THAAD

*Source:* Missile Defense Agency, "THAAD Radar (AN-TPY-2)," accessed 2 November 2016, https://www.mda.mil/global/images/system/thaad/4._TH_Radar.jpg; Missile Defense Agency, "THAAD System," accessed 2 November 2016, https://www.mda.mil/global/images/system/thaad/fto02e2a/THAAD-2nd-Launch2.jpg.

[34] Lockheed Martin, "PAC-3 Missile," accessed 22 October 2016, http://lockheedmartin.com/content/dam/lockheed/data/mfc/pc/pac-3-missile/mfc-pac-3-pc.pdf.

Terminal High Altitude Area Defense (THAAD) is a land-based BMD element designed to augment the limited range of the PATRIOT system by being capable of shooting down ballistic missiles both inside and just outside the atmosphere during final, or terminal, phase of flight. The high-altitude intercept is designed to mitigate the effects of enemy weapons of mass destruction before they reach the ground. THAAD uses hit-to-kill technology to destroy the incoming warheads. THAAD is globally-transportable via air, land and sea.

The THAAD sensor is the Army Navy/Transportable Radar Surveillance (AN/TPY-2). The AN/TPY-2 is a transportable X-band radar (wavelength of 2.5-4 centimeters and a frequency of 8-12 gigahertz) which searches, tracks, and discriminates objects and provides updated tracking data to the THAAD interceptor. An AN/TPY-2 can be operated in Terminal Based Mode (TBM) or Forward Based Mode (FBM). TBM is when a AN/TPY-2 is directly linked to a specific THAAD battery, and provides data only to that weapon system. FBM is when the AN/TPY-2 is not associated with a specific THAAD battery and the sensor provides data to a network of shooters.

## Aegis BMD

Aegis BMD was developed through lessons learned from the highly successful PATRIOT system. Utilizing the advantages of a ship-borne system, designers of the Aegis BMD system would incorporate more powerful
SPY-1 radars and greater range SM-3 interceptors.

Aegis BMD has two modes of deployment within BMD, ship-borne and land-based. The Aegis Weapon System (Combat Control, SPY-1 radar, and interceptors) is placed on Navy cruisers and destroyers to create a highly mobile ballistic missile defense

platform. The same Aegis Weapon System is placed at fixed land bases and is known as Aegis Ashore. Aegis Ashore only has an inventory of SM-3 interceptors used to defeats short- to intermediate-range ballistic missile threats above the atmosphere, whereas an Aegis BMD ship will contain the exo-atmospheric SM-3, as well as the endo-atmosphere SM-2 Block IV and SM-6 Dual I/II used to combat short-range ballistic missiles.


Figure 6. Aegis BMD

*Source:* Missile Defense Agency, "Aegis BMD Transition From Sea to Shore," accessed 16 May 2017, https://image.slidesharecdn.com/syring-140329091805-phpapp02/95/syring-mda-briefing-11-638.jpg?cb=1396084730; Missile Defense Agency, "Aegis System," accessed 16 May 2017, https://www.mda.mil/global/images/system/aegis/ftm-10.jpg; Reseau International, "ABM Aegis Ashore Complex Concept USMDA," accessed 16 May 2017, http://reseauinternational.net/wp-content/uploads/2015/04/ABM_Aegis_Ashore_Complex_Concept_USMDA_lg.jpg; Wikimedia, "USS Antietam," Wikipedia, accessed 16 May 2017, https://upload.wikimedia.org/wikipedia/commons/thumb/d/d8/USS_Antietam-AN-SPY-1_Antenna.JPG/1200px-USS_Antietam-AN-SPY-1_Antenna.JPG; Missile Defense Agency, "Aegis BMD SM-3 Missile Profile," accessed 16 May 2017, http://2.bp.blogspot.com/-FZWiprR200I/U2s9vF-cJdI/AAAAAAAAF-c/dShMgypknQc/s1600/aegisunexpected2.png.

The Aegis Weapon System's sensor is a four-faced SPY-1 S-Band (wavelength of 8-15 centimeters and a frequency of 2-4 gigahertz) phased array radar capable of providing both 360-degree tracking and discrimination data for ballistic missiles.

Aegis uses the Missile Communications Command, Control, Communications, Computers and Intelligence (C4I) system for fire control processing and can use the Link-16 uplink to share data amongst other BMD ships. Link-16 has limited operational value as it creates positional target data into the fire control system without the actual sensor data. This creates possible multiple representations of targets, and the ghost images require further coordination and deconfliction. Aegis also utilizes the Navy Cooperative Engagement Capability (CEC) system:

> Cooperative Engagement Capability (CEC) contributes to theater ballistic missile defense by providing a continuous fire-control quality track on the missile from acquisition through splash. Although each ship is only able to maintain track for part of the missile flight, the CEC composite track, based on all the data, is continuous. Cues based on the composite track allow the downrange ships to detect the target earlier and to maintain track longer. The CEC cues and relay of composite track data will also allow defending ships maximum battle space in which to engage ballistic missiles when the SM-2 Block IVA missile becomes available.[35]

An emerging Aegis concept of operations is the Distributed Weighted Engagement Scheme (DWES) capability. The DWES provides an automated engagement coordination scheme between multiple Aegis BMD ships that determines which ship is the preferred shooter, reducing duplication of BMD engagements and missile expenditures while ensuring BMD threat coverage.

