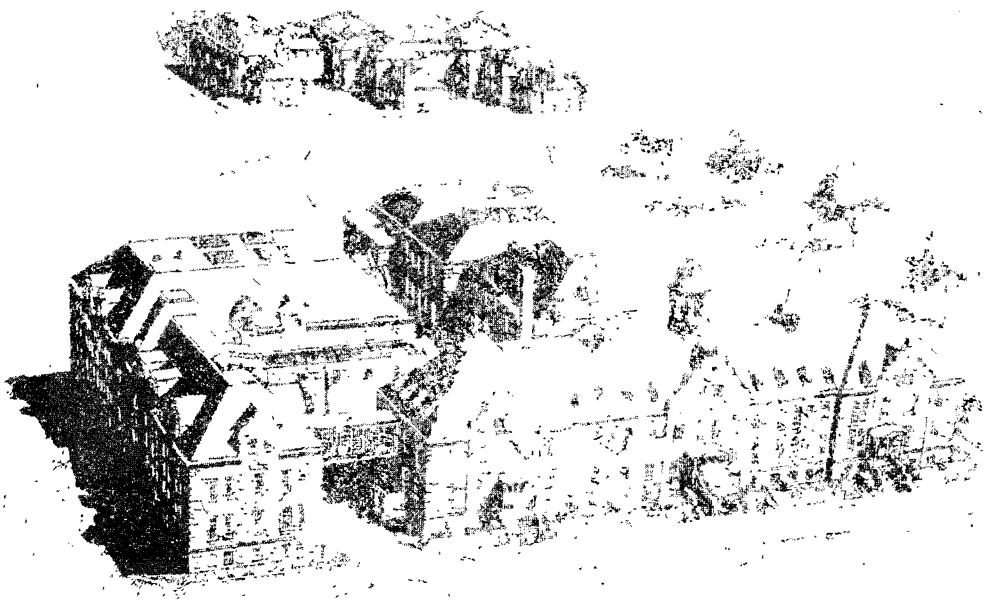
The Newport Papers

Fourteenth in the Series

THEATER BALLISTIC MISSILE DEFENSE FROM THE SEA

Issues for the Maritime Component Commander



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Foreword

As we enter a new millennium, many nations are striving to acquire advanced weapons of war. Since the 1980s, the most favored symbols and instruments of power among lesser powers have been theater ballistic missiles. In concert with chemical, biological, or nuclear weapons of mass destruction, theater ballistic missile systems present a challenge to American military forces, threatening three vital centers of gravity: the forces themselves, the unity and resolve of potential regional partners and allies, and the political will of the United States to exercise a military option.

In the next decade, sea-based ballistic missile defense will offer joint power projection forces a vital, flexible, and increasingly robust theater defense capability. Weapon and sensor development; communications, computers, and intelligence architectures; and battle management command and control issues are all being addressed with vigor—a measure of the gravity of this evolving and imminent threat.

However, defensive power from the sea emerges from a unique and complex arena, where combat takes place in three dimensions against many dissimilar threats, in three overlapping and competing environments which, by their very nature, cause conflicting tasking of limited assets. Therefore, the promise of naval theater ballistic missile defense must be studied with this operational complexity in mind.

In this Newport Paper, which originated as an Advanced Research Project in the Center for Naval Warfare Studies at the Naval War College, Commander Swicker proposes that naval theater ballistic missile defense can realize its full potential only if the Maritime Component Commander understands and addresses the key issues involved in its operational employment. I urge all involved in conceptualizing, planning, and executing naval surface warfare to take heed of his deep and discerning examination, which provides valuable insights and encourages us to address the full range of possibilities for, and requirements upon, tomorrow's naval theater ballistic missile defense.

Arthur K. Cebrowski
Vice Admiral, U.S. Navy
President, Naval War College

Acknowledgments

This project began in the fall of 1994 upon my arrival at the Naval War College. Professor Tom Grassey, who had guided and edited my first graduate thesis at the Naval Postgraduate School, invited me into his office, explained the option of doing an Advanced Research Project (ARP), and volunteered to curb my verbosity once again. His help was vital throughout, from initial brainstorming through briefing rehearsals, long hours of editing over take-out pizza, a *Naval War College Review* article hewn from the central chapter, and now, finally, to the finished Newport Paper. I thank him as both his student and as a friend.

The ARP program exists because of the energy and dedication of Dr. John B. Hattendorf. His encouragement was essential, as was the able guidance given by his assistant, Commander Bill Burns. Mrs. Barbara Prisk completed the team, handling administrative matters with grace and skill.

During my research travel in the summer and fall of 1995, many individuals in the ballistic missile defense community were remarkably generous with their time, even when a scheduled visit to one key facility led to a short-notice call on another. At the Ballistic Missile Defense Organization, I would like to thank Captain John Langknecht, Mr. Richard Sokol, and the Chief Systems Architect, Dr. Bruce Pierce. From the Navy's Program Executive Office for Theater Air Defense, Mr. Dusty Schilling, Lieutenant Commander Steve Petersen, and Mr. Mike Chi provided not only information and advice but also an opportunity to travel to the National Test Facility at Schriever Air Force Base, Colorado, for TMD Wargame 95B. From the Naval Postgraduate School in Monterey, California, Professor Paul Bloch provided key background information from previous TBMD-related projects. At the Pentagon office of the Navy's Director for Theater Air Warfare (N865), Commanders Dan Morgiewicz and Rich Durham and Lieutenant Commander Taylor Skardon were most helpful. Rear Admiral Rodney Rempt, N865 in 1995, and now the Deputy Assistant Secretary of the Navy for Theater Combat Systems, made time in his schedule on an October afternoon in Newport for a one-on-one briefing of the final draft, and for that I am grateful.

Words must be backed up with facts, and for those facts I turned to the technical and intelligence communities. Lieutenant Commander Mac Davis from COMOPTEVFOR got me started in the right direction. At the Naval Surface Warfare Center, Dahlgren Division, Mr. Al Hales, Mr. John Canning, and Lieutenant Jon Hill provided essential background on the unique challenges

of TBMD, while Ms. Cathy Cheney and Mr. Mike Jobe at the National Maritime Intelligence Center explained the true nature of the rapidly evolving TBM threat.

Contractors and consultants, many of them retired senior naval officers, lent their own perspectives to my ideas in everything from formal briefings to informal discussions over morning coffee. I would particularly like to thank retired Vice Admiral J.D. Williams, who was the first to hear the general outline of the final paper after I roughed it out on a laptop in Colorado Springs. My thanks also to Mr. Ward Clark of Techmatics, Mr. Fred Jerding of SPA, and Mr. John Flynn of PRC.

Once the final draft of a major project is complete and the author feels he has worked hard and done an honest job, he can tend to feel that his words are immutable and thus resist encouragement to carry his thoughts just a bit further. Dr. Grassey finessed this problem by enlisting the acute minds of Professors Frank Uhlig and Tim Somes, both of whom read the entire draft and then offered clear and cogent suggestions for additional areas of emphasis. Their guidance added significant insight, especially in the area of NCA-level command and control.

Most of all, I would like to thank my wife, Gayle, whom I abandoned in Florida for the duration of my War College tour, choosing instead to live the life of a geographic bachelor in her parents' home outside New Bedford. Now that we are living in Virginia and I am at the Pentagon, she scarcely sees more of me. Last of all, I owe a special debt of gratitude to Professor Frank Teti of the Naval Postgraduate School, Monterey, California. Ten years ago, with thumbs hooked in his suspenders and half-glasses perched precariously on the end of his nose, he lectured, ruminated, pontificated, and demanded . . . that this sailor could also be a scholar. I hope I have heeded his words.

Vienna, Virginia
August 1998

Introduction

A sense of urgency informs *Theater Ballistic Missile Defense from the Sea: Issues for the Maritime Component Commander.* Theater ballistic missiles armed with chemical, biological, or nuclear Weapons of Mass Destruction (WMD) will be acquired and deployed by hostile forces in the developing world, posing an imminent threat to the U.S. and coalition forces that must operate in that world. The gravity of this evolving threat is recognized in our national military strategy. Army, Navy, Air Force, and Marine theater ballistic missile defense (TBMD) systems are also evolving, but with the exception of the Patriot PAC-2 missile system, none are yet fielded. Recognizing this constraint, this study looks ten years ahead, to 2008, toward the challenge of joint and multinational power projection operations against a TBM-WMD armed adversary. In such a regional contingency, the first TBMD-capable forces on the scene are likely to be naval. It will thus be the duty of the Joint Force Maritime Component Commander to plan, fight, and win the initial TBMD battle in order to enable the introduction of follow-on TBMD forces from the other Service components, as the campaign moves inland from the littoral.

This study's particular value lies in the attention it invites towards issues that concern the Joint Force Maritime Component Commander in his responsibility to perform the essential enabling task of delivering TBMD from the sea. To this end, I spent the summer of 1995 reviewing the current literature, followed by research trips to several key "nodes" within the naval and joint theater ballistic missile defense communities. These visits included Naval Surface Warfare Center, Dahlgren Division; the Program Executive Office, Theater Air Defense (PEO TAD-B); the Ballistic Missile Defense Organization; and the office of the Navy's Director for Theater Air Warfare (N865). This initial effort led to my further travel as an observer for the TBMD Wargame 95B held at the National Test Facility, Schriever Air Force Base, Colorado Springs, in September, and finally to a personal project briefing for Rear Admiral Rodney Rempt (then N865) at Newport, Rhode Island, in October.

This five-chapter, unclassified study is designed to raise more questions than it answers. With that purpose in mind, expeditious accessibility and wide dissemination are essential to facilitate further research—thus the specific intent to remain unclassified. The properly cleared reader, however, is encouraged to pursue potential areas of further inquiry at any appropriate level of classification, using the more than seventy military and non-military sources in the bibliography as points of departure.

Chapter I details the purpose of the study as well as its enabling assumptions. The specifics of future conflict and the actual capabilities of yet-to-be-fielded systems cannot be determined in advance. This paper, however, is not devoted to an in-depth examination of specific technical issues—and indeed cannot be, due to both its unclassified nature and, more importantly, the inability to discuss in detail that which is still being developed. The intent is to examine, at the level of the flag officer serving as the Joint Force Maritime Component Commander (JFMCC), the *implications* of these capabilities and the difficult issues to which they will give rise in the future. To discuss these issues in a meaningful manner, certain capabilities and conditions must be assumed.

Chapter II provides the reader with a brief overview of the TBM-WMD threat that will face U.S. forces in the near term and into the future. Current active defense capabilities against that threat are explained, as are the potential consequences of any diminution of TBMD research and development in the face of continuing budgetary constraints. The chapter concludes with a survey of projected U.S. naval theater ballistic missile defense capabilities to the year 2008.

The central portion of the study, chapter III, establishes a set of first principles that enables the Joint Force Maritime Component Commander facing a TBM-WMD threat to focus his attention. Each of the four areas of concentration—Logistics; Command, Control, and Intelligence; Warfighting; and Rules of Engagement—is examined to place the operational challenge of theater ballistic missile defense within the multimission complexity of maritime warfare in a littoral theater.

Successfully performed, TBMD is unlikely to remain a purely naval mission. Indeed, the vital nature of naval TBMD is to enable complementary Army and Air Force systems to enter the theater and contribute to the battle. According to the National Military Strategy, allied and coalition assets will also be, whenever possible, an integral part of such a U.S. effort. Chapter IV examines potential joint and multinational contributions to the campaign's overall TBMD operations.

Finally, chapter V summarizes the study by considering the essential nature of theater ballistic missile defense through specific defining characteristics derived from the preceding sections. These essential TBMD "themes" are:

- The challenge of conflicting missions and limited means.
- The reality of hard choices.
- The fact that theater ballistic missile defense is one mission enabling many, rather than an end in itself.

The pervasive impact of these themes on both theater ballistic missile defense forces and the officers who control and direct these forces is examined to illustrate that TBMD is an enabling capability.

Given the likelihood of a dispersed, Theater Wide TBMD battle, the challenge of logistics illustrates the value of a straightforward operations analysis approach to the vital discussion of fuel and vertical launch system rearming—a discussion which reveals the true complexity of war in the littoral, where the TBMD mission will not exist in isolation.

The area of command, control, and intelligence considers that same complexity at three different levels: above the JFMCC at the NCA level; among competing component commanders at the theater level; and from the JFMCC down to the unit level. Significant operational friction is held to exist at every level: political versus military objectives up the chain of command; mission versus mission at the theater level; and effective decentralized control versus efficient centralized control of TBMD engagements down the chain. Encompassing them all, comprehensive intelligence preparation of the battle space is essential to the JFMCC's mastery of the TBMD mission's subtleties and thus his ability to make the hard choices necessary for effective execution.

Warfighting specifies some of the hard choices that will face the JFMCC owing to his own logistical limitations and the operational priorities of his superiors. The logistically competing but operationally complementary natures of Navy Theater Wide (upper tier) capability and Navy Area (lower tier) are considered. This discussion illustrates the vast potential defensive leverage of upper-tier systems as well as the essential requirement for lower-tier systems in the conduct of amphibious power projection.

The vital issues of national policy and international law which must inform U.S. theater ballistic missile defense operations are presented under the rubric of Rules of Engagement. The confluence of political constraints on U.S. actions and the tactical challenges posed by the speed and lethality of enemy TBM-WMD systems will likely result in two trends: Defensive TBMD ROE (i.e., engaging incoming TBMs) will become increasingly permissive, while offensive TBMD ROE (i.e., Attack Operations—"Scud-hunting") will remain centrally controlled and highly restrictive. The JFMCC and his subordinate commanders must be able to operate effectively within the bounds of this dichotomy.

The conundrum posed by conflicting missions that must be executed within limited means affects the Joint Force Maritime Component Commander's every decision when confronting the TBM-WMD challenge. A clear grasp of his superiors' operational intent will allow an initial triage of missions, sorting out what must be done now from what can wait; but even then the tyranny of

numbers and the challenge of distance may force assets to be apportioned more thinly than doctrine demands.

Conducting operations while facing a TBM-WMD threat will require that the JFMCC make hard choices. These decisions will be all-encompassing and continuous, part of an iterative process of evaluating mission priority, unit tasking, tautness of command and control, degree of political constraint, and the impact of the NCA's overall intent on the TBMD rules of engagement that are in place. Making these difficult choices in a timely, forthright manner and, whenever possible, in accordance with Joint TBMD doctrine, will help ensure a smooth transition of the TBMD fight when the campaign begins to move inland from the littoral.

Such a transition will have been made possible only through a successful TBMD battle waged by the maritime component "holding open the door" for follow-on TBMD forces deploying into the theater thus defended. This capability cannot be considered in isolation. Theater ballistic missile defense in general, and TBMD delivered from the sea in particular, is the means that enables the successful conduct of other operations in the face of the TBM threat.

This study presents a preliminary analysis of the many inherent and unavoidable complexities of TBMD conducted from the sea. As present and future commanders envision this mission and prepare the Navy to meet its challenges, they should recognize that, however important TBMD certainly will become, it will be a supporting and enabling function for other naval and joint operations. Most importantly, they should find the principal lessons of this study illuminating, realistic, and deserving of additional detailed investigation.

I

Assumptions for Discussion

THE U.S. NAVAL THEATER BALLISTIC MISSILE DEFENSE, tasked against the threat of ballistic missiles that may be armed with Weapons of Mass Destruction (WMD), will be one of the new, key military capabilities deployed in support of joint operations over the next ten years. Technical development issues and doctrinal command and control questions are gradually being resolved as near-term systems approach initial operational capability. As with many new military capabilities, programs and studies tend to focus on discrete areas rather than on an integrating overview of flag-level concerns affecting operational naval TBMD. This paper addresses that need by examining the issues that the Joint Force Maritime Component Commander may need to consider when operating against a TBM-WMD threat.

The intended approach of this study is straightforward, written by a serving surface line officer with extensive AEGIS experience. The assumptions that inform the remainder of the study are detailed immediately to avoid the loss of credibility by a reader who encounters "emergent assumptions" down the line.

The nature of the missile and WMD proliferation threat and the worldwide dynamics that drive it provide a background in the nature of the TBMD challenge, now and into the future. The basic tenets of Joint TBMD are set forth, and the current baseline capabilities to respond to the threat are examined along with an overview of naval active defense TBMD capabilities as currently projected to 2008.

Chapter III *is the heart of this study.* In logical progression, it sorts and sets forth those critical issues to which the Joint Force Maritime Component Commander must pay personal attention when tasked to operate against a TBM-WMD threat. Quite simply: what questions will keep him awake at night,

and how might he possibly address them? Much like a Defense Support Program (DSP) satellite will soon cue a TBMD AEGIS cruiser, the intended purpose of this study is to detect and pass on the nature and parameters of the problem, not to consummate the intercept and solve that problem. Too much is yet uncertain; too much is still evolving. This paper is successful if it illustrates the scope and direction of that evolution, thereby providing a sound intellectual basis for dealing with uncertainty.

An Unprecedented Challenge

Theater ballistic missiles transcend the accepted boundaries of conventional warfare. In speed and altitude, they exceed the envelope of conventional Air Warfare (AW) defenses. In range, they may cross AOR boundaries of geographic CINCs, thus exceeding the "envelope" of traditional in-theater command and control. When armed with weapons of mass destruction or targeted against population centers, the asymmetric political leverage they potentially provide to otherwise impotent aggressors is a new and profoundly unsettling phenomenon. The military response to such unprecedented capability must inevitably be joint.

In an era of reduced U.S. presence overseas, the first American theater ballistic missile defense capability on the scene of a developing crisis is likely to come from the sea—but it will be enabled, supported, and eventually reinforced by the complementary capabilities of all branches and possibly bolstered by the synergistic contributions of allies and coalition partners. The ability of these forces to stand firm, build up, and wrest the initiative from hostile forces either diplomatically or operationally may well rest on the ability of the Joint Force Maritime Component Commander to execute the theater ballistic missile defense mission, not in isolation, but in the midst of the messy complexity of multimission warfare in the littoral.

Bounding the Problem. The current state of ferment in the TMD/TBMD arena is the sure sign of a dynamic challenge dynamically addressed. Different concepts, architectures, and systems compete for funding and patronage in an evolutionary process that will eventually produce coherent doctrine and capable hardware. However, in order to examine the theater ballistic missile defense issues of concern to the Joint Force Maritime Component Commander in 2008, the problem must be bounded. The following assumptions do so:

- This study is primarily concerned with the active defense capability of naval theater ballistic missile defenses under the command of a Joint Force Maritime Component Commander in a littoral theater in 2008.
- In 2008, the Joint Force Maritime Component Commander will have available Navy Area TBMD capability, using the SM2 Block IVA interceptor.
- Navy Theater Wide (NTW) capability also will be operational in the form of the SM3 exoatmospheric interceptor.
- All Navy TBMD interceptors will be launched by AEGIS combatants.
- The projected basic theater ballistic missile defense BMC4I (battle management command, control, communications, computers, and intelligence) architecture of a joint planning network (JPN), joint data network (JDN), and joint composite tracking network (JCTN) will have been implemented. These new networks will be based on current initiatives: the global command and control system (GCCS) and the joint maritime command information system (JMCIS) for the JPN; the joint tactical information distribution system (JTIDS/LINK 16) for the JDN; cooperative engagement capability (CEC) for the JCTN.[1]
- Stereo defense support program (DSP) satellite TBM launch-cueing information of the type now received and processed by the joint tactical ground station (JTAGS) will be available on board AEGIS combatants.
- SBIRS-LOW, the space-based infrared system-low earth orbit component of the space and missile tracking system SMTS (derived from the SDIO Brilliant Eyes concept) will not yet be operational.[2]

As theater ballistic missile defense concepts continue to evolve, common themes emerge from otherwise disparate documents. It is assumed that by 2008, some of these themes will be fully accepted as tenets of joint theater ballistic missile defense doctrine, to include:

- The keystone of effective theater ballistic missile defense is centralized planning with coordinated, decentralized execution.[3]
- Theater ballistic missile defense is considered a subset of theater missile defense (TMD), and thus of theater air defense (TAD), rather than a separate mission.
- Within the joint TAD chain-of-command, the Area Air Defense commander (AADC) is responsible for TBMD active defense, while the Joint Force Air Component Commander (JFACC) is responsible for TBMD attack operations (offensive operations directed against TBM launchers, C2 nodes, and support infrastructure).

Operational Assumptions. Finally, this study examines what is assumed to be the most challenging kind of operational contingency envisioned for a U.S. Joint Force Maritime Component Commander:

- An emergent crisis in 2008 involving an undeveloped theater, facing a littoral opponent from the developing world who possesses multiple WMD-capable TBM systems.
- This WMD threat includes a baseline weaponized (20kt fission/single reentry vehicle-per-TBM) nuclear capability.
- Some enemy TBM systems have sufficient range to hold the capitals and major population centers of possible U.S. regional coalition partners at risk.
- Potential regional allies have no organic TBMD capability. However, some of their TACAIR, SOF, and C2 assets could contribute to multinational attack operations, and their naval forces could contribute to non-TBMD maritime tasking.
- U.S. ground-based TBMD systems are not forward deployed in the region, and the ports and airfields through which they will be delivered are currently undefended against TBM attack. Once the ports and airfields are secure, U.S. Army THAAD (theater high altitude area defense) and Patriot PAC-3 (ERINT) will be available. MEADS, the medium extended air defense system (formerly known as CORPS SAM), entangled in budgetary infighting since the mid-1990s, is not yet available.
- Air Force wide-body transport (B747) airborne laser (ABL) platforms are operational, but have not yet been deployed to the as-yet undefended airfields in theater.
- The Joint Force Commander views amphibious power projection as an option in his concept of operations (CONOPS). Several potential amphibious objective areas are under consideration.
- Enemy short-range missile capabilities (SS-21, FROG-7, SMERCH multiple launch rocket system) are robust, as are his littoral defense anti-ship cruise missiles (ASCM), mine warfare capabilities (MIW), diesel submarine and fast patrol boat forces. On paper, his air order of battle is impressive, but his level of pilot training and quality of aircraft maintenance are questionable. His air arm has never faced an opponent possessing U.S.-level proficiency.

While other kinds of situations are expected to arise, the above conditions are regarded as the most stressing while remaining within the time frame of the next decade.

II

Naval Theater Ballistic Missile Defense Overview

AS THE NEW MILLENNIUM APPROACHES, the United States looks out on a world in ferment—nations and peoples attempting to define their place in an international order shattered by the end of nearly three generations under a bipolar system. Pessimists preach a dark future: "Technology is changing how man knows, and the resulting dislocations are culturally cataclysmic. Half the world is looking for God anew, and the other half is behaving as if no god exists."[4] Optimists couch their views in terms reflecting the dichotomy within the common Chinese character for chaos and opportunity. "We live at a fantastic moment of human history. . . . The spread of the Third Wave economy has galvanized all of the Asia Pacific region, introducing trade and strategic tensions, but at the same time opening the possibility of rapidly raising a billion human beings out of the pit of poverty."[5]

The Joint Chiefs of Staff take the middle ground and see "a world in which threats are widespread and uncertain, and where conflict is probable, but too often unpredictable."[6] To the JCS, that world holds four principal dangers for the United States:

- Regional instability
- The proliferation of weapons of mass destruction,
- Transnational dangers [e.g. terrorism, drugs], and
- Dangers to democracy and reform.[7]

Threat, Vulnerability, and Defense

These four challenges are intertwined in a dynamic that is emerging from the confluence of international instability and the worldwide diffusion of

technology. As more and more nations consider themselves to be standing alone before their enemies, no longer sheltered by the suzerainty of a superpower, they also are increasingly able to buy, steal, or indigenously develop the technologies through which they hope to "achieve strategic security—the chance of a millennium."[8] Often, these striving nations believe that this chance is to be found in the complementary technologies and synergistic power of theater ballistic missiles and the second "principal danger"—weapons of mass destruction.

TBM and WMD Proliferation. Evolution, whether of organisms or organizations, arises from the selective pressure exerted by the surrounding environment and will continue for the duration of that pressure. The selective pressure of the international environment may drive the leaders of developing nations to acquire theater ballistic missiles as a means to achieve strategic security, both for their people and for themselves. This is the vital, indeed primal, "demand side" of the proliferation equation. Why nations who otherwise lack significant political or military leverage wish to acquire such disproportionate capabilities is often more important than how they achieve that goal. In a world of increasingly decentralized technology and an ever-expanding base of scientific knowledge, these nations *will* succeed. Unless the pressure for nations to assure their own strategic security can be eliminated, supply-side controls on proliferation are doomed to eventual failure. Determined proliferators will arm themselves before they will feed their people. For example:

> The Iraqi government has used a covert network of purchasing agents and dummy companies to buy millions of dollars worth of sensitive missile parts from firms in Europe and Russia.... The missile-related orders reflect Iraq's willingness to spend tens of millions of dollars to rebuild a key facet of its prewar military capability, even though the country's leaders claim it is financially strapped.[9]

Consider what Third-World nations stand to gain from such decisions. These weapons confer national prestige upon a regime and its leader; they allow formidable international intimidation of regional foes; and they are available on the world arms market as turnkey systems with required training levels that are achievable in the developing world.

No longer the exclusive Cold War preserve of Nato and the Warsaw Pact, TBMs have been successfully employed in tribal civil wars in Afghanistan and Yemen, proving that neither a national technical infrastructure nor a highly trained tactical air arm is necessary to strike quickly and deeply at an enemy's key military and political targets.[10] Even against a nation with modern, well-trained

forces, unless capable theater ballistic missile defenses are fielded, such strikes will get through, expending replaceable TBM "ammunition" rather than valuable TACAIR pilots.[11]

By 2008, more than twenty countries will be able to field some form of TBM capability, including key regional powers in the flashpoints of northeast Asia, the South China Sea littoral, the Indian subcontinent, southwest Asia, the Levant, and North Africa. International efforts to counter TBM proliferation, including such Western supply-side "technology cartels" as the missile technology control regime (MTCR), may increasingly push these same nations toward the development of indigenous technology.

The nature of indigenous technology in the Third World will tend to limit missile accuracy more than it will warhead lethality. In this regard, the intelligence community will have to closely monitor emergent TBM applications of global positioning system (GPS) technology. In general, however, the precise guidance systems necessary to achieve a small circular error probable (CEP) with a ballistic system are, simply, more difficult to design and manufacture than are, for example, basic chemical warheads for that same system. This "selective pressure" will thus encourage the evolution of systems with poor accuracy but powerful payloads.

Historically, the targets of choice for systems thus constrained have been civilian population centers—large, soft, stationary targets of dubious military value but of great political importance. Therefore, these systems may not be able to defeat a developed nation militarily, but they can confer potent political leverage through the threat, as French strategic planners once put it, of "tearing off an arm."

Readiness to exercise that option, though, may not be constrained by traditional concepts of strategic deterrence. Speaking specifically of small nuclear forces in the developing world, Jerome Kahan identifies three factors which increase the likelihood of use for *any* form of WMD:

> Strategic discourse between . . . adversaries may be nonexistent, raising the prospect of a breakdown in deterrence at the regional level. . . .
>
> Third World states tend to have imperfect and incomplete intelligence information about their relative positions in a conflict. . . .
>
> Small nuclear forces, especially in the hands of technically unsophisticated countries, may well be deficient in command and control arrangements.[12]

Thus, by 2008, the United States may face a variety of regional powers deploying tenuously controlled TBM systems of prodigious reach with problematic accuracy offset by powerful warheads.

Why, in a discussion of theater ballistic missile defense, should weapons of mass destruction, especially nuclear WMD, be emphasized when these devices have yet to be combined with TBMs and used in regional conflict? The "leverage" inherent in a given weapon system derives, in part, from how effectively it can engage and neutralize its intended target. During Operation DESERT STORM, the United States gained great leverage from the conventionally armed Tomahawk land attack missile (TLAM), successfully conducting operational fires with this weapon, to the full depth of the theater, in the critical early days of the war. That leverage was gained by what was, in effect, nothing more than a slow-flying 1,000-lb. bomb. However, TLAM was in reality a "system of systems," a weapon whose nominal power was multiplied by precise accuracy gained from complex guidance systems, systems in turn supported by an unrivalled National Technical Intelligence system, a comprehensive Mapping, Charting and Geodesy system, and a mission-planning system employing a national network of experts with access to massive computational power. All the missile had to do was fly to a given point in three dimensions and explode—but the synergistic support systems that planned the mission for that one missile had marked and mensurated that point to within inches.

In developing nations, these support systems are generally missing. National technical intelligence with which to conduct strategic reconnaissance is limited or nonexistent (as noted by Kahan). In a permissive prehostilities environment, an intelligence operative with a hand-held GPS can record the coordinates of a stationary target, but the TBM system tasked against that target is unlikely to be able to take advantage of the precision thus provided. Though enhanced ballistic missile systems that approach U.S. cruise missile accuracy will someday be fielded, supply-side proliferation controls and the resultant limitations of indigenous technology will tend to push that day into the future. Thus, while First World land attack cruise missiles gain their leverage through stealth and accuracy derived from a system of systems, Third World theater ballistic missiles stand alone and must rely on speed and brute force.

The solution for poor targeting of denied areas and poor system accuracy once a TBM gets there is to increase warhead lethality. As long as accuracy remains constrained, this is an evolutionary imperative for TBM systems and therefore represents an imminent threat for TBMD forces. In 1991, crude chemical warheads were available for Iraqi Scuds, but were not used. In 2008, TBM-weaponized WMD could include bulk chemical and biologic warheads,

chemical submunitions, and that most challenging threat of all—the TBM-carried nuclear weapon.

Much debate currently swirls about the defensive difficulties posed by various incarnations of putative chemical submunition warheads. The sound and fury of these cost and operational effectiveness analysis (COEA) arguments tend to push the reality of the nuclear threat into an indeterminate future scenario. Modern chemical weapons are indeed deadly, and it is possible to design a worst-case submunition warhead to carry them, which will give TBMD interceptor engineers cold sweats—but an important fact gets lost in the debate. Chemicals and bioagents kill. Nuclear weapons obliterate.

Since August 1945, nuclear weapons have had a special resonance in world affairs, unmatched by the other two members of the WMD unholy trinity. The use of chemical weapons in recent conflicts has been universally decried—and, in those cases, universally tolerated. One wonders what the world community would have done if the final offensives of the Iran-Iraq war had been heralded by tactical nuclear exchanges rather than by the muffled midnight bursts of mustard and cyanide shells. Likewise, had the Libyan CW plant at Rabta actually been producing highly enriched uranium (HEU), might it not have disappeared under a swarm of TLAM long before the hardened facility at Tarhuna was built? Also, note that the Ballistic Missile Defense Organization (BMDO) draft Theater Missile Defense Command and Control Plan contains a nuclear—not a biological, not a chemical—annex, for nuclear weapons attack everything simultaneously, burning, blasting, poisoning, and causing the C2-vital electromagnetic spectrum to fibrillate even as they turn the very sand to ash and glass.

Proliferators in the developing world know this. Chemical and biological weapons are more easily produced—but they are the B-Team. A-Team capability is available for a sufficient investment of time and treasure. Israel, India, Pakistan, South Africa, and North Korea know this. It is hoped that before the murder of Hussein Kamel al-Majid in March 1996, the intelligence community interrogated the Iraqi inner-circle defector and WMD-development chief concerning the details of the Iraqi nuclear program in early 1991—thereby suggesting how the similar Iranian program may be progressing today. "The Iranian effort to acquire nuclear weapons technology mirrors the push by President Saddam Hussein to build a nuclear bomb in Iraq over the last 15 years. The Iranians use many of the old Iraqi smuggling routes and contacts. . . ."[13] Both in the Gulf and beyond, the TBM-WMD threat is imminent. By expedience and necessity, that threat in the short term will be chemical and biological. By evolutionary imperative, the threat in the future will be nuclear.

Three Centers of Gravity. WMD capability will give theater ballistic missiles a degree of leverage they have not heretofore demonstrated. Conventional Scuds arcing into Haifa and Tel Aviv presented the United States with a severe, but ultimately manageable, operational and diplomatic challenge. The same could not have been said if the Scuds had been carrying weapons of mass destruction. WMD-capable TBMs will be able to hold at risk not only specific individual targets, but entire centers of gravity, both military and political.

At the operational-tactical level of conflict, an enemy so equipped can threaten the military center of gravity consisting of the opposing power projection force itself. One way of doing this would be to interdict ports, airfields, supply depots, and fixed assembly areas.[14] Aggressor forces employed chemical TBM barrages against just this target set early in the northeast Asia MRC of Global Wargame '95.[15] Using conventional TBMs, the Iraqi military attempted the same tactic, for the same reasons, against rear areas such as Jubayl, Saudi Arabia, in 1991.[16] These conventional attacks were largely ineffective. However, were a credible chemical, biological, or nuclear threat posed, it probably would force the assembly, concentration, and resupply of a power projection force to take place outside the range of hostile TBM systems; such a threat-induced operational requirement would make the movement-to-contact phase of a major campaign significantly more complex and costly.

Also at the operational-tactical level of conflict, a second way of attacking the military center of gravity is to use the TBM-WMD system against concentrated formations of combat forces. Hence, the DESERT STORM model of massive force marshaled, magnified, then suddenly unleashed in high tempo, synchronized combat probably will be difficult to emulate. Heavy ground forces concentrating in fixed assembly areas in theater would likely be superseded by more maneuverable (thus more survivable, albeit lighter) forces deployed from longer range—perhaps by means of an extended period of air and naval strike tasking, followed by airborne and amphibious operations that would themselves attempt to minimize their suitability as targets for WMD.

At the operational level of war, the WMD-TBM vulnerable center of gravity is political: the cohesion of U.S.-allied regional coalitions. Multinational operations are an integral part of the national military strategy, for "our Armed Forces will most often fight in concert with regional allies and friends, as coalitions can decisively increase combat power and lead to a more favorable outcome to a conflict."[17] However, when facing a TBM-armed adversary during the time frame of this study, the territory of the United States itself is unlikely to be directly threatened, while that of regional allies may well be. If that threat is chemical, biological, or nuclear, the political leadership of likely coalition

partners may look to their own strategic security and decide that making common cause with the United States against a local hegemon is not an attractive option. "A window for internationally supported military action against a proliferator may close as the country gains the capability to retaliate against additional countries at greater ranges."[18]

If, however, the National Command Authorities see U.S. vital interests set sufficiently at risk, the nation can pursue unilateral military action. This is a fundamental tenet of the national military strategy. However, such a course not only risks potential collateral damage to, and direct retaliation against, U.S. friends in the region, but also focuses attention on a vital and vulnerable third center of gravity at the strategic level of war: the political will of the American people.

Since facing German mustard gas and phosgene in 1918, American forces have not had to operate on a WMD battlefield, and the American body politic has *never* felt the stunning shock of a nuclear weapon. While overwhelming American conventional military superiority can directly threaten a regional enemy's ability to make war on American forces, that enemy could in turn use TBM-delivered WMD capability to threaten American will to make war on him. In the media age, U.S. military action is increasingly dependent on the vicissitudes of public support—and the American public does not support long wars or heavy casualties. The public reaction to hostile use of weapons of mass destruction, covered minute by minute on CNN, might well collapse popular support for national policy.

Emotional popular reaction can sway policy either way, however. Thousands slain at Pearl Harbor stiffened national will, while eighteen dead in Mogadishu catalyzed withdrawal. Public perception of world events cannot always be accurately predicted by military and political professionals. What is certain, though, is that in our democracy, however imperfect, public perception determines public support for national military action; and if the strategic security of the United States is not perceived to be at risk, that support might well evaporate. The initiation of armed conflict is the ultimate expression of the political will of the people of a democracy, and such conflict cannot long continue unsupported by that will.[19]

Four Pillars of TBMD. An imminent threat to these vital centers of gravity—the military force itself, the cohesion of a regional alliance or coalition, and the political will of the American people—demands a robust response. As theater ballistic missile defense systems and doctrine have evolved since DESERT STORM, discussions of Joint TBMD capability have settled upon a common construct of "Four Pillars of TBMD"—actually, three pillars and a plinth: Active

Defense, Attack Operations, and Passive Defense, all supported by a base of Battle Management Command, Control, Communications, Computers, and Intelligence (BMC4I).

TBMD active defense, the interception of theater ballistic missiles in flight, is the focus of this study; it is the centerpiece of naval TBMD capabilities. In the era of the Soviet threat, an early basic tenet of U.S. naval antiair warfare doctrine was "Shoot the archer, not the arrow." Destruction of strike aircraft offered far greater defensive leverage than attempts to individually intercept their inbound weapons. Since TBMs are ground-launched, active defense assets must face the arrows, and this constraint defines the nature of active defense operations.

Entirely aside from the mechanical and mathematical challenges posed by small, high-speed ballistic targets, active defense is innately difficult because it must start out from "behind the power curve." Planning for TBMD active defense attempts to compensate for the challenging nature of the target by working to achieve defense in-depth: early sensor cueing, followed by multiple shot opportunities for complementary interceptor systems throughout the course of an inbound missile's flight. In the Joint TBMD environment of 2008, this might include airborne laser attacks against a theater ballistic missile while it is still in boost phase (ascending, rocket motor burning); Theater Wide TBMD system attack during ascent phase (after boost, before apogee); multiple Theater Wide system interception opportunities during midcourse flight (after apogee, before reentry); and endgame attacks by area defense TBMD systems in the terminal phase (following reentry).

The defining characteristics of TBMD active defense thus include:

- The need for the earliest possible warning of TBM preparation and launch, along with the most rapid netted cueing of active defense sensors and systems;
- A related requirement for close, highly automated coordination between complementary defensive systems in the joint environment;
- A tactical preference for systems that achieve intercept early in the TBM trajectory in order to mitigate WMD warhead effects and avoid the need for single-target endgame defense; and,
- Rigorous fire discipline and reliable kill assessment to prevent wasteful expenditure of a limited interceptor inventory.

All of these requirements are likely to be magnified by a potential force mismatch between the number of TBMD interceptors available in theater and the number of TBMs in the enemy order of battle at the outset of hostilities.

Attack operations—aggressive interdiction of enemy TBM assets and infrastructure on the ground—have the highest potential defensive leverage and

pose by far the greatest operational challenge of any pillar of TBMD. If successful, they can destroy missiles and associated WMD before launch, decimate vehicles and infrastructure to prevent further launches, and put fearful pressure on enemy TBM transporter-erector-launcher (TEL) crews to run, hide, and fire in sloppy haste—if at all. If, on the other hand, the friendly force's attack operations are relatively unsuccessful, they can entangle vast numbers of strike, tanker, and reconnaissance aircraft needed elsewhere in theater, and fruitlessly risk highly trained special operations personnel deep in enemy territory.