The Aegis program is currently undergoing an upgrade to Aegis Baseline 9:

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[35] GlobalSecurity.Org, "Cooperative Engagement Capability (CEC) AN/USG-2(V) Cooperative Engagement Transmission Processing Set," 2011, accessed 29 April 2017, http://www.globalsecurity.org/military/systems/ship/systems/cec.htm.

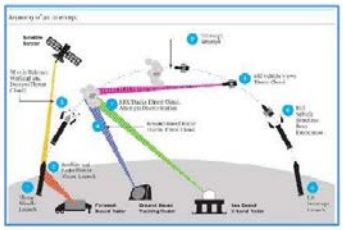
> Based on the tactical threat picture, Baseline 9 Aegis ships will be able to allocate their computer resources more dynamically in a single computing environment to maximize their BMD performance without degrading their air defense role. The principal enabler of this capability is the multi-mission signal processor (MMSP) for the Aegis SPY-1D radar. Earlier BMD computing suites for the radar used a separate signal processor, meaning a BMD-equipped surface warship could engage either a ballistic missile or an aircraft/cruise missile threat, but not both threats simultaneously. This situation resulted in difficult trade-offs that limited the system's anti-air warfare (AAW) capability to an unknown extent. The MMSP, however, effectively integrates signal-processing inputs from the BMD signal processor and the legacy Aegis in-service signal processor for the radar. This integration enables the SPY radar to go from single-beam to dual-beam capability to meet the power resource priorities for simultaneous antiair warfare and BMD sector coverage. The MMSP's up-to-date commercial off-the-shelf hardware and software algorithms control radar waveform generation and allow for simultaneous processing of both AAW and BMD radar signals. Critically, the MMSP improves Aegis SPY radar system performance in littoral environments, for example, against sea skimmers in a high-clutter environment. For BMD, the processor also enhances search and long-range surveillance and tracking and BMD signal processor range resolution, discrimination, and characterization, as well as real-time capability displays.[36]

At a 12 September 2016, Naval Integrated Fire Control-Counter Air (NIFC-CA) test, potential new integration was demonstrated when an unmodified U.S. Marine Corps F-35B acted as an elevated sensor and detected an over-the-horizon threat. The F-35B sent data through the aircraft's Multi-Function Advanced Data Link (MADL) to a ground station connected to the Aegis Weapon System on the USS *Desert Ship* (LLS-1), a land-based ship located at White Sands Missile Range. The target was subsequently engaged and successfully intercepted by an SM-6, demonstrating showing the capability to extend the battlefront through the integration of multiple service assets.

[36] John F. Morton, "The Aegis Warship: Joint Force Linchpin for IAMD and Access Control," *Joint Forces Quarterly* 80 (1st Quarter 2016): 110-115, accessed 4 February 2017, http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-80/jfq-80_110-115_Morton.pdf.

GMD

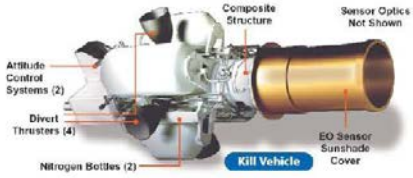
Ground-based Midcourse Defense (GMD) is a silo-based BMD system designed to provide limited missile defense of the U.S. homeland.



Ground Based Interceptor Launch


Exo-atmospheric Kill Vehicle

Upgraded Early Warning Radar




Sea-Based X-bad Radar (SBX)

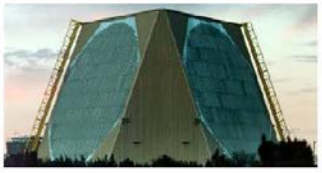


Figure 7. GMD

*Source:* Union of Concerned Scientist, "Anatomy of an Intercept," accessed 16 May 2017, http://www.ucsusa.org/sites/default/files/images/2016/07/nuclear-weapons-m-how-missile-defense-works.jpg; Missile Defense Agency, "Ground Based Missile Defense CTV-02," accessed 16 May 2017, https://www.mda.mil/global/images/system/gmd/GM-CTV-02_002.JPG; Missile Defense, "Exo-Atmospheric Kill Vehicle," accessed 16 May 2017, https://missiledefense.files.wordpress.com/2011/04/ekv.jpg; Missile Defense Advocacy, "NSS News," accessed 16 May 2017, http://missiledefenseadvocacy.org/wp-content/uploads/2014/10/rtn11_nss_news04_g02-770x400.jpg; Boeing, "Missile Defense Ground Based Midcourse," accessed 16 May 2017, http://www.boeing.com/resources/boeingdotcom/defense/missile_defense-ground-based_midcourse/images/gmd_hotspot_inset_05_320x207.jpg; Defense Update, "SIBRS Architecture," accessed 16 May 2017, http://defense-update.com/wp-content/uploads/2016/10/sbirs_architecture_500.jpg.