Along with basic passive defense measures and area defense-capable Patriot active defense, rudimentary attack operations formed the only coalition TBMD capability available during DESERT STORM; the results were decidedly mixed. Attack operations will evolve and advance by 2008, but they will still have to be able to overcome the basic challenge they face today—an extremely demanding tactical timeline.

A defining construct for attack operations is the military mnemonic of the "OODA Loop," the cycle of observe, orient, decide, act. The combatant who has sufficient information and agility to consistently operate "inside" his opponent's OODA loop, deciding and acting faster, is likely to prevail. Against TEL-mobile TBMs, the attack operations OODA cycle is very challenging. Attack assets, either airborne or ground-based, must be in position, armed, fueled, and alert when a TBM launch occurs or a TEL is detected. These assets must then be able to orient on their designated target and initiate an attack before the TEL moves and hides. The decision timeline from detection to attack is measured in minutes, and is still not consistently met, even years after DESERT STORM. During the Roving Sands 95 Joint Tactical Air Operations Exercise, "even with special operations forces and a Pioneer unmanned aerial vehicle dedicated to locating [an] SS-21 battery, it successfully fired all missiles—many with [simulated] chemical warheads—against some 20 corps and division targets."[20]

Furthermore, although attack operations form a pillar of theater ballistic missile defense, the nature of these actions is distinctly offensive, carried out by U.S. or coalition forces on territory controlled by the enemy. Rules of engagement and command and control issues are therefore certain to be different and likely to be more constrained than those associated with active defense. While a commander may see much to be gained through the vigorous pursuit of attack operations, his actual freedom to carry them out, especially in the early days of a conflict (when active defense forces are likely to be severely challenged) may nonetheless be distinctly circumscribed.

The defining characteristics of TBMD attack operations include:

- High defensive leverage due to a potential ability to prevent or degrade TBM launches and destroy WMD on enemy territory;
- High difficulty and high danger due to a compressed decision cycle and the need for operations in or over enemy territory;
- A need to address the emergent threat of an enemy's coordinated use of highly capable SAMs (e.g., SA-12) to defend TBM launch areas;[21]
- The likelihood that mission execution and rules of engagement will be under very restrictive centralized control; and,
- The imperative for continuous improvement of sensor-to-shooter connectivity and cross-service linkage of joint sensors (including those active defense sensors that can aid attack operations).

Passive defense "reduces the probability of and minimizes the effects of [TBM] attack by limiting an enemy's target acquisition capability, reducing the vulnerability of critical forces and supporting infrastructure, and improving the potential to survive and resume operations after an attack."[22] The very limitations that cause regional aggressors to rely on TBM forces may tend to decrease the utility of some classic passive defense measures such as the use of decoy targets and EMCON. Hostile systems with long range, large warheads and poor CEP are most likely to be fired against large, fixed, area targets such as ports and airfields; and they are more likely still to be simply launched against cities as terror weapons attacking political centers of gravity.

Passive defense directed against an enemy's limited battle damage assessment capability, or used to enhance dissemination of early warning to civilians, has more promise. Dispersal, mission-oriented protective posture (MOPP) passive measures against WMD, inoculation of personnel against bio-agents, and temporary fortification of military facilities and individual units can be accomplished through training, doctrine, and habit.[23] By their very nature, military formations are acculturated to the basic practices of passive defense, and thus are resilient and survivable if properly equipped and well-led. The same may not be said of urban civilian populations. Aggressors know this, and "soft" population centers are thus attractive as TBM targets.

Such Douhetian thinking is borne out by the results of Global Wargame '95 at Newport, Rhode Island, and Wargame 95B at the National Test Facility, Schriever Air Force Base, Colorado. Both examined major hostile TBM efforts directed against nonmilitary population centers. In a regional conflict, then, the CINC might well reap significant benefits through multinational-force coordination of passive defense efforts for population centers on his theater Defended Assets List (DAL). "It is critical to plan for and disseminate TM

[theater missile] launch warning and impact area prediction to civil authorities, as well as coalition forces. . . . The theater CINC and his subordinates should consider assisting the host nation civil authorities in establishing passive defense measures for the civilian population."[24]

The defining characteristics of TBMD passive defense thus include:

- The vital importance of intelligence and early warning. The specific capabilities of the threat must be well understood in order to plan effective passive defense measures. Implementation of those measures in a timely manner (and with a minimum of false alerts) requires effective early warning.
- Despite an understandable propensity on the part of military commanders to concentrate on the maintenance of their military capabilities and the welfare of their personnel, political realities may well shift that concentration toward provision of passive defense for threatened civilian populations.
- Early warning of a TBM launch and a determination of the likely target are relatively easy to obtain. Presently, it is harder to disseminate this information quickly, effectively, and jointly.

Intelligence, early warning, and information dissemination are vital to effective passive defense. A key enabler, then, for this pillar of TBMD is the capability which also supports active defense and attack operations, the plinth beneath the pillars: battle management command, control, communications, computers and intelligence.

BMC4I for the TBMD battle encompasses far more than issues of command and control. It is indeed an "architecture," a commander's "system of systems." BMC4I seeks to overcome the greatest difficulties of TBMD—distance (great) and time (little)—by integrating focused intelligence collection, early warning, sensor cueing, defensive system response, and assessment of system effectiveness.

As TBMD systems and capabilities evolve toward 2008, the BMC4I core concept of integration becomes critical, much more than just a matter of semantics. Under the necessary developmental discipline imposed by the need for joint TBMD operations, more and more systems are achieving a degree of interoperability, either through initial design or by means of "gateways" added to older systems. "Interoperability suggests a compatibility of communications means and message formats. It produces a capability to share information directly."[25]

This is constructive but strictly evolutionary. The NAVCENT portion of lessons learned from the major TBMD training exercise Roving Sands 95 reads, in part: "We are still a long way from true interoperability. . . . We are not sharing

data, merely conducting communications, passing tracks and overlays . . . and providing correlation."[26] As envisioned for joint TBMD, BMC4I seeks to achieve the revolutionary seamless battle space implied by true integration. Thus, in the words of the Joint Staff: "Integration suggests more than just compatibility. It suggests a decision to respond to shared information in accordance with prearranged conventions and agreements. The net effect is a degree of synergy which would not otherwise occur."[27]

The characteristics of BMC4I for effective TBMD include:

- An overall responsibility for comprehensive coordination of the TBMD battle, from initial intelligence preparation of the battle space (IPB) to interceptor kill evaluation and assessment of damage to protected assets following TBM attack;
- The need to disseminate TBMD surveillance and warning data derived from national technical systems in such a way that time-critical defensive operations in theater are supported, while national technical capabilities are not compromised;
- A fundamental importance to the execution of TBMD active defense, attack operations, and passive defense;
- The pivotal objective of achieving a "system of systems" for TBMD which is truly integrated, allowing automated exchange of data between joint TBMD components in a seamless manner (design requirements of the projected joint planning network, joint data network, and joint composite tracking network reflect this goal); and,
- A daunting degree of complexity which currently presents the most massive and difficult technical challenge of any dimension of theater ballistic missile defense.

Present Capability

The international tendencies and trends that demonstrate the need for capable theater ballistic missile defenses are compelling, as is the historical evidence of that need stemming from DESERT STORM. However, before examining the TBMD-related issues of concern to a Joint Force Maritime Component Commander in 2008, it is necessary to establish "ground truth," a brief, accurate description of where U.S. active defense TBMD capabilities stand now. If a regional contingency involving a TBM-armed, WMD-capable adversary were to erupt tomorrow, what active defense systems could U.S. forces bring to the fight?

Baseline TBMD Active Defense Capability. "Today, the nation's existing TBM defense capability rests with the Patriot system and its evolving improvements."[28] In the numerous exciting reports of ongoing TBMD development, it is easy for the seagoing operator to become confused by the whirl of programs and budgets, COEA studies, R&D pilot ventures, operational tests and evaluations, battle group workups, "future studies," and wargaming simulations. Thick briefing books and lengthy slide presentations show a plethora of systems in advanced stages of development, either being tested or awaiting further funding. There is, however, only one active defense weapon ready to go to war now, and that is Patriot (MIM-104).

Patriot was conceived as a mobile, all-weather air defense missile, with the XMIM-104 design specified in 1965.[29] TBMD capability was not available until the deployment of Patriot Advanced Capability 1 (PAC-1) in 1988. PAC-2, the Patriot version that earned fame in the Gulf War, was not deployed until DESERT SHIELD in 1990. Thus, the current version of the MIM-104 is a product-improved variant of an interceptor designed three decades ago.

Since DESERT STORM, the missile has been modified twice, first under the Patriot quick response (QR) program (1991-1992), and more recently through the introduction of Patriot PAC-2 GEM (guidance enhanced missile) in February 1995. "We will field about 350 of these missiles, which will provide the principal improvement in our defensive capability until the Patriot Advanced Capability-3 begins deployments. . . ."[30]

Patriot is an area-defense weapon, intercepting TBMs in the terminal phase of their trajectory, well inside the atmosphere, and engaging them with a proximity-fuzed blast-fragmentation warhead. This type of system has inherent limitations against TBM chemical submunitions, a critical concern which drove the selection of an entirely new missile, the extended range interceptor (ERINT), using hit-to-kill technology, for Patriot PAC-3. The very short standoff range of PAC-2 intercepts also makes likely effectiveness against a barometric-fuzed nuclear TBM problematic, and destruction of very high-speed long-range TBM reentry vehicles impossible.

The system itself, consisting of headquarters, communications, and support equipment, 4-cell launching stations (LS) organized into 8-LS fire units (FU), each with its own MPQ-53 radar, and 6-FU battalions (192 missiles), is air-transportable, but not tactically mobile.[31] Emplacement and relocation of fire units can be done expeditiously, but Patriot cannot "fire on the move." In effect, it is a fixed point defense system for stationary targets.

Getting Patriot into theater takes lift. Lots of lift. Movement of a PAC-2 battalion with one full missile reload takes 301 C–141 sorties.[32] Moving two fire

units from Germany to Israel during DESERT STORM "required more than 50 C–5As, and because of bed-down limitations and refueling requirements, diverted over 120 sorties each day [through 48 hours] from other high priority lift requirements."[33]

Since regional deployment of Patriot means installation of U.S. military equipment and personnel on foreign soil, such deployment is unlikely prior to imminent hostilities, except in relatively developed theaters such as western Europe or northeast Asia (e.g., South Korea). Even in such "TBM-rich" environments as the Arabian Gulf, political sensitivities may impede timely deployment or reinforcement of this single U.S. TBMD active defense system.

TBMD as a "System of Systems." The relatively short range and limited mobility of the Patriot PAC-2 restricts the nature of active defense TBMD plans built around this system. Current concepts feature "enclaves" provided for specific critical assets. "The composite envelope, which is the collection of fire units producing the protected envelope and the critical assets in the area under the envelope, is designated an enclave."[34] Since DESERT STORM, interim TBMD enhancement efforts have involved initiatives to expand the volume of Patriot enclaves. Because the MPQ-53 radar out-ranges the MIM-104 interceptor itself, one way to enlarge an enclave would be to move fire units down-range (down the likely threat axis) from the radar supporting them. The quick response (QR) program of 1991-1992 did just this, giving the system the ability to "deploy missile launchers up to 12km from their associated fire-control radar, which enlarges the defended area."[35] However, given the absolute performance limitations of the PAC-2 missile, further enhancements to the enclave concept have had to come from other areas, such as improving overall system performance through leveraging BMC4I and pursuing the synergistic effect of a "system of systems."

Enclave defense with range-limited weapons has always demanded a measure of grit from warriors. In 1775, holding Breed's Hill outside Boston, Colonel William Prescott considered the effectiveness of his smoothbore muskets, scant artillery, and limited ammunition, and told the patriots commanding the batteries, "Don't fire until you see the whites of their eyes." Today's Patriot battery commander cannot fire until the white-hot meteor of a reentering TBM streaks through the sky inbound to his enclave. At least Prescott could see the British coming for a long time. Early warning as to the size, nature, and disposition of a threat increases situational awareness and thus the efficiency of the defense. For the TBMD battle today, that warning comes from space.

Current TBMD space-based early warning depends on Defense Support Program (DSP) satellites originally deployed to detect strategic ICBM launches.

Their capability against smaller TBMs with associated lower signatures is limited, but has been enhanced by USSPACECOM through the implementation of the ALERT (attack and launch early report to theater) system. "It is the operational version of prototype TM [theater missile] warning efforts developed by the tactical exploitation of national capabilities (TENCAP) office under the Talon Shield program."[36] ALERT and its theater-deployed derivative, JTAGS (joint tactical ground station), process information from multiple satellites viewing a single launch, thus gaining "stereo DSP" data.

> System software calculates tactical parameters such as time, latitude, longitude and altitude for comparison with known theater ballistic missile profiles. . . . Identifying the missile by means of the profile allows . . . a least-squares fit of observed altitude and downrange distance as a function of time. . . . Loft can be added to the four-state fit as a fifth parameter to permit manipulation of the profile in both altitude and downrange distance.[37]

The ALERT system can thus provide TBM launch time and estimated launch position (critical for attack operations), probable missile type (which may have specific engageability and warhead implications), missile state vectors (for midcourse prediction), and impact point prediction (for efficient area defense and effective passive defense).

ALERT, however, is part of the national tactical event system (TES), located in proximity to many other national capabilities near Colorado Springs, Colorado. Communications restrictions imposed by the need to filter other sensitive national systems data carried on the same nets can retard dissemination of ALERT fused data. The system can meet a warning goal of 90 seconds—but that window represents elapsed time from sensor to CINC—not sensor to TBMD shooter. Studies have shown that some enemy missiles may impact their targets before the associated ALERT cues reach the in-theater defensive assets that need them. The operational BMC4I solution to this time lag is the modular, truck-mounted, air-mobile DSP theater processing node—JTAGS.

The JTAGS system can process, fuse, and disseminate information from up to three DSP satellites (if its antennae can "see" that many of the geosynchronous sensors). Two prototypes are now operationally deployed, one in Germany and the other in South Korea. The contractor has an option for production of a further five units.[38] JTAGS-processed DSP information provided in theater to an Army force projection tactical operations center (FPTOC) can enhance existing TBMD active defense capability by quickly determining which of several enclaves may be threatened by a given TBM launch, forwarding the cueing information to the correct Patriot information coordination central (ICC)

vehicle at the battalion level, and thence to the individual MSQ-104 engagement control stations (ECS).

Though the MPQ-53 radar cannot directly accept external cueing data, that is a major goal of current TBMD BMC4I integration efforts. Exercises are ongoing, especially involving AEGIS SPY radar data provided to Patriot via the Navy's new cooperative engagement capability (CEC). For example, one recent test "was designed to show how CEC could help defend Europe. . . . A total of 31 simulated 'Scud' missiles were 'launched' from locations in North Africa. The launch and predicted impact point of each target, together with 'very near real-time' control data, was calculated by CEC and transmitted to [a] Patriot battery some 1,450km away. . . ."[39] What must be borne in mind, however, is that such recently demonstrated capabilities are experimental rather than operational. Again quoting CENTCOM lessons learned from the recent Roving Sands 95 exercise: "The inability to real time cue and coordinate sensor data between AEGIS SPY and Patriot MPQ-53 radars limits our effectiveness."[40]

Implications of the Baseline. The implications for TBMD active defense failure to move beyond this baseline are far-reaching. The procurement power of such TBMD organizations as the Ballistic Missile Defense Organization (BMDO) and the Navy's Program Executive Office for Theater Air Defense, PEO (TAD), is not in doubt; but fiscal constraint has been a significant factor in Department of Defense program planning since 1985. Hence, in considering the state of U.S. theater defenses against an evolving threat, one must carefully consider what James Edward Pitts has called the "consequences of *not funding*."[41]

Regarding Patriot during DESERT STORM, to paraphrase Dr. Johnson: it was not the fact that it did its job well that amazes, but the fact that it did it at all. The current system, especially when deployed with the latest guidance-enhanced missile (GEM) and supported by JTAGS, will be quite capable against that same baseline threat. However, as the first section of this chapter explained, the "baseline threat" is inexorably evolving beyond the Patriot PAC-2 engagement envelope, pushed by two great TBM trends: increasing ballistic missile system range and the frightening capability of weapons of mass destruction.

Increasing theater ballistic missile range (which can be achieved by decreasing payload, adding stages, or simply strapping on additional boosters) increases reentry velocity. Baseline defensive systems with limited standoff range, such as Patriot PAC-2, rapidly reach a point where they cannot acquire, track, launch, and achieve intercept quickly enough. The kinematics of the attacking missile have gotten inside the OODA loop of the defending interceptor. Such absolute

physical limitations can only be overcome by fielding a different system; this fact has compelled development of PAC-3 ERINT and even longer range systems such as SM2 Block IVA Navy Area, Army THAAD (theater high altitude area defense), and the very long-range Navy Theater Wide (NTW, using the SM3 missile) system. None is a substitute for another; all are complementary components of an evolving active defense family-of-systems.

In addition to providing robust capability against long-range, high-speed systems, or shorter range, high-apogee (lofted trajectory) TBMs, exoatmospheric TBMD systems such as THAAD and NTW provide an essential capability against weapons of mass destruction, which—to repeat—baseline systems do not. Even a highly lethal area defense hit-to-kill design such as PAC-3 will cause the release of some WMD components into the air upon intercept consummation. Only the Theater Wide defense systems have the ability to make the kill in space, forcing any surviving WMD materials to careen into the atmosphere unshielded.

Theater Wide systems also extend the battle space, a primary goal of any commander, while the baseline system does not; indeed, the current baseline system surrenders not only battle space, but also vital intelligence to the enemy. The fixed enclaves and point-defense limitations of PAC-2 announce clearly which assets on the DAL the CINC intends to defend, and thus, conversely, which he is willing to sacrifice.

The CINC may not even be able to make that admittedly difficult choice expeditiously, for political sensitivities may constrain his ability to emplace TBMD assets before the onset of hostilities. Once conflict commences, strategic lift sensitivities could inhibit his ability to reactively deploy active defenses even more. "When a crisis occurs, the real-time decision to devote scarce airlift assets to move a Patriot battalion instead of infantry or artillery equipment will be difficult and pressing."[42]

If the TBM threat continues to evolve, then joint TBMD capability must progress beyond the baseline. In the military world, as in the natural world, over-specialization is an invitation to catastrophe. A robust response to an evolving threat requires diverse capabilities fully integrated through a common BMC4I architecture. During the crucial early days of a regional contingency, when "the Navy kicks open the door and holds it open for the heavy land forces," the TBMD active defense capabilities most likely to be picked from that diverse palette by the Joint Force Maritime Component Commander will be naval.[43] If the U.S. military moves resolutely beyond the baseline, the JFMCC will have flexible, deployable, multitiered naval TBMD capability available by 2008. The projected characteristics of those specific systems are the subject of the next section.

Naval TBMD Active Defense Capabilities to 2008

"The Navy TBMD system shall be comprised of two tiers, which provides for an Area (lower tier) defense and Theater Wide (upper tier) defense. The Naval TBMD system shall provide capability against the full range of TBM threats for protection of joint forces, sea and air lines of communications, command and control facilities, vital political and military assets, supporting infrastructure, and population centers."[44] Navy Area TBMD will be provided by the SM2 Block IVA interceptor, while Navy Theater Wide (NTW) will likely depend on the SM3 missile, carrying an infrared-homing kinetic warhead. Sensor capability will be built around the AEGIS-organic SPY radar, with off-board cueing from JTAGS-type fused DSP data. Because of the highly automated, highly integrated, self-contained nature of modern warships, much of the framework for the projected joint TBMD BMC4I architecture is already in place on AEGIS combatants. As stated in chapter I of this study, it is presumed that the architecture will be fully functional by 2008.

Navy Area TBMD. The SM2 Block IVA interceptor represents the latest stage in the remarkable evolution of the Navy's standard missile, a weapon whose roots reach back to the TARTAR and TERRIER offspring of the BUMBLEBEE antiair warfare program of the 1950s. Navy Area is one of the Ballistic Missile Defense Organization "core" TBMD systems, and thus (along with Patriot PAC-3, THAAD, and Navy Theater Wide) has a great deal of developmental and bureaucratic momentum. A contingency capability of two Navy Area AEGIS cruisers with at least 35 SM2 Block IVA missiles will put to sea by the end of the century.[45]

The Block IVA missile itself is a boosted, high-mach, long-range, solid-fuel interceptor with "dual mode" terminal homing (IR primary and semi-active RF secondary) and a blast-fragmentation warhead specifically enhanced for the TBMD role. The combination of precise guidance (which increases the chance of a direct "skin-to-skin" hit or very near miss) with a powerful explosive warhead makes this interceptor extremely potent.[46] Proximity-fuzed, it therefore does not suffer the one major drawback of kinetic-energy hit-to-kill systems—their all-or-nothing gamble on flawless guidance and successful terminal homing.

Like Patriot PAC-3, SM2 Block IVA will be multimission capable, lethal against cruise missiles and manned aircraft in addition to TBMs. However, as shown during Roving Sands 95, its "defended footprint" will be far larger than that of PAC-3, allowing a rudimentary layered defense using only "lower-tier"

systems if Patriot is in place in a littoral enclave. Against a simulated 600km-range TBM, a Navy Area engagement at 120km is possible many more times than is a PAC-3 intercept against the same target.[47] Maximum intercept altitude, which is critical against WMD warheads, is also considerably greater, at 35km—a height of over 113,000 feet.[48] Additionally, it should be noted that for short-range TBMs with apogees (highest point of ballistic trajectory) within the atmosphere, Navy Area will be the only naval active defense system capable of engaging, because the Navy Theater Wide SM3 interceptor functions outside the atmosphere.

Such figures, however, need to be evaluated carefully. The defended footprint of any area defense TBMD interceptor decreases as the velocity of the incoming TBM target increases. Ballistic missile terminal velocity is a function of system range; so the longer the range of the enemy system, the smaller the area that can be defended by lower tier systems. For example, against a 900km-range TBM, Navy Area engagement range drops to 65km, or approximately thirty-five nautical miles—ranges familiar to shipboard operators of early fleet AW SM2 variants.[49]

The thoughtful reader must beware of oversimplification. The concept of a "defended footprint"—in effect a Navy Area enclave—represents a complex geometry dependent on many factors, including TBM range and related terminal velocity, radar cross-section (RCS), and the spatial relationship between the AEGIS ship and the asset it is defending. Furthermore, in a littoral environment, Navy Area systems will have to provide greater coverage than equivalent ground-based systems because of the prospect of a shoal-water "buffer" between the TBMD ship and the DAL target it is defending. Area defense systems generally benefit from collocation with the assets they are defending, but it often will be difficult for a Navy Area ship to patrol in proximity to the asset it is assigned to protect. Until ground-based systems are emplaced in theater, Navy Area ships will need all the reach they can get to "hold open the door."

Well forward, defending an amphibious objective area or other military assets against short-range TBM threats, that inland Navy Area "reach" will be considerable. Defending political or population targets far from the main military engagement, however, not only takes multimission ships and tethers them to single targets; it also markedly shrinks the footprint area and engagement altitude of their defended envelopes against just those hostile systems (long-range TBMs) most likely to be employed with WMD, weapons which tend to negate the value of close-in point defense. This long-range, politically targeted WMD-capable threat postulated for 2008 drives the need for

another layer of protection to complement the versatile, capable, but limited scope of Navy Area. That seagoing "upper tier" capability is Navy Theater Wide.

Navy Theater Wide (NTW). Interception of theater ballistic missiles outside the atmosphere using Theater Wide active defense systems is fundamentally different from the more intuitive "goalkeeping" defense accomplished by lower tier systems. Conceptually, it may be helpful to think of Theater Wide defenses as being akin to long-range CAP engaged in the classic AW outer-air battle, with area defenses fighting the close-range battle within the battle group's missile engagement zone (MEZ). As with CAP aircraft, the area defended by an NTW ship depends more on the location of the defensive platform than on the location of the defended target.

Rather than an enclave-like defended footprint surrounding a single target, NTW involves an "area of negation" within which a single AEGIS ship can patrol in order to intercept TBMs en route from a hostile launch area to many different friendly targets. Herein lies the tremendous leverage of NTW, and the explanation for TBMD briefing slides that show a handful of NTW ships defending all of southern Europe or all of Japan from TBM attack. The kinematics of the NTW interceptor have eliminated the need for these ships to be collocated with single defended assets. Instead, the ships are positioned either somewhat forward in large areas of negation that allow multiple exoatmospheric midcourse and descent-phase intercepts in support of hard-pressed area defense systems, or well forward, where they can exercise the upper tier capability unique to the Navy Theater Wide system—ascent phase intercept.

Ascent phase intercept is the holy grail of naval TBMD. The only active defense technique that can possibly exceed its leverage is boost phase intercept (BPI), attacking TBMs while the missiles are still accelerating away from their launchers. Boost phase systems and doctrine remain primarily in the Air Force corner of the joint TBMD arena. Ascent phase active defense, by contrast, engages the strengths of NTW AEGIS combatants, which can patrol in international waters off a hostile shore, with their SPY radars looking inland, awaiting (but not requiring) a DSP cue. As soon as a launch is detected and ROE are met, an NTW interceptor can be on its way to destroy the TBM as soon as it rises above the atmosphere.[50] Such a proactive capability produces a defended area covering tens of thousands of square miles.

The only TBMD weapon that will do this is the SM3. Only four inches longer than the SM2 Block IVA, the SM3 missile is actually a four-stage system, starting with the Mk72 booster and Mk104 solid rocket motor it shares with the Navy Area interceptor. "The inertially guided, nozzle-controlled advanced solid

axial stage (ASAS) [Now "TSRM" for "Third Stage Rocket Motor"] motor will constitute the third stage. . . . The fourth stage will be the autonomous LEAP KKV [Kinetic Kill Vehicle]."[51] Guidance technologies used in this extremely long-range system include missile command uplink, inertial, GPS, and infrared terminal homing. The kinetic warhead (KW) contains no explosive charge. Maneuvering autonomously with thrusters, it homes on the IR signature of the hot TBM revealed against the cold vacuum of space, closing for the kill at several times the velocity of the fastest rifle bullet. The kinetic energy of a moving object equals one-half the object's mass times the square of its velocity. Thus the small but *very* fast KW packs a serious kinetic punch. When combined with the squared inbound velocity and much greater mass of the incoming TBM, the energy released in the intercept collision is tremendously destructive. If that TBM is carrying a chemical, biological, or nuclear payload, the components are shattered and dispersed outside the atmosphere.

The potential capability of this system is so significant that challenges to its development have proven to be not only technical but political. There has been considerable controversy surrounding the potential effect of NTW on the 1972 Anti-Ballistic Missile (ABM) Treaty. Again, though, it is necessary to review the numbers carefully. When considering Russian strategic systems, "ICBM speed of 6-7 km/sec easily outdistances the 4-5 km/sec of the interceptor, precluding an ascent phase intercept. If an AEGIS ship is near the terminal target of the ICBM—by the time an interceptor can be fired and flown out to intercept, the RVs [Reentry Vehicles] are below the minimum altitude of the exoatmospheric hit to kill vehicle."[52] Consequently, while the SM3 is potentially extremely capable against medium range ballistic missiles, it is not capable of effectively engaging the high-speed reentry vehicles of a strategic ICBM.

The eventual influence of modern theater ballistic missile defense technology on a treaty involving strategic defense signed nearly a quarter century ago is still being hotly debated, but naval TBMD active defense development is continuing apace and could be available as currently envisioned in 2008. "Both the Navy Area TBMD and the Theater Wide capability have been certified by the Department of Defense to the Congress as fully treaty compliant."[53]

Sensors. The primary sensor for naval TBMD active defense will be the AEGIS SPY radar. The TBM-tracking capabilities of SPY are being explored and expanded through the use of non-tactical data collection (NTDC) software "patches," experimental modifications that will lead to a tactical TBMD-capable program version. Thus modified, SPY radars have "demonstrated the ability to track TBMs at ranges well in excess of 500km. . . ."[54]

As with any radar, tracking range is highly dependent on the radar cross section (RCS) of the target, and SPY autonomous ranges against more challenging TBMs will decrease accordingly. Here, battle space can be regained through cooperative tracking by two AEGIS ships, the forward "picket" linking tracks to a consort downrange until the second ship can acquire the target. This capability has been demonstrated in several TBMD extended tracking exercises, including Joint Task Force (JTF-95) demonstrations of the new Cooperative Engagement Capability (CEC), the present-day precursor to the joint composite tracking network postulated for 2008. JTF-95 tests included "a CEC cueing and composite tracking of a TBM target, initially detected by USS ANZIO's SPY-1 radar just after launch. . . . Other CEC units . . . were all automatically cued to acquire the target within seconds. Each maintained a single composite track on the target until it splashed down."[55]

Cooperative tracking against low-RCS targets can also be enhanced by stationing ships off-axis from the threat trajectory. Multiple aspects of the TBM are thus illuminated by the SPY radars of more than one ship. What might be a very challenging target head-on may give a useful return from its beam aspect. The composite data shared via CEC takes advantage of this phenomenon and thus provides all platforms in the network with the best possible track on the target TBM.

Battle space can be gained not only through sharing track data between radars, but also by using the RF energy of any given radar more efficiently. SPY must search for and detect a TBM before it can acquire and transition-to-track. If radar waveforms and anticipated search volume can be "fine-tuned" early for TBM detection, SPY can acquire and track much faster, thus gaining time in the all-important TBMD OODA loop. Off-board cueing is the key to efficient radar management and early detection.

In 2008, cueing to AEGIS will be primarily a USSPACECOM function via theater-based JTAGS, CONUS-based ALERT, and the third component of the tactical event system, the Navy's Radiant Ivory-derived TACDAR (tactical detection and reporting) capability. The Joint Force Maritime Component Commander must therefore bear in mind that "as friendly operations shift in time and place, the T[B]MD planner must continually reevaluate the areas to be covered by DSP, and effect continual coordination with USSPACECOM to obtain that coverage."[56] He must remember, however, that these sensors are in a geosynchronous constellation and are therefore far out in space. Any modification to the geometry of that constellation will therefore involve many miles of satellite repositioning, with the associated consumption of limited thruster fuel. It will also take time. The need for stereo DSP coverage should be

established and agreed upon in the initial TBMD planning process, rather than when enemy launches commence.

A significant limitation of national overhead sensors such as the DSP constellation is an inability to gather data on TBMs after boost phase, when the hot plume of the rocket motor no longer exists. This cueing gap will not be fully remedied until the space-based infrared system—low earth orbit (SBIRS-Low)—is deployed (pending full funding). Even then, since SBIRS-Low is by definition a low-earth orbit system, it will have periodic, multipass coverage rather than the continuous "staring" coverage given by a geosynchronous sensor. Without post-boost information, JTAGS-type data will be sufficient to support search volume limitation and waveform selection for SPY, but will not meet criteria for an optimum single beam cue, "an uncertainty volume small enough to be covered by a single beam of a Fire Control Radar system."[57]

The importance of post-boost-phase sensors for supporting single beam SPY cueing has been clear to the Navy for several years, as shown by the work of Robert Powers, advocating the adaptation of infrared search and track (IRST) equipment to the E-2C aircraft.[58] Airborne IR systems can continue to track a TBM after its motor burns out by sensing skin heating of the missile body caused by the friction of its passage through the atmosphere. The E-2C/IRST concept was first known as Gatekeeper.[59]

III

Issues for the Maritime Component Commander

WHAT, THEN, ARE THE TBMD ISSUES with which the Joint Force Maritime Component Commander must specifically concern himself? When considered in light of projected U.S. naval capabilities and anticipated regional threats ten years hence, areas of useful concentration for his particular attention coalesce around four key topics. These are:

- Logistics
- Command, Control, and Intelligence
- Warfighting
- Rules of Engagement

Logistics will be dealt with first, since this subject clearly illustrates the value of a straightforward operations analysis approach in order to bound an important discussion—a discussion which, when so bounded, reveals important caveats regarding the true complexity of war in the littoral, an arena of conflicting missions prosecuted with limited means.

Command, control, and intelligence follows logistics, and considers that same complexity at three separate levels of leadership: above the JFMCC at the NCA level; among competing component commanders at the theater level; and from the JFMCC down to the unit level. Encompassing all levels, comprehensive intelligence preparation of the battle space is held to be essential to the JFMCC's mastery of the subtleties of the TBMD mission, and thus his ability to make the hard choices necessary for its effective execution.

The section on warfighting derives its arguments directly from the debates illustrated in the preceding pages, setting forth some of those hard operational choices which will inevitably face the JFMCC as a result of his own logistical

constraints and the operational intent of his superiors. The contrasting but complementary capabilities of Navy Theater Wide and Navy Area TBMD are thus considered.

Finally, the essential issues of national policy and international law that must inform U.S. TBMD operations are presented below in a section on rules of engagement. As the final portion of the core chapter in this study, this consideration of the legal dilemmas and the inherent uncertainty with which the JFMCC must wrestle perhaps represents an allegory, a cautionary tale, for the whole topic of theater ballistic missile defense delivered from the sea.

Logistics

With the general background provided in the preceding chapters, the reader is in a position to anticipate the issues that will confront the Joint Force Maritime Component Commander. For simplicity, this section will begin with the most straightforward: the physical characteristics of one's own force and an operations analysis-type approach to the issues that arise. The JFMCC must be fully cognizant of the key capabilities and limitations of his own forces. In preparing for the theater ballistic missile defense mission, one of his primary concerns must thus be logistics, especially the unique stresses TBMD will place on the vital tasks of refueling and rearming his AEGIS combatants.

Iron Logic of Fuel: CG versus DDG. In a rapidly developing conflict against a TBM-capable foe, the Joint Force Maritime Component Commander may find himself cast as the JFC's Leonidas, holding the pass at Thermopylae as the Persian arrows rain down, buying time for reinforcements to arrive in theater. If the limited naval theater ballistic missile defense capability initially available in theater is likely to be overmatched by sheer numbers of hostile missiles at the outset of a fight, then that capability must be used both effectively and efficiently.

One of the strengths of modern U.S. naval combatants, and especially AEGIS ships, is their multi-mission versatility. Costly, complex, and capable, these ships excel at the "up, out, and down" missions of AW, SUW and USW. Their role as potent TLAM strike platforms was critical during DESERT STORM: by 2008, naval theater ballistic missile defense will be a major new AEGIS mission. The TBMD battle, however, is unlikely to take place in isolation—thus it will have to be conducted in both competition and cooperation with the other important missions given to the maritime component of the Joint Force, as its ships, aircraft, and Marines stand fast and secure the rapid buildup of land and air power in theater.

The Joint Force Maritime Component Commander must use his highly capable but numerically limited AEGIS assets wisely, both in how he apportions them for a variety of missions and how he assigns them different tasks within the TBMD mission. Different ships and different missions are not created equal. For example, NTW brings more to the fight than Navy Area. If, however, enemy TBMs are short-range and low-apogee, this is a moot point, for they will not be engageable by Theater Wide defenses. Nonetheless, the highest leverage hostile systems will generally be those with the longest range, able to reach out and touch political targets, able to threaten the political centers of gravity of coalition cohesion and national will-to-fight.

NTW counters this threat and counters it efficiently, by fielding a system with kinematics that allow TBM engagements in the ascent phase, during midcourse, and during descent before the endgame of area defense systems. One NTW platform can thus defend many targets on the DAL. Therefore, when faced with a robust enemy TBM order of battle and an ad hoc defense by whatever naval TBMD capability is currently deployed in theater, the Joint Force Maritime Component Commander should seek to maximize the NTW portion of the naval theater ballistic missile defense mission.

If possible, the JFMCC needs to get his NTW-capable AEGIS ships close to the enemy TBM launch areas and keep them there. Herein lies the rub. Both AEGIS cruisers (CG 47/52 class) and AEGIS destroyers (DDG 51 class) could, by 2008, be equipped to perform the NTW mission. But which ship would be more efficient at a task which is, in effect, an antimissile deterrent patrol in a distant, perhaps isolated, NTW area of negation? A straightforward operations analysis approach may prove useful.

In a hypothetical contingency, an AEGIS cruiser and destroyer are steaming in company with the CV and the AOE, having just refuelled to 100 percent capacity (98 percent available). They are both ordered to proceed at 25 knots to separate NTW patrol areas, both 1,000 nautical miles distant. Upon arrival, they are each to patrol at quietest speed in accordance with their class combat systems doctrine, until they reach a fuel state of 50 percent, with contingency authorization to remain on station to 30 percent fuel. An escorted AO will refuel them on a regular RAS circuit until they are relieved by other NTW units.

All ships have unique fuel consumption curves, and consumption rates will vary with sea conditions and degree of bottom fouling; but using the generic data contained in Class Tactical Manuals,[60] the CG 47 Class Combat Systems Doctrine,[61] and a recent unclassified message from the AEGIS Program Office,[62] basic fuel consumption comparisons between the two AEGIS classes can be made. They are instructive.

After a 1,000nm sprint, the cruiser can remain on station at 13 knots for 6 days to 50 percent fuel, with a load on the electrical plant sufficient to keep SPY radiating at high power. Shifting the main plant to the nonstandard-configuration low speed quiet mode (by following classified information in the combat systems doctrine) should boost endurance to 7½ days at 5 knots. If the decision is made to drop to 30 percent fuel, on-station time is 10 days at 13 knots, and just over 12 days at the low speed quiet mode 5 knots.

Note the reason for the high 13-knot patrol speed. The cruiser, like most U.S. twin-screw combatants with controllable reversible pitch propellers, is most quiet with both shafts powered and both props at 100 percent pitch. The Prairie/Masker system must also be aligned in accordance with the specific classified parameters in the class combat systems doctrine. Below 100 percent pitch, the props cavitate. The slowest speed the cruiser will normally make at 100 percent pitch on both shafts is between 12 and 13 knots. Low speed quiet mode achieves improved quieting, lower speed, and greater fuel economy, but at the cost of a nonstandard plant configuration that takes engineering control away from the bridge watch team.