Ground-based Midcourse Defense GMD) is composed of Ground-Based Interceptors and Ground Support & Fire Control Systems components. The Ground-Based Interceptor (GBI) is a silo launched, multi-stage, solid fuel booster, with an Exo-atmospheric Kill Vehicle (EKV) payload. The EKV is a kinetic kill vehicle where only the kinetic force of the direct collision is used to destroy the target warhead. Once released from the booster, the EKV uses guidance data transmitted from Ground Support & Fire Control System components and on-board sensors to close with and destroy the target warhead. The intercept occurs in the midcourse portion of the ballistic missile trajectory and therefor is outside the earth's atmosphere.

Ground Support & Fire Control Systems consist of redundant fire control nodes, interceptor launch facilities (Fort Greeley, AK and Vandenberg AFB, CA), and a communications network. GMD Fire Control (GFC) receives data from Space Borne Infrared Satellites (SIBRS), ground based Upgraded Early Warning Radar (UEWR) and Sea-Based X-Band (SBX) Radar sources, then uses that data to task and support the intercept of target warheads using Ground-Based Interceptors. The GFC also provides the Command & Control, Battle Management and Communications (C2BMC) element with data for situational awareness.

## C2BMC

Command, Control, Battle Management and Communications (C2BMC) integrated Command, Control, Battle Management, and Communications system that can actively coordinates all elements of the Ballistic Missile Defense System. C2BMC is an integral part of the GMD system and can also receive and respond properly to J-series messages from Aegis BMD and THAAD:

The Command and Control, Battle Management and Communications (C2BMC) program is the integrating element of the Ballistic Missile Defense System (BMDS). It is a vital operational system that enables the U.S. president, secretary of defense, and Combatant Commanders at strategic, regional and operational levels to systematically plan ballistic missile defense operations, to collectively see the battle develop, and to dynamically manage designated networked sensors and weapons systems to achieve global and regional mission objectives. C2BMC supports a layered missile defense capability that enables a synergized response to threats of all ranges in all phases of flight. C2BMC is the force multiplier that globally and regionally networks, integrates and synchronizes autonomous sensor and weapon systems and operations to optimize performance. C2BMC is an integral part of all system ground and flight tests which verify and exercise all current and future BMDS capabilities. Through its operational software and networks, the C2BMC program provides redundant connectivity and enables on-site operations and sustainment for global Combatant Commanders. It provides key BMDS operational services through six product lines:

Ballistic Missile Defense Planner

- Allows the Warfighter to collaboratively plan, coordinate, and optimize high demand-low density BMD resources.

- Provides the means for collaborative planning and defense design development at all levels of command – strategic, operational, and tactical—between the combatant commands and the BMDS element planners. Command and Control

- Provides situational awareness by transforming diverse and complex data into decision quality information for Combatant Commanders.

- Emphasizes a common, single, integrated ballistic missile picture and provides the status of the overall BMDS to the President on down to the operational levels of command. Battle Manager

- Supports multiple tier engagement coordination and provides BMDS battle management capability.

- Acts as a force multiplier to achieve an integrated and layered ballistic missile defense system through improved sensor resource management and engagement coordination. Ballistic Missile Defense Network

- Provides secure network communications for the individual sensors and weapon elements of the BMDS.

- Provides robust, high-availability connectivity to quickly and unambiguously share information across the global BMDS. Concurrent Test, Training, and Operations.

- Affords Combatant Commanders the ability to maintain their operational capability, participate in exercises, provide training, and test and rehearse mission scenarios while the system is in an operational or "on alert" state.

- Enables the Warfighter to conduct distributed, high–fidelity, Operator-in-the-Loop, end-to-end training for missile defense.[37]

C2BMC is constantly being refined and further developed by the MDA C2BMC National Team. The National Team consists of members from all missile defense manufacturing companies, MDA, and JFCC IMD. The construct of the National Team allows subject matter experts from all the systems to provide input into what the next upgraded software version of C2BMC needs to incorporate in order to maximize the effectiveness of BMD.

C2BMC demonstrated its integration capability between systems during the 10 December 2015 Aegis Ashore Test. The test consisted of an AN/TPY-2 radar in Forward Based Mode, located at Pacific Missile Range Facility (PMRF), detecting the target and relaying target track information to the C2BMC system. C2BMC then relayed the track data to the Aegis Weapon System at the Aegis Ashore site which used the data to enable the Aegis Ashore AN/SPY-1 radar to quickly acquire, track, and develop a fire control solution to engage the target.