Under the same conditions, the endurance of the DDG is strikingly different. Patrol time to 50 percent is just under 3 days at 13 knots, with about 5½ days total to 30 percent fuel state. The DDG 51 class combat systems doctrine does not yet detail a low speed quiet mode configuration for the class; but if a setup similar to that for the cruiser is presumed, then endurance to 50 percent would be boosted by a day, and to 30 percent by 2 days, maintaining a patrol speed of 5 knots. Thus, at the lowest speed and lowest fuel state, the cruiser can remain on station more than 1½ times as long as the destroyer. At a more responsive 13 knots and a more responsible 50 percent fuel state, the cruiser will have lasted twice as long as the destroyer—and will have done it with 35 percent more VLS cells.

While this simplistic arithmetic shows the logic of selecting the cruiser for the NTW mission, it also helps to highlight one of the JFMCC's greatest logistical challenges: the iron logic of fuel. Warships have redundant weapons, redundant sensors, and plenty of manpower. When the fresh fruit and vegetables run out, a Navy ship's galley can still serve macaroni and cheese well into the next century. Fuel, however, is an absolute. Empires were built around coaling stations for good reason, and the NTW cruiser captain who finds himself at 30 percent fuel in the face of the enemy is not going to sleep well.

To fight the theater ballistic missile defense battle efficiently, the Joint Force Maritime Component Commander should favor Navy Theater Wide systems, if he can. But in order to defend the DAL and also be prepared to establish an

amphibious objective area, he will also have to retain Navy Area assets for both endgame TBMD defense and conventional AW.

By the very geometry of their missions, NTW and Navy Area assets will tend to be widely separated, as they are best employed at opposite ends of a ballistic trajectory that may extend for hundreds of nautical miles. Under the umbrella of layered defense that they provide, other ships will go about other essential missions—and they will all need fuel.

The days of the amphibious ready group and carrier battle group moving about the theater as near-contiguous blocs of military power and logistical organization have been over for some time, but the unique time-distance stressors associated with theater ballistic missile defense have the potential to overwhelm current ad hoc logistics solutions to dispersed tasking. Recent events, such as those involving AEGIS combatants in the Adriatic or UN-sanctioned maritime interdiction force (MIF) board-and-search operations in the northern Red Sea, have seen the frequent use of allied replenishment-at-sea assets and unescorted U.S. auxiliaries. Examples include everything from a Canadian Forces oiler fueling the Red Crown AEGIS CG off Montenegro to a lone USNS T-AO rotating down to Hurghada, Egypt, to support the MIF. In future contingencies involving TBMD, allied or coalition logistical support is not initially guaranteed and thus may not be counted upon to augment U.S. replenishment capability in theater at the very moment U.S. naval TBMD assets may be spread farthest and thinnest.

Even as the theater develops, the fuel problem will remain challenging. In the Phase 2 (day 70) portion of the 2005+ scenario of NTF Wargame 95B, eighteen TBMD-capable AEGIS combatants ranged the length and breadth of the Mediterranean and Aegean seas, escorting three CVNs, performing TLAM strikes and local AW, and conducting NTW and Navy Area patrols.[63] Replenishment was not simulated.

If the enemy TBM effort against the defended asset list develops in a manner not anticipated by the JFMCC's initial resource allocation, then TBMD assets may have to be shifted rapidly, with the resulting full-power sprints consuming even more fuel. Knowing this, the Joint Force Maritime Component Commander must carefully evaluate his ability to carry out a robust, flexible TBMD plan while still providing his ships with sufficient fuel for safe operations and combat tasking.

VLS Capabilities and Limitations: Reload and Loadout. A warship cannot live without fuel, but it cannot fight without ammunition. As weapons systems become increasingly complex and specialized, the ability of a weapons platform to execute a given mission is increasingly tied to its reserves of a specific

munition. If the AEGIS CG demonstrates superior endurance for the remote NTW mission, that advantage is squandered if the ship carries an insufficient loadout of NTW interceptors.

If all its SM3 missiles are gone after two days on-station, the CG's superior fuel reserves are rendered irrelevant. Except as a sensor or cueing platform, the ship is useless for NTW and is probably out of position for any of the other missions it is potentially capable of performing. Furthermore, unlike fuel, VLS reloads cannot be provided on station. The ship must leave its patrol area and proceed to port, perhaps taking itself out of the fight entirely.

As originally designed, the Mk41 vertical launching system and its variants have a nominal underway replenishment capability. The practical limits of this capability are sufficiently great that in the late 1980s, the Center for Naval Analyses (CNA) studied a series of possible improvements. The results of that study, driven by the old Soviet regimental raid threat, are still relevant in light of the emerging TBMD mission.

Looking at older ship classes, CNA found that "typical rates for the transfer of large missiles between ships at sea [were] on the order of two to six missiles per hour."[64] In regard to VLS, "limited testing of the VLS UNREP system indicates the fleet can expect about 3 missiles per hour as a consistent strike-down rate in calm seas (sea state 3 or less)."[65]

However, the two most important VLS munitions in the current inventory, Tomahawk and SM2 Block IV, cannot be transferred at sea at all, since they are several thousand pounds too heavy for the launcher-installed VLS handling crane. This problem first became a major issue during DESERT STORM, when hundreds of Tomahawks were launched in a matter of days, and entire VLS magazines had to be reloaded in theater.

In the TLAM strike world, standard operating procedures were developed, tested, implemented, and finally incorporated in detail into the *NWP 3-03.1* series (Tomahawk Land Attack Missile (TLAM-C/D) Employment Manual).[66] Referring to TLAM rearmament procedures while discussing TBMD is instructive primarily because the logistical challenges of Tomahawk and TBMD missile size and weight are similar. The Mk14 VLS canister for TLAM and the Mk21 canister for SM2 Block IV and its variants (including SM3) are the same size, and while TLAM will probably remain the heavier of the two missiles, encanistered weights are within 1,000 lbs. of each other.

NWP 3-03.1's rearming site requirements are clear:

> Rearming requires pierside handling facilities, airfields and airlift capability (lower volume and higher expense), seaport and sealift capabilities (slower, higher volume, and lower expense), and trucking from seaport or airfield to pierside. . . . Any

> ordnance-certified mobile crane with a "power-down" mode having sufficient rated capacity, boom length and hook height may be used to load.... QR [Quick Reaction] teams may also be used to support loading and unloading operations at anchorage with a barge and floating crane or cross-decking operations with a destroyer [tender].[67]

How many tenders, both AD and AS, will the Navy actually have in 2008? Also left unstated is the fact that "double-ended" VLS ships such as AEGIS cruisers and destroyers can be rearmed twice as fast if two cranes are available (a frequent bone of contention at stateside weapons stations). With both cranes swinging canisters and enough forklifts and pier-side handlers to keep up with them, a motivated AEGIS crew can completely reload the ship's VLS systems in one (long) day. Note the optimum requirements, though: a pier of sufficient length and with water alongside to accommodate ships up to 563 feet long and 32+ feet in draft; cranes, forklifts, trucks, and/or flatbed rail rolling stock; and contiguous or near-contiguous cargo ports or airfields. Such a facility is precisely the kind of "logistics node" that the JFMCC will be attempting either to defend or seize early in a regional conflict. When in friendly hands, such a facility is a prime TBM target in its own right, as seen at Jubayl, Saudi Arabia, on 16 February 1991, when an Iraqi Scud impacted within yards of an ammunition pier berthing seven ships, a supply barge, and the USS *Tarawa*.[68]

Logistics for supplying the rearming site itself are daunting. If airlift is used to expedite VLS reloading, more than four dedicated C5 sorties will be needed to fully rearm a single AEGIS CG with TBMD and TLAM munitions.[69] What must be borne in mind, though, is that the AEGIS ship thus reloaded can then protect that same airfield in order to allow the 128 C5 sorties required to move a Patriot battalion into theater.[70] Furthermore, the Joint Force Commander will still be confronted with the reality of competing missions, only one of which is TBMD.

The logistical challenges associated with rearming VLS combatants in theater clarify the reason that current CONOPS tend to state that follow-on loads of VLS munitions will arrive in the magazines of deploying combatants. If VLS reloading or load "tailoring" via cross-decking will thus be difficult in an engaged theater of operations, then the initial loadout with which a VLS AEGIS ship departs home port is crucial to the combat effectiveness of that ship.

By 2008, there will be over 5,500 VLS cells arming the AEGIS combatants of the fleet.[71] Competing for this finite space will be SM2 Block IVA, SM3, 4-missile packs of Evolved Sea Sparrow (ESSM), vertical launch ASROC (VLA), Tomahawk TLAM-C and D variants, and perhaps SM4 Standard load attack missiles.

Only one of these missiles, the Navy Area SM2 Block IVA, is a true multimission weapon, with capability against aircraft, cruise missiles, and theater

ballistic missiles. With single-mission weapons, however, initial VLS loadout is a zero-sum game. For every missile loaded to support Mission A, Mission B loses capability.

One of the historical strengths of naval forces has been their ability to carry out a variety of missions. The maritime component is versatile, flexible, mobile and survivable, an adaptable "force package" for the JFMCC to task as required. There is thus a strong institutional prejudice toward mixed-mission loadouts for VLS AEGIS ships. These combatants were designed and built at great expense to do many missions and to do them all well. Furthermore, the true nature of any regional contingency seldom becomes clear before battle is joined. If maritime forces are to be first on the scene, then they must be capable of responding immediately to a variety of hostile challenges.

This is all true—to a point. Mixed loadouts are appropriate, but the theater CINC and the officers he may potentially task as Joint Force Commander and JFMCC should use peacetime intelligence preparation of the battle space as a tool to best match loadout to potential tasking for combatants *prior* to deployment. By 2008, this will become a far more complex process than that which determines the current, common 70/30 loadout split between SM2 and TLAM.

For example, if there is a significant long-range TBM threat in theater which can be leveraged by forward-positioned NTW, then consideration should be given to increasing the SM3 load percentage in AEGIS CGs deploying to that theater. The "Chinese puzzle" problem of shuffling VLS canisters around the battle group could be solved by shifting the TLAM and Navy Area missiles thus displaced to AEGIS DDGs, which in turn would be tasked with the brunt of potential Navy Area TBMD and strike missions. Every AEGIS combatant would retain the multimission Navy Area interceptor, but would otherwise "load the dice" with the single-mission missile best suited to a given ship type and the unique challenges of a particular deployment in a particular theater of operations.

Command, Control, and Intelligence

Issues of command and control contrast with issues of logistics because C2 does not answer easily to the rational power of numbers. Considered in isolation, logistical problems lend themselves to mathematical solutions, to the computational clarity of operations analysis. This is not true of command in war. Van Creveld writes: "So far, I have spoken of command as if it were solely a rational process (or rather, a combination of processes) in which information is used to orchestrate men and things toward performing their missions in war.

This is not strictly true, however, since war is an irrational business par excellence."[72] A significant danger when studying any new and evolving form of warfare is to be seduced into oversimplification, into generalized force-on-force comparisons, into enumeration of technical characteristics rather than operational complexities. The purpose of discussing TBMD command, control, and intelligence issues is to muddy the waters upon which the preceding logistical arguments float, and thus prepare the reader for the complex realities of warfighting that follow.

The exercise of efficient and effective command and control in war finds its counterpart and helpmate in the decision-theory art of "satisficing,"[73] a dynamic, ever-evolving cycle of demand and compromise which attempts to counteract the fog of war by resolving internal conflicts. These may be conflicts of mission, conflicts of tasking, conflicts of rank, conflicts caused by lack of data, or even conflicts stemming from information overload. The commander who exercises effective command and control is the commander who can best resolve the incessant tension between conflicting missions and limited means, a tension which is inherent in all military operations.

This tension will affect the Joint Force Maritime Component Commander at three levels: above him, at the JFC/CINC/NCA level, where theater ballistic missile defense will be highly visible; at the theater level, where the Joint Force Maritime Component Commander must work out initial TBMD plans in competition with other missions and prepare for the eventual shift of the AADC and/or JFACC roles ashore; and at the individual unit level, where the JFMCC must balance the importance and visibility of the TBMD mission with the distinctly limited number of naval platforms and interceptor missiles initially present in theater.

The resolution of these tensions associated with competing tasking and levels of command must take place under the rubric of mission, the overall intent of the CINC and Joint Force Commander. Finally, the potential impact of theater ballistic missile defense on that mission can only be evaluated through the rigorous execution and thorough understanding of the TBMD-related intelligence preparation of the battle space (IPB).

Political Nature of TBMD: C2 up the Chain of Command. The asymmetric power granted an aggressor through possession of TBM capability elicits an asymmetric response from those threatened by that power. The hundreds of ScudCap missions flown over the western desert of Iraq during DESERT STORM, the redeployment of Joint Special Operations Command (JSOC) special mission assets, and the dozens of C5 sorties flown to support a rudimentary TBMD area defense capability for Israel stand as testimony to this.

In 2008, the captain of an NTW-capable AEGIS cruiser positioned for ascent-phase intercept off the North African littoral could well find his single ship defending many of the capitals of southern Europe against attack by nuclear, biological, or chemical-capable TBMs.[74] This degree of threat, and the potential leverage of a single ship against that threat, will resonate up the chain-of-command in a way that the conventional air warfare mission never has. The Joint Force Maritime Component Commander must anticipate both support and interference commensurate with that resonance. How he deals with this inevitable phenomenon will directly affect his ability to support the Joint Force Commander, both with theater ballistic missile defense and with the other essential missions under his purview.

The netted battle management command, control, communications, computers, and intelligence (BMC4I) architecture assumed for a 2008 scenario will be vital to the efficient execution of the theater ballistic missile defense mission, but will inevitably affect the freedom of action of every level of the chain of command, making each subject to the guidance of all levels above, delivered in real time. Nelson could not have gotten away with holding his long glass to his blind eye if First Sea Lord Sir John Jervis had been sitting at a joint maritime command information system (JMCIS) terminal in Whitehall.

Indeed, to chafe at such centralized oversight has been an identifying trait of naval components throughout history. In the joint context, however, and especially in regard to joint theater ballistic missile defense, centralized, high-level "meddling" is both inevitable and understandable, for theater ballistic missiles are uniquely "political" weapons and have been so since the first V-2s smashed into the streets John Jervis once walked.

In the simplest terms, the mission of theater ballistic missile defense forces is to safeguard areas on the theater defended assets list (DAL) as prioritized by the CINC and Joint Force Commander. It is instructive that at National Test Facility Wargame 95B, whose TBMD portion simulated the defense of southern Europe against a WMD-capable TBM threat from the Levant and North African littoral, the first priority on the DAL was the regional national capitals target set, followed by major friendly population centers, with the defense of military targets a distinct third. Similarly, in the Global '95 game, limited NTW assets were completely expended in the Northeast Asian MRC defending the population centers of an essential ally at the direction of the National Command Authority.[75] These game results acknowledge the primacy of political centers of gravity in the TBM target set. The Joint Force Maritime Component Commander must be prepared to deal with the consequences.

Military forces possessing unique capabilities related to political centers of gravity tend to see their command and control architectures "stovepipe" toward centralized control by the National Command Authority. Strategic nuclear forces assigned to the United States Strategic Command (USSTRATCOM) or special mission units assigned to the Joint Special Operations Command (JSOC) of the United States Special Operations Command (USSOCOM) come immediately to mind. Naval forces have traditionally been resistant to such centralized consolidation of control, as seen in the debate over the ballistic missile submarine force during the post-Cold War creation of USSTRATCOM, the preservation of a degree of naval special warfare autonomy within USSOCOM, and, during the years that nuclear Tomahawk was deployed, the designation of that weapon as "tactical"—thus keeping the ships and submarines carrying it under Navy control.

To this day, naval doctrine espouses flexibility and individual initiative based on a clear understanding of mission. Indeed, *Naval Doctrine Publication 6,* "Naval Command and Control," cites historical precedent and states:

> Armed with an understanding of their senior's intent, the subordinate commanders were expected to conduct a wide range of operations on their own initiative. This style of command has been an enduring characteristic of naval operations and continues to distinguish the way naval commanders exercise command and control today.[76]

While acknowledging the spirit of independent initiative that lies at the soul of the naval service, the Joint Force Maritime Component Commander must grapple intellectually with the fact that modern command and control technology will inevitably erode that independence. In the specific arena of naval TBMD, especially high-leverage Theater Wide defense, that erosion will be accelerated due to the overarching political importance of particular targets to be defended. NTW assets may well come under the direct control of the Joint Force Commander, the CINC, or even the NCA; and as a theater matures, the JFACC and AADC may well be consolidated—potentially putting those same ships at the beck and call of an Air Force general ashore.

The details of such command relationships represent novel arrangements for both the Joint Force Maritime Component Commander and the surface Navy. The potential of naval TBMD is so great, though, that conventional notions of naval autonomy must be respected only insofar as they bring to bear the maximum effect of these new capabilities. As with other naval assets of recognized political or strategic importance, such as ballistic missile submarines since their introduction and carrier battle groups in recent decades,

commanders of naval surface assets may well have to adjust familiar arrangements to cope with new challenges. Theater ballistic missiles represent such a challenge in our age, a challenge which may require development and acceptance of new command and control relationships for maritime forces. To do otherwise is to risk marginalizing key naval capabilities in future conflicts.

The degree of connectivity and consultation demanded by the NCA for the theater ballistic missile defense mission may well exceed that now associated with sensitive special operations and peacetime TLAM strikes. When tasked as Area Air Defense Commander, the Joint Force Maritime Component Commander will be responsible to the Joint Force Commander for TBMD active defense plans. These plans will have their basic grounding in the theater-specific TMD CONOPS, which in turn will be based on joint doctrine and joint CONOPS.

CONOPS are by their very nature quite general, and plans, by necessity, are specific. The ability to articulate the plan up the chain of command will be an essential skill for the Joint Force Maritime Component Commander if he is to preserve a degree of autonomy. Specific TBMD knowledge above the theater level may well be based on CONOPS, leading to a constant chorus of secure SATCOM and teleconferencing in search of clarification and detail. The Joint Force Maritime Component Commander cannot avoid this, and should not attempt to forestall it by flooding unsolicited detail up the chain in a preemptive attempt to remain unfettered. He must plan for an ongoing, interactive dialogue unique to this particular mission, a dialogue perhaps best handled by a dedicated TBMD cadre on his staff.

Much as in special operations or TLAM mission planning, a small team set up as a dedicated node of corporate knowledge at every level of the chain of command can facilitate understanding and clarity of purpose, and decrease confusion and repetition when discussing the mission in real time. If the Joint Force Maritime Component Commander can thus aggressively and lucidly detail his plan and his progress up the chain, he decreases the very real risk that he will be bypassed down the chain by the NCA giving rudder orders directly to the captain of an NTW AEGIS cruiser.

Competing Missions: C2 at the Theater Level. During an emerging crisis in an undeveloped theater, facing a TBM-armed, WMD-capable adversary, the Joint Force Commander may assign duties as both Area Air Defense Commander and Joint Force Air Component Commander to the Joint Force Maritime Component Commander. If substantial U.S. Air Force assets are already positioned in theater, the JFACC could well be separate, although the Joint Force

Maritime Component Commander might retain Area Air Defense Commander responsibilities due to his force's naval theater ballistic missile defense capability and mobile, survivable, carrier-based air power. As operations progress and the theater matures, the cycle may be completed by the Joint Force Maritime Component Commander relinquishing Area Air Defense Commander duties to the JFACC ashore. The point of these permutations is simple: if the JFMCC is likely to be the pivotal component commander in the crucial early stages of a conflict involving theater ballistic missile defense, then he must pay particular attention to the complex relationship and competing operational prerogatives of the Area Air Defense Commander and the Joint Force Air Component Commander.

When facing theater ballistic missiles, the moment of greatest danger occurs early in the conflict, due to the likely mismatch of offense and defense. The enemy TBM inventory will be at its maximum, while U.S. theater ballistic missile defense assets will for the moment be limited to those deployed in theater, unless a lengthy (and unlikely) pre-hostilities period has allowed an unopposed friendly force buildup. "Naval TBMD provides the earliest capability just when the heaviest TBM attack intensity is likely, and when other TBMD systems are still en route or present only in small numbers."[77] Such a "window of vulnerability" starkly highlights the conflicting missions of the JFACC and AADC, a conflict which the Joint Force Maritime Component Commander must be able to resolve.[78]

The basic dichotomy is that of offense and defense. The nature of modern offensive operations drives air planners to seek diverse target sets that have a synergistic effect when struck simultaneously (e.g., local C2 nodes in combination with a regional power grid). The goal is to enhance combat effectiveness by conducting parallel operations to the full depth of the theater, shocking the enemy with a pulse of power rather than by incremental attacks delivered sequentially. In pursuit of decisive concentration, this style of operation demands a certain "critical mass" of aircraft and cruise missiles in order to bring an adequate weight of metal to bear on enough targets in a sufficiently short period of time. The Joint Target Coordination Board and the Joint Target List are established to ensure the optimum employment of this critical mass.

However, in the operational circumstance where the Joint Force Maritime Component Commander is most likely to be designated as JFACC and Area Air Defense Commander, available strike assets will by definition be limited, primarily to the aircraft on the one or more carriers in theater, and the Tomahawk inventories in the VLS magazines of their escorts. These same

VLS-capable combatants will be desperately needed to redress the early theater ballistic missile defense window of vulnerability, as will be JFACC-controlled TBMD attack operations sorties.

The joint target list and the defended assets list will thus be set in opposition to each other. It will be up to the triple-hatted JFMCC/JFACC/AADC to cut this Gordian knot while simultaneously discharging traditional naval component missions such as SLOC protection, CV escort, maritime interdiction force (MIF) operations, USW, MIW, and protection of MPS assets as they arrive in theater. The challenge is accentuated by the inevitability of limited assets and exacerbated by the improbability that these diverse tasks will be geographically compatible for any given placement of the force assets.

Strike units and those conducting reconnaissance and USW/MIW sanitization of potential amphibious objective areas will tend to be well forward. NTW assets will patrol large "areas of negation," TBMD launch baskets covering thousands of square miles, dynamically determined and continuously reshaped by automated planning tools evaluating enemy TBM disposition, capability, and an optimum defended footprint.[79] Units protecting the DAL as Navy Area platforms will be restricted to rigidly limited patrol areas as goalkeeper for a particular target. Ships conducting escort and logistics support missions must be able to range the full depth of the theater.

The Joint Force Maritime Component Commander is unlikely to have enough ships, aircraft, and VLS cells to fully service the joint target list, provide initial defense-in-depth to the DAL, and prepare both his forces and an AOA for power projection operations ashore. He must, in effect, continually prioritize and subject to risk analysis all of his subordinate missions as JFACC, AADC, and Maritime Component Commander in order to best support the overall intent of the Joint Force Commander.

The JFMCC must be utterly forthright in assessing his own capabilities and evaluating the tasking given him from above. If theater ballistic missile defense is a priority, and his forces are spread too thinly over the DAL, he must call for either more assets or a reduction in the defended target set.

To this end, a precise delineation of mission, from the CINC through the Joint Force Commander to the JFMCC, is essential, so that the Maritime Component Commander may reconcile his conflicting responsibilities through a clear statement of commander's intent. That statement also will provide guidance and continuity when and if the Joint Force Air Component Commander and Area Air Defense Commander duties shift to other service components later in the campaign.

Some of the lessons thus incorporated are directly applicable to the NTW mission.

At least one real-world TLAM contingency mission in recent years would have failed if assigned to a single ship. Last minute combat systems casualties were operationally overcome by the use of a mutually supporting backup shooter, who successfully fired the mission. The same principles apply to high-leverage, high-visibility NTW tasking. If the ship designated to engage cannot get the shot off—for whatever reason—a second cruiser sharing the TBM track via the JCTN can respond immediately in accordance with established AEGIS TBMD doctrine and thus preserve as much of the intercept/kill evaluation/refire decision timeline as possible.

With so much potentially riding on NTW, the JFMCC should give serious consideration to the TAG team concept. The extra assets committed may dramatically increase the likelihood of mission success.

Amphibious Objective Area Protection: USMC Concerns. While the unique characteristics and challenges of Navy Theater Wide defense help illustrate the central TBMD theme of resolving conflicting missions and limited means, Navy Area defense must not be neglected. It is a complementary rather than an inferior capability, and it is essential to the pivotal TBMD tenet of layered defense. In specific areas of the Joint Force Commander's operational concept and intent, it may indeed dominate TBMD planning. Amphibious operations represent just such an area.

As DESERT STORM demonstrated, amphibious assault is not necessarily required for successful power projection against a littoral objective. Indeed, as critics of the Marine Corps never tire of pointing out, a major opposed landing has not been attempted by U.S. forces since Inchon, which by 2008 will have receded more than half a century into history. However, the successful conclusion of conflict will often require the introduction of ground forces onto hostile territory, and those ground forces will increasingly require protection from both air-breathing threats (e.g., aircraft and cruise missiles) and ballistic missiles, protection which Navy Area ships can provide until land-based systems are in place to shoulder the defensive burden.

In a perverse twist of operational logic, the gradual spread of TBMs and persistent proliferation of weapons of mass destruction may in fact revive the utility of some types of amphibious operations. One of the centers of gravity which WMD tend to hold at risk is the power projection force itself. Large, relatively fixed, land-force buildups, such as took place in Saudi Arabia prior to the beginning of the DESERT STORM ground war, are clearly vulnerable if

The TAG concept, however, has operational value that is greater than the sum of its parts for reasons that go beyond mutual defense and enhanced TBM engagement. The mundane realities of required maintenance, systems limitations and real-world reliability are equally important.

The essential sensor for naval TBMD engagements until well into the next century will be the SPY radar. Versatile, capable, and reliable, various versions will have been in service with the fleet for more than twenty years by 2008. Like any complex sensor, though, SPY requires maintenance. The primary radar of an AEGIS ship is not brought on line at the beginning of a deployment and secured six months later. The systems test officer (STO) on a cruiser would like a few hours out of every seventy-two with the radar down for maintenance. Various "work-arounds," such as shutting down the forward or aft arrays only, and then maneuvering the ship to ensure coverage of the likely threat axis, are possible; but these are stopgap measures, and the system will eventually degrade.

Thus, if a single ship is assigned to an NTW patrol area, the JFMCC is confronted with a simple but serious dilemma. In order to remain fully mission capable, SPY must shut down periodically. Whenever it does, a portion of the DAL is put at risk for the duration of the maintenance period. Furthermore, if the NTW ship is optimally stationed well forward, an adept enemy may well detect the moment that SPY secures and thus be able to exploit the resulting window of vulnerability of both the DAL and the ship itself.

The cruiser has redundant systems which will decrease its own vulnerability, such as the SPS-49 air search radar, EW and chaff systems, CIWS, Harpoon, and the SPQ-9 radar incorporated in the Mk86 gun fire control system (GFCS). Good technicians, given warning, can also bring SPY out of maintenance quickly. However, the timeline of TBMD engagements is so challenging that even the most agile combat systems team may not be able to bring the radar back up and generate the required high-power waveforms quickly enough once a TBM launch is remotely detected and cueing data is passed to the ship.

Two ships in mutual support can decrease the impact of both planned SPY maintenance and the inevitable, unexpected component failures which occur in even the best maintained complex combat systems. Additionally, the redundant radar coverage thus provided will allow continuous NTW coverage during evolutions such as LAMPS launch and recovery, and underway replenishment, all of which require temporary degradation of SPY coverage by the ship involved.

Finally, the concept of a backup shooter for critical launch operations has been validated for years by TLAM CONOPS. TLAM pubs such as the *NWP 3-03.1* series serve as useful examples of how a related mission has been exhaustively analyzed and addressed in light of actual operational experience.

available for horizon search and other functions. This is not a new phenomenon—but the unique demands of TBMD tend to exacerbate the problem. A Navy requirement for TBMD enhancement of the AEGIS combat system is the ability to perform TBM engagements and self-defense concurrently; but TBM tracks will still require a significant percentage of total radar energy and processing power.

The human factor must also be considered. If a given NTW ship is responsible for the defense of a dozen key political targets and population centers on the DAL, all threatened by the WMD-capable missiles of a bellicose regional power, the attention of the CIC watch team will understandably gravitate toward the TBMD mission. If it does not, vociferous SATCOM consultations between the JFMCC and the cruiser CO will make it so. Training, doctrine, and deckplate professionalism can resist—but probably not overcome—such tactical tunnel vision. Under these circumstances, it will be prudent to have a heavily armed partner helping with the close-in threat.

The scouting and USW capability inherent in the dual helicopter SH-60 LAMPS detachment organic to each cruiser, plus LAMPS HAWKLINK, the joint data net, TBMD cueing from space-based sensors, and the track-sharing capability of the CEC-derived JCTN, will allow effective mutual support from well over the horizon. The lower the non-TBM threat, the more this baseline can be lengthened. Such separation of TAG platforms allows extended cooperative tracking of TBMs, as shown in the RED TIGRESS test of 1993,[94] the USACOM JTF-95 TBM exercise in August 1994 and cooperative engagement capability workups of the *Eisenhower* battle group,[95] and more recent PACFLT extended tracking exercises during 1995.[96] The resulting increased tracking time will facilitate multiple NTW shot opportunities and improve the timeline for kill assessment. If, for some reason, space-based TBM launch cueing is not available, cooperative tracking by NTW ships will be vital in order to preserve an engagement window constrained by the time lost between TBM launch and first detection by the forwardmost SPY radar.

Looking toward 2008, evolutionary advances in enemy TBM technology will likely reduce reentry vehicle radar cross-section. Cooperative tracking by NTW ships on a widely spaced baseline can help overcome the RCS challenge posed by more advanced high-ballistic-coefficient ("skinny and pointy") separating RVs, by simultaneously radiating multiple aspects of the target and using a track derived from the strongest return. Such a capability also helps hedge against the eventual deployment of penetration aids on more advanced TBM systems and will facilitate kill assessment against any TBM following intercept.

prepackaged in discrete units—ships. With a limited number of ships available in theater, and a limited number of potential reinforcements to bolster them, the JFMCC must constantly weigh the relative leverage a given mission allows him against the number of ships required to accomplish that mission.

In a force-on-force analysis, Navy Theater Wide TBMD capability often appears to give the JFMCC great leverage, with a single ship defending multiple targets on the DAL. That leverage, though, must be tempered by the real-world complications of other warfare areas and multiple hostile threats, the impact of systems reliability issues, and the concomitant requirement for systems maintenance even in the face of the enemy.

That said, the defensive leverage of NTW remains and is potentially so great that the JFMCC may wish to consider providing a robust, survivable capability through the use of dedicated, mutually supporting assets, a TBMD Action Group (or TAG Team). Such a concept is really a specialized maritime version of the generic Ballistic Missile Defense Organization construct of the active defense group (ADG), "comprising relatively autonomous packages of both sensors and shooters. . . . In general, these ADGs were assumed to possess all of the capabilities required to detect, acquire, track, engage, and kill hostile missiles."[93]

The advantages that accrue when two NTW ships are assigned to a single NTW patrol area are significant. Intuitively obvious is the doubling of VLS inventory and the potential for mutual support in a multithreat environment. Additionally, if continuous NTW defensive coverage is to be guaranteed, the vital issues of systems maintenance and equipment casualties can be dealt with meaningfully *only* by two identical platforms operating in concert.

The NTW mission is best carried out in proximity to the enemy. A littoral foe sufficiently advanced to field long-range TBMs can probably comprehend the significance of SPY radar emissions detected by his coastal EW sites. Depending on the nature of the aggressor and the characteristics of the operating area, threats posed in opposition to an NTW cruiser could include diesel submarines, ASCM-armed fast patrol boats, mines, shore-based ASCMs, strike aircraft, or even unconventional stratagems such as special operations forces deployed from merchant vessels, fishing craft, minisubs or fast motorboats. As in aerial combat, diverse challenges can best be met by two platforms covering each other while executing the primary mission.

Secondly, the advantages of mutual support are defined not only by the nature of the threat, but also by the nature of the sensors critical for TBMD. SPY radar energy is a finite quantity. As more and more of it is "squeezed" into the specialized waveforms required for TBM detection and tracking, less will be

Decreasing the inherent friction between NTW and strike will require the close cooperation of the AADC and the JFACC, respectively responsible for TBMD and TLAM operations. If these duties all devolve upon the JFMCC early in the conflict, so much the better, one might say, for this would allow unity of command to foster unity of effort. A "first-cut" on the degree of mission overlap can be achieved by comparing the most likely TLAM launch baskets with the most likely NTW areas of negation as established by the Tomahawk mission distribution system theater mission library, peacetime intelligence preparation of the battle space, and the automated TBMD planning tool resident in the JPN. If these expanses of ocean are mutually exclusive—in effect, Venn diagrams which do not overlap—then strike evidently will be a dedicated mission perhaps best apportioned to a mix of DD-963 and DDG-51 combatants, with NTW tasked to CGs. Ideally, these cruisers will have been loaded out with a reduced TLAM VLS cell count in order to increase their SM3 capacity.

If, however, there is significant launch basket/area of negation overlap, the AADC and JFACC have something to work with and can attempt an accommodation. For example, how is the DAL affected if NTW ships patrol only that portion of an area of negation which overlaps TLAM launch baskets? How can the JFACC adjust Tomahawk missions so that the size of those launch baskets is increased to give maximum coverage of NTW patrol areas?

If NTW ships can still patrol effectively within a TLAM launch area, the JFACC and his Tomahawk strike coordinator can maximize the utility of such TLAM as remain in the cruiser VLS cells by assigning these ships strike missions which allow large launch baskets. TLAM mission profiles which use GPS primary guidance, or which do not require enhanced time-on-target control or precision strike Tomahawk (PST) capability, and which do not require maximum range flight past the first preplanned waypoint (FPPWP), tend to increase the size of the useable launch basket.[92]

Neither strike nor NTW can be considered in isolation. When their distinguishing sources of friction (launch baskets versus areas of negation) are rigorously compared, areas of friction can perhaps be resolved into areas of overlap, with multimission capability thus enhanced. The JFMCC must ensure that a comprehensive, cooperative comparison of mission characteristics and operational objectives is made, both at the theater level and by his subordinate commanders.

TBMD Action Group (TAG) Concept for NTW. The Maritime Component Commander's means to carry out a variety of missions come to him

In a theater where the TBMD mission will be leveraged by both NTW and Navy Area, logistical considerations of endurance and magazine capacity will cause the CG to be favored for NTW tasking. Reduced radar cross-section and improved track processing in the littoral environment provided by the SPY-1D(V) radar may cause the DDG to be favored for the AOA support role. For this mission, the DDG's lack of organic helicopter capability is offset by the ability to provide support and an agile staging deck for the diverse rotary wing assets of the ARG. The DDG's less robust fuel endurance, which could be a critical liability on detached NTW patrol, may be of no consequence when operating with the battle group in the CV escort role. Both classes of AEGIS ship are versatile, powerful, and highly capable. The JFMCC and his battle group commanders must constantly review the overall intent of their tasking and ensure that class-specific capabilities are focused to best effect.

When potential friction is inherent in a mission rather than being a by-product of platform characteristics, the JFMCC must look more closely. Two critical missions that will conflict regardless of ship type will be NTW TBMD and TLAM strike. Both require ships forward-positioned in circumscribed launch areas, and both require dedicated, competing VLS capacity. Friction thus exists at the outset and must be resolved by the JFMCC and his subordinates.

This inevitable operational friction between strike tasking and NTW defense will be severe. The improved WDU-36 warhead fitted to the Block III TLAM-C is still only a 1,000 lb.-equivalent weapon and is therefore most effective in massed strikes by one or more ships, potentially using a significant portion of their available VLS capacity. Launch timelines and time-on-target windows tend to be rigorous in order to achieve maximum effect from a given "pulse" of striking power. Thus, timely arrival in designated TLAM launch baskets is critical, closely monitored by the JFACC and his Tomahawk strike coordinator (TSC). The resulting ship-wide tactical focus on strike, from receipt of the first INDIGO tasking message until the last Tomahawk drops its booster and transitions to cruise flight, does not contribute to the expeditious execution of the equally challenging NTW mission.

Of course, the impact of TLAM on TBMD can be ameliorated by maximizing the use of DD-963 platforms as strike assets; but unless the conditions of the conflict are extremely permissive, or enemy capabilities distinctly limited, the *Spruance*-class destroyers will still require AW protection. Furthermore, by 2008, the lead ship of this revolutionary class will have served for more than three decades. Increasingly, the preponderance of the fleet's VLS capability will be carried by AEGIS ships.

and MIW. For NTW ships in far-forward ascent phase intercept areas of negation, the capabilities of enemy fast patrol boats, coastal surveillance, maritime strike, and shore-based ASCM batteries must also be considered. For all AEGIS ships, historical data regarding local meteorological impact on SPY radar propagation and Navy Area interceptor infrared seeker performance should be included in the planning process. IPB is iterative, a constantly evolving game of "what if?" designed to reveal answers to issues driven by enemy capabilities and actions.[91] Comprehensive intelligence preparation allows the Joint Force Maritime Component Commander to better anticipate possible enemy courses of action and to exercise effective command and control to counter them.

Warfighting

If the great strength of naval combatants lies in their innate ability to perform many different missions, then one of the greatest challenges facing the Maritime Component Commander will be to prioritize those missions in support of the Joint Force Commander's operational intent, and apportion his limited assets accordingly. To do so, both effectively and efficiently, the JFMCC must have a clear understanding of the operational capabilities and limitations of his combatants, and the zones of friction which exist between their competing missions.

Reality of Competing Missions. The degree of mutual interference between competing missions varies with the protean nature of conflict. A DDG providing Navy Area protection to an amphibious objective area may also be able to support Marines ashore with its 5-inch gun, and fire SM2 missiles to destroy enemy aircraft counterattacking the beachhead. That same DDG, tasked to provide Navy Area coverage for a vital port while land-based TBMD systems are off-loaded and made ready, may not be able to support the JFMCC with any other mission.

Such tradeoffs are difficult to anticipate and must be dealt with as operations progress and requirements become clear. What operational planners can do in anticipation of regional contingencies is to try to illuminate constants, "first principles" of mission overlap and conflict that do not tend to vary (or tend to vary less) as the specifics of a given contingency change.

One such constant is the mission capability of different platforms. Missions themselves are mutable, but ships and their associated systems are known and quantifiable. Conflict and friction between overlapping missions can be decreased if an optimum match between platform and mission is sought.

control engagements only under rare circumstances, such as defending against known WMD."[85]

The theater ballistic missile defense plan should seek to position NTW shooters as far forward as possible to shorten the TBM-launch to first-intercept timeline. NTW kill assessment will depend on "tactical telemetry in all missile stages and recording of essential AEGIS systems data. Additionally, it will include telemetry of kill vehicle seeker imagery to the firing ship."[86] Consummation of an NTW intercept can take several minutes. Developing a plan to take advantage of early intercept opportunities will increase time available for kill assessment, and decrease pressure on other units to launch.