To balance the straight good news data provided by the developers and manufactures of the BMD equipment, studies by the Union of Concerned Scientist and the April 2013 United States Government Accountability Office critique of BMD were included within the research. It is important within this study to include both the best and

[37] Missile Defense Agency, "Fact Sheet: Command and Control, Battle Management, and Communications," accessed 28 April 2016, https://www.mda.mil/global/documents/pdf/c2bmc.pdf.

worst spin on the same material in order to come to a clearer picture of the materials composing the BMD system.

## Leadership and Education

Congressional testimony from BMD leadership included with the research of this study. This is an important factor as this is how the leaders of each specific organization or command describes their mission statement and success of their program. This allows insight into the minds the most senior leaders with the BMD community.

Joint Professional Military Education Phase I core curriculum was examined to determine the education provided to non-BMD mid-grade officers within the U.S. military. This was important to this study as BMD is just one facet of modern warfare. As most combatant commander will not come from a BMD background, it is important for future non-BMD commanders to understand how to properly employ BMD assets to maximize effectiveness.

BMD officer joint leadership education occurs through the myriad JIAMDO, MDA and JFCC IMD sponsored exercises and conferences which are designed to promote and education. Some of the exercises and conference which were examined include the following: Air and Missile Defense Exercise (AMDEX), Joint Air and Missile Defense Exercise, Austere Challenge, Terminal Fury/Global Lightning, EUCOM AMDEX, Keen Edge, Ulchi Freedom Guardian, Vigilant Shield/Global Thunder, BMDS Wargame, Planning Exercise, Joint Tactical Air Picture, National Missile Defense Conference, Nimble Titan, Joint Deployable Integrated Air and Missile Defense, Integrated Air and Missile Defense Center Senior Level Seminar, Huntsville Wargame, and the Missile Defense Advisory Committee Wargame. It was important to examine the

lessons learned from each of the exercises to understand what level of joint integrated BMD training was being provided from these event

## Personnel

Manning documents from Bureau of Naval Personnel and Army Human Resources Command show both services are at or exceed missile defense personnel quotas; however, there are no joint operational BMD billets within the U.S. military. The examination of manning documents was important to this study to discover if the services were having problems filling just filling the operational slots required to fully man their own systems and that was causing a lack of available bodies to be posted to joint billets.

## Facilities

For the purpose of this study, the term facilities refers to a real property entity consisting of schoolhouses, training simulators or missile ranges. Facilities examined within this study include United States Naval Surface Warfare Center Dahlgren Division, Fires Center of Excellence, Missile Defense Integration and Operations Center (MDIOC). Pacific Missile Range Facility (PMRF), Kwajalein Atoll/Reagan Test Site, NAVAIR Point Mugu, and White Sands Missile Range. Very little unclassified, non-For Official Use Only literature exists for any of these sites.

## Conclusion

The review of literature provides insight into secondary research questions. The secondary research questions will form the basis for the analysis structure of chapter 4 to answer the primary research question of, do capability gaps exist that are causing limited

joint integration of Ballistic Missile Defense? The next chapter, chapter 3, will present the research methodology used for this study.

# CHAPTER 3

# RESEARCH METHODOLOGY

## Introduction

The purpose of this chapter is to describe the research methodology that will be used to answer the primary research question of, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense? The focus will not be to evaluate how well the doctrine is written or the capability of each individual system, but rather if joint integrated BMD is supported within the doctrine, organizations, training, materials, leadership and education, personnel and facilities construct.

## Evaluation Criteria

The joint integration of BMD will be evaluated using criteria generated from the DOTMLPF secondary research questions. The secondary research questions are:

1. What current Ballistic Missile Defense doctrine exists and to what extent is it integrated? The researcher hypothesizes the BMD doctrine is joint and integrated.
2. What organizations and commands comprise Ballistic Missile Defense and to what extent is the organizational manning jointly optimized at the operational level? The researcher hypothesis is the organizations and commands are joint and integrated but with very little oversight to ensure they maintain that way.
3. What institutionalized joint Ballistic Missile Defense training exists within the various services' training pipelines prior to operational execution? The researcher hypothesizes there is no joint training.

4. What material components comprise Ballistic Missile Defense systems for each service and whether/how these systems integrate between services? The researcher hypothesizes this gap was caused by BMD systems being developed independently and now are being retrofitted in order to become joint.
5. To what extent is Ballistic Missile Defense leadership educated to maximize the joint integration of their systems? The researcher hypothesizes BMD leadership educated on the joint integration of missile defense but little training exists to the non-Air Defender/non-Aegis officer core.
6. To what extent are Ballistic Missile Defense assets deployed at the operational level manned jointly to maximize experience and overcome service differences? The researcher hypothesizes there is no operational joint manning.
7. Do joint facilities for Ballistic Missile Defense exist? The researcher hypothesizes that all missile test ranges could be utilized for joint integrated training.

A gradient evaluation system will be used to determine where the biggest obstacles to a joint integrated BMD system are located within the DOTMLPF construct. Evaluation gradient criteria is as follows: Only one military department involved is not joint and integrated, two military departments involved is partly joint and integrated, and three military departments involved is fully joint and integrated. Not applicable will be reserved for items where joint integration is not feasible. Table 1 depicts the set of criteria

applied to this research and contains the gradient system against which each question will be evaluated.

Table 3. Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 1) Is current Ballistic Missile Defense doctrine joint and integrated? | | | | |
| 2) Are the commands and organizations responsible for developing and fielding BMD promoting a joint integrated BMD system? | | | | |
| 3) Is service-based, institutionalized Ballistic Missile Defense training providing joint integrated training prior to operational execution? | | | | |
| 4) What material components comprise Ballistic Missile Defense systems for each service and whether/how these systems integrate between services? | | | | |
| 5) To what extent is Ballistic Missile Defense leadership educated to maximize the joint integration of their systems? | | | | |
| 6) To what extent are Ballistic Missile Defense assets deployed at the operational level manned jointly to maximize experience and overcome service differences? | | | | |
| 7) Do joint facilities for Ballistic Missile Defense exist? | | | | |

*Source:* Created by author.

## Methodology

A five-step methodology will be conducted within this study to bring clarity to the subject matter in order to answer the primary research question and enable the researcher to draw conclusions and make recommendations.

Step 1: Define the environment. This was conducted in chapter 1 with the brief history of ballistic missiles and the development of ballistic missile defense.

Step 2: Conduct a literature review based upon the DOTMLPF construct that comprises the BMD system. Chapter 2 comprises the literature review.

Step 3: Perform an analysis of the information gathered from the literature review in order to provide answers to the secondary research questions. This will be contained within chapter 4.

Step 4: Aggregate the findings of the evaluation criteria in order to answer the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense? This will be contained within chapter 4.

Step 5: Draw conclusions and make recommendations based on the answer to the primary research question. This will be contained in chapter 5.

## Threats to Validity and Biases

There are a several issues that pose a threat to validity and bias to the research. Threats to validity affect the accuracy of the research and soundness of the conclusion. The available documentation came from BMD Program Offices, MDA, BMD commands and organizations, and DoD defense contractors. All these entities have their funding tied directly to the success of BMD. This creates a publication blindness to the researcher where only the information which promotes the good news and therefore will provide

fiscal longevity to the BMD program is available. To counter this threat to the validity of the research, all available BMD audits by the United States Government Accountability Office (GAO) and Director, Operational Testing and Evaluation (DOT&E) were also reviewed.

Biases or psychological traps, can also threaten the validity of this study. The researcher picks a subject in which he considers himself a subject matter expert. The subject matter is intriguing to his intellectual process and the researcher has an idea where the research may go and what the outcomes and answers to the primary and secondary research questions might be. Personal biases in research can only be overcome by the vastness of research. The more articles, books, and studies, including dissenting opinions, to which the researcher is exposed within the course of a study will minimize the researcher's personal biases. By recognizing the threats to validity and biases, the researcher endeavors to mitigate the negative effects of personal bias upon conclusions reached within the study.

## Conclusion

The goal of using the qualitative analysis methodology is to succinctly answer the primary research question given the threats to validity, biases, limitations, and delimitations. The answers to the secondary research questions will form the basis for the researcher to perform an analysis based in doctrine, organizations, training, leadership and education, personnel, and facilities, in order to make recommendations to minimize the discovered gaps. The next chapter, chapter 4, contains an analysis of the data collected within this study.

# CHAPTER 4

# DATA PRESENTATION AND ANALYSIS

> Most of my childhood revolved around wondering when we would be blown up by the Russians. I couldn't stand the news, I knew that if the missile were launched, mortality would arrive in half an hour, so I spent a lot of my childhood feeling that I was 30 minutes from being dead.
>
> ― Jane Smiley, Brainy Quotes

## Introduction

This chapter contains a presentation of the data collected in this study in order to answer the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense? Throughout the course of this study, the literature review and the research methodology leads to answering the secondary research questions and ultimately this primary research question.

## Doctrine

Doctrine, as defined by the U.S. Department of Defense, comprises the fundamental principles by which military forces guide their actions.[38] Doctrine seeks to define the broad concept of how military forces will fight. The beginning of Missile Defense doctrine begins in the Integrated Air and Missile Defense, and drills down into both the Command and Control for Joint Land Operations and Command and Control for Joint Maritime Operations doctrine. The doctrine itself is nebulous to promote coordination and yet definitive enough to promote discipline initiative by the missile

[38] JCS, JP 1-02, 143.

defense commanders. The air space over the battlefield is complicated and must be carefully coordinated to prevent fratricide and still achieve success.