Preplanned responses to a "positive-no-kill" determination should follow sequentially in accordance with doctrine all the way to the area defense endgame so that no TBMD shooter along the target's trajectory is forced to fire-by-default and thus chance wasting missiles. "Decisions could be based on pre-established algorithms for maximizing engagement opportunities against specific targets or for maintaining balanced inventories."[87]

If correctly designed and promulgated to TBMD units through mission-style orders, the Area Air Defense Commander's theater ballistic missile defense plan should be capable of execution with minimal direct intervention. The AADC is then free to coordinate decentralized execution of the plan by remotely monitoring remaining VLS inventories, observing the enemy level of effort against the DAL, and realigning his forces as necessary as the battle progresses.

Intelligence Preparation of the TBMD Battle Space: "The days, weeks and months preceding hostilities must be used to plan, prepare and organize for the execution of TMD active defense, which is accomplished in terms of minutes and seconds."[88] Execution of the theater missile defense intelligence preparation of the battle space is the responsibility of the Area Air Defense Commander.[89] If the Joint Force Maritime Component Commander is tasked as the AADC, this vital work will devolve upon him to include the complex TBMD subset of theater missile defense intelligence preparation.

As component commander for the theater ballistic missile defense assets likely to be first committed, the Joint Force Maritime Component Commander must use intelligence as a vital adjunct to enhance his ability to exercise effective TBMD command and control. The Naval Doctrine Command cites five elements comprising IPB:

- *Battle space evaluation* defines the area of operations and focuses intelligence assets on the battle space.

duty, maritime interdiction force patrol, and TLAM strike may not be in position for either Navy Area or NTW tasking. Finally, real-world equipment performance must be taken into account. The demonstrated reliability of even the best complex systems is somewhat less than 100 percent.

Thus, once the Joint Force Commander and Joint Force Maritime Component Commander have completed their initial appraisal of the Defended Assets List and Joint Target List, and have decided what portion of the available naval component can be dedicated to theater ballistic missile defense (or can conduct TBMD tasking while executing other missions), the JFMCC will find his actual engagement capability to be much more modest. When set against the likelihood of a preemptive main effort by enemy TBM forces, the need for rigorous fire discipline becomes obvious.

With individually guided interceptors such as SM2 Blk IVA and SM3, the probability of kill, P_k, against an incoming target does not vary directly in accordance with the number of rounds in the air, as it would with VT-fuzed "dumb" projectiles from antiaircraft artillery. Blackening the sky with missiles may possibly boost P_k incrementally, but it will surely deplete VLS cells drastically. The netted C2 architecture projected for 2008 is correctly seen as the key to a solution for this problem; but the Joint Force Maritime Component Commander should reflect carefully on how he chooses to use the capabilities that the joint planning net, joint data net, and joint composite tracking net will give him.

The traditional naval response to limited SAM inventories has been close control of the inner air battle—in effect circling the wagons and having the Force Air Warfare Commander issue "take" orders. If the joint data net and joint composite tracking net are implemented as currently planned, the Joint Force Maritime Component Commander (as AADC) could conceivably do the same for the theater ballistic missile defense battle. This is not the intent of the netted C2 architecture.

The TBMD battle is likely to be fluid, dispersed, and sporadic, flurries of rapid launches followed by varying periods of quiet, as TELs attempt to relocate, rearm, and hide from attack operations forces. Fluid conditions in battle are best dealt with by tactical formations having good communications, a thorough grasp of doctrine, and mission-type orders that allow them maximum flexibility in achieving coordinated decentralized execution of the commander's intent. In the context of theater ballistic missile defense, fire discipline must derive from doctrine and planning rather than from centralized control by the Area Air Defense Commander. "The AADC will invoke positive control procedures to

Fire Discipline and Effective Defense: Unit Level C2. In future conflict, several factors may motivate aggressors to use their TBM capability early. First is the intuitively obvious theater ballistic missile defense window of vulnerability. TBMD interceptor inventory in theater is unlikely to be initially robust, especially when spread over a DAL encompassing political as well as military targets.

The other significant motivator for early TBM use is a relic of strategic deterrence theory—the threat of "use it or lose it."[80] In the Cold War context of nuclear-armed ICBMs, the increasing need to launch quickly and early in any given exchange was directly proportional to the enemy's hard target "silo-busting" capability. In the context of TBMs, the equivalent of silo-busting is attack operations, the pillar of joint TBMD that seeks out and destroys missiles, transporter-erector-launchers (TELs), and support vehicles on the ground.

Joint exercises such as the Roving Sands series show that much work remains to be done in this difficult area. However, evolving sensor-to-shooter capabilities, new systems such as the pod-mounted APG-76 synthetic aperture radar for attack aircraft,[81] and geo-predictive databases such as GALE (generic area limitation environment),[82] developed and deployed by DIA, all show that the relative immunity of the DESERT STORM-era Scud TEL is eroding quickly. Any potential enemy with a fundamental grasp of the open literature will appreciate that by 2008, U.S. attack operations capabilities will pose a significant threat to his TBM forces. Thus, if the correlation of offense and defense will be favorable to him before U.S. capabilities in theater can build up, and he understands that attack operations will become increasingly effective as those forces build up, he will be sorely tempted to launch early and often.

The initial JFMCC force structure for the 2005+ phase of NTF Wargame 95B showed an "AEGIS-rich" CVBG composition that included four DDGs and two CGs per battle group.[83] A nominal VLS capacity for such a force is easily determined. Credit 90 cells to each DDG and 122 to each cruiser. Allow four cells each for vertical launch ASROC, and apportion the remaining cells 70 percent/30 percent for SM2/3 and TLAM.[84] This gives 60 available non-TLAM cells in each DDG, and 82 in each CG. In a battle group with four DDGs and two CGs, the grand total will be over 400 VLS cells available for air warfare (AW) and TBMD missiles.

This is initially impressive, but deliberately simple-minded. Navy Area ships must, in effect, be collocated with the DAL assets they are defending, while Navy Theater Wide engagements are best conducted close to the TBM launch point in order to attempt intercept in the ascent phase. Ships assigned the many other missions of the Joint Force Maritime Component Commander, including escort

they fall within the range of WMD-capable TBM systems. Operational maneuver from the sea can give the Joint Force Commander potential alternatives.

A recent RAND Corporation study of the implications of regional nuclear proliferation states: "An overwhelming operational need is to engage the regional opponent with forces that can operate effectively from beyond the enemy missile range or independently of fixed bases."[97] Until the sea echelon is in place and actually assaulting the AOA, TBMD-capable amphibious power projection forces remain mobile, difficult to locate, and equipped for both active and passive defense against WMD. Once the assault begins, tactical and logistical agility are required on the part of the enemy in order to bring his WMD assets to bear on the AOA; more importantly, he will have to make the political decision to use weapons of mass destruction on an objective he is attempting to defend.

In some circumstances, then, the JFC may wish to employ operational maneuver from the sea. To do so with confidence, he will require robust Navy Area TBMD assets. The Navy's Director for Theater Air Warfare (N865) has written: "We must be able to force our way ashore even under the threat or actual conduct of TBM strikes."[98] In this context, the Marines are primarily concerned with the threat posed by short-range systems such as FROG-series artillery rockets, the SS-21 mobile SRBM, and the powerful Russian-built SMERCH multiple launch rocket system (MLRS).

Roving Sands 95 demonstrated both the active defense potential of Navy Area systems,[99] and the difficulty of attack operations directed against the small, fast-moving SS-21's TEL,[100] while the challenge posed by modern multiple-launch rocket systems is so stressing that DoD has committed an advanced concept technology demonstration (ACTD) to address this problem.[101] Recent U.S./Israeli initiatives to accelerate development and deployment of the laser-based Nautilus anti-rocket defense system have shown promise. However, until such systems and the doctrine for their employment are proven and fielded, the solution to the extended-range (70km), course-corrected, guided-submunition-capable SMERCH[102] probably lies with enhanced attack operations and will thus remain under the purview of the JFACC rather than the Area Air Defense Commander. SS-21 and WMD-capable MRBMs targeted on the amphibious objective area will remain important targets for the Navy Area platforms supporting the amphibious operation.

Because of their kinematics, systems such as the SS-21 (with apogees below the minimum engagement altitude for SM3) are unlikely to be vulnerable to Navy Theater Wide defenses. These shorter range systems, however, will enter the SM2 Block IVA engagement envelope in the endgame. In 2008, the need for

defense of the AOA against both manned aircraft and cruise missiles will bolster the utility of the multimission SM2 Block IVA interceptor and will thus favor a VLS loadout of Navy Area (and strike weapons, such as the SM4) for the amphibious objective area support role.

In addition to its TBMD role, SM2 Block IVA represents a critical resource for the JFMCC in support of the multitude of naval missions that take place concurrently with TBMD. In 2008, the Navy Area interceptor will be the primary AW weapon for surface combatants riding shotgun for the CV, escorting MPS ships, and protecting underway replenishment groups shuttling throughout the theater resupplying TAG teams, MIF forces, CVBGs and one or more ARGs. Indeed, this overarching need for conventional force AW protection has been a primary driver for the Evolved Sea Sparrow Missile program, since the ESSM VLS 4-pack will provide enhanced self-defense for VLS platforms, while freeing up more launcher space for SM2/3 variants.

Platforms, though, will still be a critical concern for the JFMCC. If the defended assets list must be protected by several TAG teams, and an AOA has to be defended by Navy Area-capable DDGs, the Joint Force Maritime Component Commander may be confronted by very hard choices regarding CV and URG escort—especially if a credible diesel submarine threat exists. A recent Naval Institute *Proceedings* article sums up the aftermath of a hypothetical enemy submarine attack succinctly: "How will the naval component commander of the Joint Task Force explain that all of his other su face ships had valid missions at the time, and that he had no more available for anti-submarine warfare protection?"[103]

While NTW may get the most visibility in its political operational-strategic defensive role, Navy Area will be a key military operational-tactical enabler, allowing friendly forces to regain the initiative and take the offensive. The JFMCC's operational vision (and its associated timelines) must determine how he apportions his limited assets between these two vital categories of TBMD in order to provide the force protection necessary to complete his other missions and thus fulfill the operational intent of the Joint Force Commander.

Rules of Engagement

"ROE should not delineate specific tactics, should *not* cover restrictions on specific system operations, should not cover safety-related restrictions, should not set forth service doctrine, tactics, or procedures. . . . ROE should never be 'rudder orders,' and certainly should never substitute for a strategy governing the use of deployed forces, in a peacetime crisis or in wartime."[104] So wrote Captain J.

Ashley Roach, JAGC, USN, in his seminal 1983 article "Rules of Engagement." Twenty-five years later, the TBM challenge of 2008 may force the Joint Force Maritime Component Commander to reevaluate his approach to rules of engagement as they apply to theater ballistic missile defense.

Nature of Modern Conflict: Impact on TBM Defense. NWP 1-14M, *The Commander's Handbook on the Law of Naval Operations*, states that "U.S. rules of engagement reaffirm the right and the responsibility of the operational commander generally to seek out, engage and destroy enemy forces consistent with national objectives, strategy and the law of armed conflict."[105] ROE are shaped by operational, political, legal, and diplomatic forces,[106] and thus tend to evolve as these forces change over time. The unique operational and political characteristics of theater ballistic missiles will have a signal impact on the evolution of rules of engagement crafted to counter them.

The ease of deployment and speed of employment associated with theater ballistic missiles make the transition from peace to war potentially very rapid when these weapons are available to an aggressor. This destabilizing alacrity was noted in the early days of Great Power strategic deterrence, when the first ICBMs figured prominently in pessimistic "Bolt from the Blue" scenarios for Armageddon. If theater ballistic missiles can be launched with little warning, and once launched can proceed to their targets at velocities measured in kilometers per second, then the JCS standing ROE are likely to be in effect when an initial TBMD response is required. To be effective, that response must be reactive, rapid, and robust.

Standing ROE derive from the national right of self defense,[107] but once a TBM leaves its TEL, national rights, international politics, and missile kinematics collide. The missile itself may not pose any direct threat to a U.S. Navy ship capable of intercepting it, but in a "worst case" scenario, the potential humanitarian and political impact of a single WMD warhead striking a foreign capital or major population center may be so great that the NCA orders a TBMD engagement. Is this unilateral action to be justified under a loose interpretation of national self-defense as an effort to protect U.S. citizens or commercial interests in the area under attack? Perhaps, for "by the year 2000, thousands of U.S. nationals and substantial numbers of U.S. military forces will be in foreign lands and vulnerable to potential nuclear attack by nuclear-armed regional states."[108] If not, though, shall the NCA then cite the inherent rights of individual and collective self-defense enumerated in Article 51 of the U.N. Charter?

These questions are rhetorical, posed to focus attention on the unique nature of the problem. TBMs may be launched with little or no warning. The warheads they

are capable of carrying imply such potent physical consequences that a single successful strike could lead to a political victory for an aggressor. System velocities are greater than any other weapon except strategic ICBMs. System ranges are such that TBMs may cross the sovereign territory of uninvolved third parties en route to their targets. The obvious and troubling corollary is that interception of these same weapons may thus occur over these third-party countries, raining down post-engagement debris, unexploded warheads, failed interceptors, and possibly WMD component contaminants, ranging from fissile materials to lethal chemicals to biologic agents and toxins. Who will the world opinion hold accountable for the results: the aggressor—or an unsolicited defender?

Between now and 2008, the United States is likely to be the only nation with both the technological infrastructure and financial wherewithal to be able to develop and deploy naval theater ballistic missile defenses with more than a local point-defense capability. The NCA, CINC, JFC, and Joint Force Maritime Component Commander must carefully ponder the Pandora's box of political and legal issues thus opened.

NTW capability will vastly expand the regional leverage of the JFMCC. It also will vastly complicate the traditional "catalytic" employment of naval forces, described by Roach as overtly political tasking to "deploy units or fleets for the purpose of catalytic force without any clear objectives in mind . . . in the hope that the Navy will do something to resolve the situation and nothing to aggravate it."[109] Such tasking has always lain at the heart of the "naval presence" mission, but the time/speed/distance challenges inherent in theater ballistic missile defense may well move the execution of that mission back toward the spirit of the 18th and 19th centuries. In that era, the commanding officer of a warship was expected to act forcefully in the best interests of national policy as expressed in his sailing orders, without recourse to higher authority. In the age of theater ballistic missiles, as in the age of sail, that awesome responsibility may again devolve upon individual naval officers, who may be forced to carry out defensive actions that may make national policy without prior or real-time guidance from national leaders.[110]

Defensive Rules of Engagement must be Permissive. True "Bolt from the Blue" strategic attacks are rare. If war is a continuation of politics by other means, then there usually is a progression of political trail blazes leading up to the point of open conflict. That these markers are often seen clearly only in retrospect shows that, while the actual attack represents merely the culmination of gradually increasing political hostility, the physical ability to achieve strategic surprise has remained constant from Pearl Harbor to Kuwait City.

In order to counter the capacity for strategic surprise and political leverage provided to regional powers by TBMs, defensive rules of engagement must be permissive. Despite Roach's dictum decrying ROE system-specificity, rules of engagement for theater ballistic missile defense must be shaped by the unique nature of the threat. The high velocities attained by TBMs and the potential consequences of WMD warhead use argue the need for very rapid, if not automatic, engagement. Normally, the counterargument set in opposition to such a permissive and deadly defensive environment involves the challenge of deconfliction, how best to prevent the possible engagement of friendly assets. However, the very kinematics that make TBMs such challenging targets also aid deconfliction. Quite simply, unlike civilian and military aircraft, there is no such thing as a friendly incoming TBM.

Furthermore, the nature of cueing systems directed against ballistic missiles entails that the actual target, or most likely area of impact, becomes clear only as the hostile missile hurtles along its trajectory. As previously explained, interception is best attempted as early in that trajectory as possible, in order to allow time for kill assessment and follow-on shots. Thus, the ROE-driven decision to engage a TBM with a Theater Wide defensive system needs to be made before the exact target of the hostile missile is known. The United States would therefore be delivering a defensive stroke without being able to articulate precisely what or who was being defended. Alliances, coalitions, treaties or the lack thereof would be rendered moot. Clearly, the legal implications thus arising from the physical characteristics of offensive and defensive systems must be fully understood and dealt with before these defensive systems are ever deployed.

One possible approach would be a public declaration by the United States, based on the same legal reasoning that guides international law regarding piracy. The 1958 Geneva Convention on the High Seas states in part that "All states shall cooperate to the fullest possible extent in the repression of piracy on the high seas or in any other place outside the jurisdiction of any state."[111] The United States could argue that it and other nations have the right to contribute to the maintenance of international peace and security by unilaterally engaging theater ballistic missiles over the high seas and over land when outside the earth's atmosphere (exoatmospheric NTW intercept), for "there is no legally defined boundary between the upper limit of national airspace and the lower limit of outer space . . . [which] . . . begins at the undefined upper limit of the earth's atmosphere and extends to infinity."[112] Appendix B to Enclosure A of the current *Standing Rules of Engagement for U.S. Forces*, while beyond the classification of this paper, is instructive in regard to this issue.[113]

Such a permissive, unilateral national policy would have to be carefully couched in terms clearly deriving from the well-defined international right to repress acts of violence "on the high seas or in any other place outside the jurisdiction of any state." Navy Theater Wide engagements would take place over the high seas and/or above the airspace of any nation, since this system is both sea-based and exoatmospheric. Serendipitously, when potential TBM trajectories are plotted from likely aggressors to likely targets on the current world scene, 70 percent of those trajectories cross international waters at some point.[114]

Successful consummation of an exoatmospheric intercept harms only the TBM and the interceptor. The SM3 warhead itself is kinetic, with a net explosive weight of zero (excluding thruster fuel). It cannot engage an airliner, bomb shelter, or baby-milk factory. Additionally, exoatmospheric intercept tends to mitigate the effects of debris on the land below, whether friendly, neutral, or hostile. Weapons components, toxic compounds, wreckage and errant interceptors will all tend to fragment, scatter, and burn up upon reentry.

ROE issues involved with Navy Area TBMD are in some ways more easily resolved. The smaller defended footprint of the Navy Area system can make its use *de facto* an act of self-defense by a U.S. warship, especially when employed against weapons of mass destruction, which might only have to detonate in the vicinity of the ship in order to be potentially deadly to it and its crew. Unit self-defense provisions of U.S. ROE might thus suffice for initial employment of Navy Area systems in an emergency. Planned, coordinated use of this capability by the JFMCC during the course of a campaign, however, will require a degree of international political cooperation in the framing of specific U.S. ROE, as with the deployment of ground-based area-defense Patriot units to Israel during the Gulf War.

Offensive Rules of Engagement Will Be Restrictive. TBMD active defense is a relatively "pure" form of warfare, a contest of sensors and projectiles that, if ideally successful, results in no loss of life on either side. Its rules of engagement can therefore be written as permutations of the universal right of unit and national self-defense.

However, the in-flight interception of TBMs represents only one pillar of TBMD. In the course of a regional conflict, a strictly defensive strategy will almost certainly fail in the long run. Consequently, attack operations, the aggressive interdiction of TBMs, TELs, and their support infrastructure on the ground, will be a vital part of any campaign involving TBMD. Nonetheless,

under the purview of the JFACC, this portion of the overall TBMD mission is likely to have very different rules of engagement.