A slight doctrine gap exists by the inclusion of the term Theater Missile Defense. NSPD-23 eliminated "the artificial distinction between 'national' and 'theater' missile defenses.[39] Yet JP 1, *Doctrine for the Armed Forces of the United States* defines TBMD as Theater Ballistic Missile Defense and refers readers to JP 3-01 *Countering Air and Missile Threats* for further elaboration. JP 3-01 makes TBMD a subset under the umbrella of Global Ballistic Missile Defense and includes it within Integrated Air and Missile Defense (IAMD). To compound the confusion, TBMD in academia is known as Theater Missile Defense (TMD), whereas TMD in PATRIOT documentation refers to Tactical Missile Defense.

Table 4. Doctrine Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 1) Is current Ballistic Missile Defense doctrine joint and integrated? | | | | X |

*Source:* Created by author.

## Organizations and Commands

The organizations and commands responsible for developing and integrating missile defense are robust and layered. Each has a clearly defined mission statement with

[39] U.S. President, NSPD-23.

another organization or command serving as a watchdog. JIAMDO, a function of the Joint Staff, is responsible to the warfighter and provides guidance to MDA. JIAMDO Governance JAT provides high level supervision of JIAMDO. MDA develops and fields missile defense systems to the warfighter and is constantly audited by the Governmental Accounting Office. MDA also has a warfighter advocated co-located at each of their two major locations (JFCC IMD and SMDC/ARSTRAT). JFCC IMD and SMDC/ARSTRAT are both component commands to USSTRATCOM. USSTRATCOM is governed by the Unified Command Plan and required to perform various missile defense oversight responsibilities. Commander USSTRATCOM is answerable to the Joint Staff and Congress for the execution of UCP designated responsibilities. As the expenditure on the development of BMD is currently at $141 billion, various independent nongovernment watchdog groups are vigilantly reporting on any perceived misuse of funds or system failures. The joint integration of missile defense is clearly defined as a required effort in every BMD organization and command. Through the mission statements and actions produced, each is expending great effort to produce a joint integrated ballistic missile system.

Although MDA has been given the charter for BMDS, they were not given the authority or accountability for the individual systems that make up the whole. There are organizational shortfalls as there is no singularity responsible for system integration, securing funding, integrated training, or ensuring availability of adequate facilities worldwide.

Table 5. Organization Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 2) Are the commands and organizations responsible for developing and fielding BMD promoting a joint integrated BMD system? | | | X | |

*Source:* Created by author.

## Training

The U.S. military's training philosophy mantra is we train how we fight; however, there is no cross-service training of personnel during the initial or advance BMD training courses. The researcher has not been able to discover any training of the Aegis Weapon System to ADA personnel or vice versa conducted in a school house environment other than a cursory two-hour capabilities and limitations lecture.

The FTI-01, FTO-01 and FTO-02 flight tests have provided operational training to the crews that fought the scenarios. It is important to note FTI-01 is the only live fire test event in which all three BMD systems were present as FTO-01 and FTO-02 Event 2a did not include a PATRIOT battery. The tests put crews together to train to learn how to communicate, practice required actions, and witness their portion of the BMD system in action. The crews selected to perform the flight tests were hand selected to help maximize the success of the expensive flight test. The researcher understands the flight test variables had to be minimized in order to evaluate the material performance of each system. MDA has conducted three integrated flight tests, so assuming each crew was completely different, there are currently only three crews trained in the operational

environment to use BMD in a joint integrated fashion. It is far more likely that there were some of the same personnel that participated in multiple flight test and therefore there are less than three crews with operational test experience. MDA has also conducted 42 Aegis and 13 THAAD flight tests. These tests help operationally train the operators on that specific weapon system. Where and when feasible, all flight tests should require a PAC-3, THAAD, and Aegis sensor packages to be manned and capture the scenario, so the other weapon systems' crews could hear the communications, watch how their own system evaluates the threat, and witness how the other system is operated.

Table 6. Training Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 3) Is service-based, institutionalized Ballistic Missile Defense training providing joint integrated training prior to operational execution? | | X | | |

*Source:* Created by author.

## Material

The material solution to the ballistic missile threat has been well designed and planned. The original BMD was the PATRIOT missile system. The PAC-3s now can communicate with each other through the Integrated Air and Missile Defense Battle Command System (IBCS) to select the shooter with the best shot, regardless of which sensor is providing the data. THAAD was specifically designed as an upper Tier system to augment and communicate with the lower Tier PATRIOT system. The THAAD

system uses the AN/TPY-2 sensor which can be operated in the Terminal Based Mode (used as the sensor to a specific THAAD battery) or Forward Based Mode (FBM). The AN/TPY-2 in FBM mode has been demonstrated to be able to provide a firing solution for the Aegis BMD Weapon System. All Aegis BMD ships can communicate and develop a Common Operating Picture through Cooperative Engagement Capability and essentially become sensor agnostic. In short, PAC-3s can communicate with all PAC-3s, THAAD can communicate with all THAADs, PAC-3s and Aegis BMD, and Aegis BMD can communicate with all Aegis BMD and THAAD. C2BMC has been designed to provide communication, command and control, and situational awareness to all elements of the BMD system.

Table 7. Materiel Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 4) What material components comprise Ballistic Missile Defense systems for each service and whether/how these systems integrate between services? | | | X | |

*Source:* Created by author.

## Leadership and Education

The crafted and well-polished congressional testimonies provided a unique insight into the minds of key BMD leadership. It was not what the practiced speeches said, but rather what they did not say. Every failure was labeled as a success because a valuable

lesson was gained. Every legacy program was praised even though billions of dollars has already been spent on it with little success. These leaders are acutely aware of the politics behind missile defense and realize their own careers are tied to the systems their predecessors began. Goldwater-Nichols Defense Reorganization Act sought to create joint integration by making service chiefs in charge of manning, training, and equipping their respective services. Manning, training, and equipping BMD assets has created the environment where little joint integration exists in those assets. BMD systems are still funded by the individual Services; meaning they must compete in intra-Service horse trading, that dual or multi-purpose systems such as PATRIOT and Aegis may suffer design and/or performance trade-offs between their BMD role and an alternate mission, and Service priorities for delivery or staffing may not be consistent with MDA's desires.

Joint Professional Military Education (JPME) was established in order to satisfy the joint requirements dictated by the Goldwater-Nichols Act. All mid-grade U.S. military officers are required to complete JPME Phase I in order to understand how their sister services will operate and fight. Joint Professional Military Education Phase I core curriculum consists of Ethics, Leadership, History, Tactics and Operations. Ballistic Missile Defense is mentioned within a two-hour tactics lecture over the Integrated Air and Missile Defense. The level of time devoted makes JPME students are now aware joint BMD exists, but little actual knowledge has been imparted. During the warfighting Tactics block of instruction on protection, the employment of Joint integrated theater ballistic missile defense should be discussed.

Participation in the JIAMDO/MDA/JFCC IMD events and exercises broadens the knowledge of missile defense warfighters with in-depth and complex scenarios. These

exercises and conferences are crucial for the leaders to practice and understand missile defense. The captured lessons learned from these exercises need to be promulgated and included within the services' BMD school house curriculums in order to give the operators a better understanding of their role with the joint integrated missile defense system.

Table 8. Leadership and Education Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 5) To what extent is Ballistic Missile Defense leadership educated to maximize the joint integration of their systems? | | | X | |

*Source:* Created by author.

## Personnel

There are no operational joint billets within the BMD community. The researcher does not believe it is feasible to remove soldiers, sailors, airmen, or marines from their communities for a two-year tour working for another service's BMD assets. Two-week temporary duty assignments would greatly enhance the knowledge base and enable operators to better understand their counterpart's roles and responsibilities. Doctrine contained within JP 3-32 dictates that the Area Missile Defense Commander (AMDC) will be stationed on board a BMD ship in order to provide deconfliction of a joint BMD fight. The first time that AMDC is on a ship should not be when missiles are about to

start flying. As JP 3-01 defines the importance of the GCC in BMD, every Combatant Commander should have completed a joint operations tours in BMD roles.

Table 9. Personnel Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 6) To what extent are Ballistic Missile Defense assets deployed at the operational level manned jointly to maximize experience and overcome service differences? | | X | | |

*Source:* Created by author.

## Facilities

There are currently no joint training facilities which have Aegis, PAC-3, and THAAD simulators. United States Naval Surface Warfare Center Dahlgren Division, and Fires Center of Excellence, possess simulation tools for their own respective weapon systems. These simulation tools do not currently simulate Aegis shots into the Army scenario or THAAD and PAC-3 shots into an Aegis scenario. The Missile Defense Integration and Operations Center (MDIOC) has a rudimentary simulation suite that was used for practice and feasibility studies leading to the integrated flight tests of FTI-01 and FTO-01. A BMDS joint simulator needs to be developed and implemented.

Pacific Missile Range Facility (PMRF), Kwajalein Atoll/Reagan Test Site, and White Sands Missile Range have all been used for flight tests. The newest and unproven systems were brought to the range, the flight test conducted, and then the systems

returned to their home stations. The tested BMD system needs to be the newest. But a program baseline set of sensors and mission control systems should be stored at the facilities in order for the non-test systems to provide operational experience. Of the three major missile defense test sites, White Sands Missile Range would be the only suitable long term placement of all three systems as the marine environment of PMRF or Kwajalein would greatly degrade any system permanently stationed at either location and travel costs to ship crews from home station to PMRF or Kwajalein and back would be prohibitive. Another interesting possibility would be the utilization of NAVAIR Point Mugu as a joint operations training facility. With the placement of PAC-3 and THAAD batteries in conjunction with actual sea going Aegis BMD ships on the range would provide the most realistic operational training available.

Table 10. Facilities Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 7) Do joint facilities for Ballistic Missile Defense exist? | | X | | |

*Source:* Created by author.

## Conclusion

Table 11. Aggregated Evaluation Criteria

| Question | N/A | Not Joint and Integrated | Moderately Joint and Integrated | Fully Joint and Integrated |
|---|---|---|---|---|
| 1) Is current Ballistic Missile Defense doctrine joint and integrated? | | | | X |
| 2) Are the commands and organizations responsible for developing and fielding BMD promoting a joint integrated BMD system? | | | X | |
| 3) Is service-based, institutionalized Ballistic Missile Defense training providing joint integrated training prior to operational execution? | | X | | |
| 4) What material components comprise Ballistic Missile Defense systems for each service and whether/how these systems integrate between services? | | | X | |
| 5) To what extent is Ballistic Missile Defense leadership educated to maximize the joint integration of their systems? | | | X | |
| 6) To what extent are Ballistic Missile Defense assets deployed at the operational level manned jointly to maximize experience and overcome service differences? | | X | | |
| 7) Do joint facilities for Ballistic Missile Defense exist? | | X | | |

*Source:* Created by author.

Do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense? As discussed in this chapter, the answer is a little bit of everything but

the most glaring gap is training. The other significant gaps occurring in Leadership and Education and Facilities are actually a subset of the training gap. There are no joint facilities in which to train. Leadership is not trained on the joint integration of BMD. Education of non-BMD personnel does not occur in the training environment of JPME. Trained joint integrated BMD must occur since the speed at which a missile fight occurs is measured in minutes and defensive action must be pre-coordinated and practiced. There is no time to learn on the fly. However, a training gap is the least time consuming gap to correct. Training programs can be developed and implemented in months. Doctrine, Organizations, Materials, and Personnel, take years to change.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## Introduction

The DOTMLPF qualitative analysis of this study answers the primary research question, do capability gaps exist that are causing limited joint integration of Ballistic Missile Defense, as the primary capability gaps reside in training and facilities. In order to promote better training, joint facilities should be established and manned with instructors from all services.

The training gap of joint integrated BMD is that there is no cross-service training of personnel during the initial or advance training courses. The strength of a joint program comes from its synergy. In order to have soldiers and sailors develop a working synergistic bond a two-week-long course should be developed in which ADA soldiers and Aegis sailors jointly attend adult learning modeled education within the same classroom facility to promote understanding and discussion of each other's systems. The first week should be dedicated to cross training the other service on the opposite services equipment on an every-other-day rotation. Practical exercises should be included within each training block to promote individual contribution and coordination amongst members. The final week should include a wargame exercise where each service is separated and is forced to communicate via radios or computer systems. The final day of instruction should be reserved for an After Action Report style debriefing.

## Conclusions

This study determined training and facilities as capability gaps causing the impacting joint integration of Ballistic Missile Defense. Doctrine is sound. The

organizations responsible for fielding and integrating BMD are robust. The BMD systems are well designed with the capability to be fully joint and integrated. BMD Leadership is educated on how to jointly employ BMD. The force has appropriate manning. The lack of joint training and the facilities in which to conduct joint training are causing limited joint integration of ballistic missile defense.

This study's title: "Hey Aegis, this is THAAD Calling," should become a reality. System-to-system communication via the Link-16 communication network is currently possible. C2BMC allows for systems to be sensor agnostic and function in a Cooperative Engagement Capability way to generate fire solutions. Technology allows different systems to speak with each other and software will allow the translation between the systems. The systems will never be allowed to work in fully autonomous mode, a human in the loop will always be required. Those humans need to be adept at understanding the other system and the other system's operators. The human communication deficiency can only be rectified by joint training and interaction.

## Recommendations

Recommendations for decision makers: Ballistic Missile Defense is a difficult subject to fully understand. The ballistic missile threat existing in the air, sea, land, and cyber domains of warfare, necessitates the need for BMDS to be joint and integrated. MDA has currently spent $141 billion to build and field missile defense systems. The services spend millions on training their operators how to use these systems. Very little is spent on the training joint integration between the services to maximize the effectiveness of the BMD. With interceptor prices varying between $125,000 for a PAC-3 to $90 million for a GBI, to be fiscally responsible, each shot must count. Having the most

robust BMD system in the world is minimized if the forces responsible for its use are not trained how to maximize BMD's effectiveness.

Recommendations to future researchers: Should future researchers pursue a similar topic, BMD in the sense of a national instrument of power should be explored. The location of a BMD asset is very much a diplomatic weapon. It shows who is friendly with the United States, and bestows great confidence that the United States is willing to put a high value asset on their soil. The greatest ability of BMD is informational. If knowledge of a BMD asset in a location causes the ballistic missile launch to seem futile and therefore prevent a launch from happening, missile defense has happened. BMD is also a military asset. BMD assets are incredibly expensive assets. Selling the military hardware to foreign governments has trade implications and financial benefits.

## Final Thoughts

At the start of this study, the researcher hypothesized the capability gap preventing full joint integration of BMD was material, that systems had been developed in stovepipes which limited possible integration of the systems. The research has proven that presumption to be false. Great minds and patriotic hearts within JIAMDO and MDA have developed a BMD system fully capable of becoming joint and integrated. Be aware and on guard of personal biases.

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