In the early stages of a regional contingency, the JFMCC may well find himself dual-hatted as AADC and JFACC, and will once again have to resolve fundamental operational conflicts within the TBMD mission, this time in regard to the ROE. The basic ROE dilemma that he will face with respect to attack operations is this: tactically, as AADC, he will need rapid, forceful action against the hostile TBM order of battle in order to decrease pressure on his limited active defense TBMD resources. Operationally, however, as JFACC, he is likely to find timely execution of attack operations initially prohibited by proscriptive, circumspect guidance from the National Command Authorities.

Consider, for illustrative purposes, that during NTF Wargame 95B, the Joint Force Commander:

a. Established initial TMD ROE as the right of self-defense.
b. Refined the ROE automatically to identify as hostile those ballistic missiles:
   1. Determined to originate from designated hostile nations.
   2. Determined to impact within the defended area of USEUCOM AOR.
   3. Assessed as part of the designated hostile nation operational order of battle (OOB).
c. Held that authorization for attack on forces of designated hostile nations within the hostile nation's borders remains with the NCA.[115]

Specific rules of engagement were (in operational sequence):

A. The interception of a ballistic missile in self-defense (own forces within kill zone of impact point) is permitted.
B. The interception of a ballistic missile, whose predicted impact is within own territory or designated friendly nations, is permitted. . . .
C. The attack on forces of a nation which has been positively identified as having launched ballistic missiles against own or designated friendly nations is permitted.
D. The interception of a ballistic missile, whose predicted impact point is within the territory of third nations, is permitted.[116]

Note that all active defense-related ROE are aligned with the principles of self-defense. The NCA, however, has retained specific control of authorization for attack operations. This clearly includes the use of TLAM or other strike assets available in the same AEGIS ships that may be tasked with the forward-positioned active defense NTW role. Thus, these ships are potentially

elements of the Joint Force, as directed by the JFC. He should prepare for the consequences of success. *He must plan to work himself out of a job.*

Joint TBMD Active Defense Capabilities to 2008

The sequential nature of the events just described is in part a rhetorical device, emphasizing the essential "enabling" role of the naval component in the phased execution of joint operations. Naval forces will clearly not carry 100 percent of the defensive burden until some magic moment in the campaign when Army, Air Force, and Marine TBMD assets are suddenly declared to be sufficiently robust and a time-out is called to effect transition of the main effort to shore-based elements.

As explained in the C2I section of chapter III, command and control of joint TBMD forces is a dynamic, mutable function. The JFMCC must understand the capabilities of non-naval systems and be able to incorporate such systems into his plan as they become available, often before these assets have built up sufficient organic strength in theater for their particular component commanders to be considered for overall command of the TBMD fight.

Several active defense systems currently under development by other services are likely to be operational by this study's target date of 2008. All are in some way complementary to Navy Area and Navy Theater Wide systems. Some provide unique capabilities not otherwise available to the Joint Force Maritime Component Commander. This section will give a concise overview of non-naval TBMD active defense capabilities anticipated to be available in 2008.

Army Active Defense. Like Navy TBMD, Army active defense will be built around a two-tier concept of defense-in-depth, with PAC-3 Patriot providing area defense and the Theater High Altitude Area Defense (THAAD) system covering the upper tier. PAC-3 replaces the GEM interceptor of the final version of Patriot PAC-2 with the smaller hit-to-kill ERINT (extended range interceptor) missile. ERINT is not a unitary kinetic weapon (like SM3), since a small ring-type tungsten projectile device called a "lethality enhancer" is fitted.[121] Like SM3, however, ERINT is intended to hit its target directly. Indeed, this new missile was selected in large measure because of its agile, hit-to-kill design. A multi-mach kinetic impact is one of the best nonnuclear kill techniques against the rugged chemical submunition warhead, a particular threat that has become the designated *bête noire* of TBMD cost and operational effectiveness analysis (COEA) lethality studies.

Much like Evolved Sea Sparrow's relationship to the larger, vertically launched SM2 series, PAC-3 ERINT is designed to use existing launchers—and also fits four missiles in the same size canister as a single PAC-2 GEM. Thus, lift requirements for Patriot formations remain unchanged and challenging—but each fire unit can bring to bear four times its previous complement of interceptors.

The defended footprint for PAC-3 will be greater than that of PAC-2 GEM, primarily due to improved kinematics of the ERINT missile. PAC-2's less efficient command guidance and track-via-missile (TVM) terminal homing are replaced in ERINT by inertially guided flight to a predicted intercept point, calculated by the fire control system and programmed into the missile before launch, followed by active terminal homing using a K_a band emitter.[122] As shown by the results of Roving Sands 95, however, the PAC-3 footprint will still be only a fraction of that for Navy Area SM2 Block IVA.

The Army's upper tier of TBMD protection will be provided by THAAD, the Theater High Altitude Area Defense system. The system itself is unique in the TBMD arena in that THAAD missiles can consummate intercepts both outside and inside the atmosphere. This fills a gap in the Joint Force Maritime Component Commander's naval TBMD engagement envelope. NTW is a strictly exoatmospheric system. As explained in chapter III, many common shorter range TBMs reach apogee within the upper atmosphere and are thus never engageable by NTW. Navy area defense is limited by the kinematics and aerodynamic controls of the SM2 Block IVA missile to a maximum intercept altitude of 35km. The resulting "engagement gap" is filled by the versatile THAAD.

Guided by updates from the ground-based radar, the missile uses a specially shielded IR seeker on a thruster-controlled kinetic kill vehicle to achieve a hit-to-kill intercept of its TBM target. The inevitable engineering tradeoff for the versatility thus offered by endo- and exoatmospheric capability is no capability against the TBM ascent phase. This remains the high-leverage province of the Navy Theater Wide SM3.

Like Navy Theater Wide, THAAD has been the subject of intense debate in regard to the ABM Treaty. Treaty compliance has been certified for UOES flight tests, but questions remain about the type and scope of cueing that future BMC4I architectures may provide to the highly capable, Strategic Defense Initiative-derived THAAD ground-based radar.[124] In 2008, any treaty-related restrictions on full BMC4I integration of this powerful sensor could have a significant effect on the overall TBMD capability of a joint power projection force.

For the JFMCC, then, the key points of interest regarding Army active defense in 2008 include:

- Capabilities and limitations of the evolved, improved Patriot PAC-3 lower-tier system. It is still lift-intensive and not tactically mobile (does not travel with maneuver elements of the ground force).
- Highly capable upper-tier system. THAAD fills the altitude gap in the joint TBMD layered-defense concept.
- THAAD lift requirements are far less challenging than those for Patriot PAC-3. A THAAD battalion with 4 fire units and 288 missiles will require 40 C5 sorties, or 94 C141 sorties.[125] This will be further ameliorated in 2008 by the contributions of the C17 airlifter.
- THAAD is not a substitute for Patriot any more than NTW can replace Navy Area. These are complementary capabilities, and indeed, current Army doctrine emulates dual-capable AEGIS ships by placing THAAD and Patriot in mutually supporting layered enclaves. As THAAD and Patriot formations begin to arrive in theater, the JFMCC must take this into account when configuring the ground-based coverage of an expanding TBMD plan.

In ideal circumstances, the incorporation of THAAD and Patriot PAC-3 in a fully integrated joint TBMD active defense plan will allow the JFMCC four layers of protection, with NTW positioned for ascent-phase and long-range midcourse intercepts, THAAD covering the upper-tier exoatmospheric and very-high-altitude endoatmospheric threats, Navy area defense providing robust capability below 35km, and fast, agile PAC-3 destroying leakers in the endgame.

Air Force Active Defense. Both during and after DESERT STORM, significant U.S. Air Force contributions to theater ballistic missile defense focused on the critical task of attack operations and the overall enabling capability of BMC4I, especially TBM launch detection and defense cueing via TALON SHIELD (and now ALERT). However, just as ascent phase intercept represents the highest leverage form of Navy Theater Wide active defense, boost phase intercept (BPI) is an emerging high leverage niche for Air Force active defense.

No BPI systems are currently fielded, but one concept shows potential for capability by 2008. Known as the Airborne Laser (ABL), a modified Boeing 747 transport will be equipped with a full TBMD BMC4I suite, an infrared tracking and laser ranging sensor—and a chemically fueled, weapons-grade laser firing through a trainable nose turret. When a TBM launch is detected and a boost phase engagement is ordered:

> Inside the 747, some 300 to 600 kilometers away, a tracking laser illuminates the first missile. Its reflected beam measures the distance between the missile plume and the red hot glow of the missile nosecone. A computer aboard the 747 determines the length of the missile body and the missile's location, course and direction. . . . Invisibly, a second, high-energy laser fires from the 747's nose, striking the first missile's body, which . . . explodes. . . .[126]

The ABL aircraft is self-deploying, although, like AWACS, it will require in-theater support, including secure, defended airfields. Additionally, refueling and maintenance facilities for the chemical laser will have to be provided. However, if the system works as intended, it can potentially operate outside enemy national airspace, conducting pre-hostilities antimissile deterrent patrols much like the NTW AEGIS cruiser described in chapter III. Once hostilities commence, the leverage of such a capable BPI system, especially against WMD-configured theater ballistic missiles, is unmatched by any other active defense capability, ensuring as it does that all WMD warhead components fall short of their intended targets, and optionally on the territory from which they were launched.

Characteristics of Air Force TBMD active defense thus of interest to the JFMCC in 2008 include:

- A significant degree of uncertainty as to how much capability will actually exist.
- The ABL can potentially offer a major non-naval TBMD capability to the JFMCC early in a conflict. If a not-too-distant air base is available for ABL staging, or if naval TBMD forces can secure an airfield "bastion" for ABL and logistics use, carrier aircraft can provide initial defensive escort for the laser platform and it can begin operations expeditiously.

With a fully integrated BMC4I architecture in place, ABL would be not only a primary active defense asset but also an invaluable sensor node, providing very accurate cueing to both other active defense systems and attack operations forces. It is thus a bold gamble. For Congressional review, it must show impressive results, on-schedule and on-budget. If ABL works as hoped, it will most certainly bolster the Air Force's "Global Reach, Global Power" contribution to national defense.

Marine Corps Active Defense. As the likely leading ground element of any power projection operation in a littoral theater, the Marines have specific requirements for organic TBMD active defense:

- Any such system must be relatively mobile to allow movement with Marine combat elements once they begin to advance from under the defended footprint of Navy Area TBMD ships protecting the amphibious objective area.
- The system must have capability against those enemy weapons seen as most threatening to Marines, threats such as tactical aircraft and short-range missiles, to include SS-21 and FROG-7. Medium and long-range TBM threats are not the primary concern and are generally considered targets for the more capable naval systems offshore.

With Patriot still insufficiently mobile and the HAWK-successor MEADS (medium extended air defense system—formerly CORPS SAM) in budgetary limbo, the Corps has continued its proud tradition-of-necessity of wringing every last ounce of value from its equipment—by modifying the venerable HAWK system for a limited TBMD role. Unfortunately, all HAWK missiles will have been retired from the active USMC inventory during 1998. However, the Marines are incorporating an improved BMC4I capability in the form of a mobile air defense communications platform (ADCP). The ADCP "receives TBM data from the TPS-59 radar and from other sources," including JTIDS/LINK 16 and the tactical data distribution system (TDDS).[127] JTIDS/LINK 16 will thus provide connectivity with the 2008-era joint data network, while TDDS receive-capability will allow receipt of JTAGS and ALERT data. Further modifications are planned to the TBM-mission-unique TPS-59 radar, modifying it to accept external cueing.[128]

A TBMD area defense system for ground forces which has the true tactical mobility needed by the Marines will not be fielded until some permutation of the MEADS program gains sufficient support and funding to achieve initial operational capability (IOC) and succeed HAWK.

Joint TBMD Command and Control

Though he may have gained crucial early leverage through the adept use of naval TBMD systems, as a regional conflict progresses, the Joint Force Maritime Component Commander will be able to incorporate more and more capabilities from other service components as the necessary systems arrive in theater. He will have to integrate these systems smoothly into the overall TBMD plan, both to increase the vigor of that plan and to consciously move toward a point in the cycle of planning, coordination, and execution where he will be able to turn over command of the TBMD battle to another component commander. For example:

> Transition of a JFACC/AADC from afloat to ashore may occur when the shore based capability to perform these responsibilities, to include command and control of joint air operations, is established. Factors dictating such a move include air sortie generation exceeding JFACC afloat capabilities, the preponderance of tactical air assets shifting ashore, or the shore based facility establishing the best C4I capability to control joint air operations.[129]

The smooth transition of a major subset of a theater operation from one commander to another is essential. Such transitions can be planned and ordered in accordance with the evolution of a campaign, or a transition may be required due to any one of a number of the unexpected contingencies that are to be expected in the fog of war. Communications difficulties, death or disablement of key personnel, or a sudden shift in the operational or political objectives of a conflict can all require the shifting or restructuring of key command relationships.

No matter how well he has done, the JFMCC must thus be prepared to hand off the TBMD fight. To be able to do this expeditiously, he must have planned, coordinated, and executed the TBMD mission from the outset in a manner that has been fundamentally understood by all components in the joint force.

Coordinating the Joint TBMD Effort. "Inherent in effective JTMD operations is an absolute requirement for vertical and horizontal technical and procedural interoperability."[130] Chapter I clearly states that in the future, the JFMCC will have the technical interoperability required, through the joint planning network, the joint data network, and the joint composite tracking network. The hardware and software of a fully netted BMC4I architecture will be there for him to use—but people will run these systems, people will use them, and people will approve and execute the TBMD plans that result. Once the main effort of theater ballistic missile defense begins to shift away from naval systems, the greatest challenge facing the Joint Force Maritime Component Commander will be people and the service cultures they represent. He must have procedural methods and mechanisms in place to ensure that joint TBMD planning, coordination, execution, and eventual transition proceed in a manner that is as integrated as the technical systems that support these functions.

Common language, common procedures, and a common approach to problem solving are relatively easy to impose on command and control systems. It is much harder to do so with the people who use those systems. Administratively, this is a function served by Joint Doctrine and a carefully codified joint planning process. Operationally, the job of coordinating the execution of a common plan by different systems from different service

components is very challenging. How this challenge will be answered in 2008 is not yet clear. However, present day simulations, such as NTF Wargame 95B and Roving Sands 95, have seen two different approaches to the coordination problem emerge—the use of a theater missile defense advisor (TMDA), and the creation of a theater air defense commander (TADC).

Theater Missile Defense Advisor. "Each intermediate command layer between the planner and the executor adds latency to orders and data and risks misinterpretation and confusion, which increases the probability of error."[131] In attempting to bolster the joint coordination function, commanders risk striking a devil's bargain by adding another link to a chain of command already burdened with the unusually stressing timeline of the TBMD battle. In the USEUCOM concept used during NTF Wargame 95B, this link was added above the AADC, in the person of the Theater Missile Defense Advisor (TMDA).

"The major role of the TMDA is to plan, coordinate and deconflict TMD operations (passive defense, active defense, and . . . attack operations). . . . The TMDA is responsible for unity of effort in TMD planning and will issue mission type orders to the AADC. . . ."[132] While the TMDA may be a component commander, he is more likely to be a member of the JFC staff and is thus in effect an agent of the JFC directing the TBMD battle above the JFMCC (who, for the purposes of this study, is tasked as AADC and JFACC).

"A TMD command structure is usually formed by assigning available assets into a relationship that is consistent with the CONOPS, comfortable to the commander in chief (CINC), and acceptable to the Service participants."[133] The origins of the TMDA "coordination from above" approach lie in the very proactive effort by a CINC (USEUCOM) to answer the question "What can be done now to improve joint coordination of the TBMD battle?" This CINC's answer has been the creation of the USEUCOM TMD cell, a cadre of TMD (TBMD and cruise missile defense) corporate knowledge supported by a deployable BMC4I node known as "TMD-in-a-box."

This theater-unique aggregate system includes the EUCOM-deployed JTAGS, connectivity to current BMC4I assets such as TDDS, and the ability to use GALE, the generic area limitation environment. "Taking a direct feed from the JTAGS, this terrain delimitation system has . . . refine [d] [a TBM] launch point to less than 500 meters in less than 60 seconds."[134] The implications for enhancing attack operations are obvious.

Having thus created a very capable team, the CINC will be wont to use it. The intent is clearly to have a mobile coordination, command and control capability to support this very difficult mission at whatever level that support is most

needed. The step from augmentation and advice to direction via "mission type orders," however, is a short one.

A theater missile defense advisor, supported by the CINC's TMD cell and its associated TMD-in-a-box hardware, is clearly in a position to usurp TBMD command, planning, and execution functions originally described in chapter III as being under the purview of the AADC and JFACC, and thus in this study, the JFMCC. In large part, this concept is a response-of-necessity by a CINC who feels that "The lack of an effective theater missile defense is a potential war-stopper for this theater."[135]

With a fully-netted TBMD BMC4I architecture still under development, the leverage provided by a trained staff cadre equipped with a unique, highly capable command and control node makes the TMDA concept very attractive. It takes care of business right now. However, in the future, with full BMC4I in place throughout all components, the JFC might well be able to forestall adding this "extra link," while keeping the TMD cell to augment the staff of whichever component commander is designated AADC. If that commander is the JFMCC, he should heed the specific mission of the cell, for it is what he must ensure happens when prosecuting joint TBMD—"expedite the flow of information, provide a dedicated focus on the JTMD mission, and provide a 'translation' node between disparate Service systems."[136]

Theater Air Defense Commander. Alternatively, an additional coordination "link" can be added below the component commander level. This approach has also found favor with a theater CINC. USCENTCOM lessons learned from Roving Sands 95 read, in part: "Intra and Inter Service TBMD firing coordination is not yet possible in real time. . . . Up to seven Army and Navy interceptors engaged a single TBM. . . . The AADC needs to have a multi-service theater air defense commander to address [these] problems."[137] Actually, since the proposed theater air defense commander (TADC) works for the AADC, this particular coordination enhancement adds two parallel links to the chain of command. While the TADC coordinates TBMD active defense for the AADC, the complementary urgent attack commander (UAC) coordinates TBMD attack operations for the JFACC.

For active defense, the main job of the TADC is to "arbitrate the gray areas" between Service TBMD control centers with overlapping defended footprints or overlapping sensor coverage. Under the current architecture, these subordinate control centers are the Force Air Warfare Commander for naval TBMD, the Control and Reporting Center (CRC) for the Air Force, the Marines' Tactical Air Operations Center (TAOC), and the Army's Tactical Operations Center (TOC) for Patriot and eventually for THAAD.

During Roving Sands 95, when uncoordinated, these control centers tended to engage-by-default. If a TBM was engageable by the weapon system they controlled, they fired. Kill rates were excellent, but interceptor expenditures were unsustainably high. Strict apportionment of geographic engagement zones reduced interceptor wastage to zero—but nine TBMs got through.[138] Clearly, some form of dynamic coordination is called for to ensure effective engagement of targets with an efficient use of interceptors. This is the gray area through which the TADC must navigate.

Again, though, this is an ad- hoc solution to a problem that exists now, due to systems limitations that exist now. If additional layers of command and control, such as the TMDA and TADC, become part of Joint TBMD doctrine in order to address these limitations, then it is the responsibility of commanders and planners to continually evaluate the contribution of these positions as BMC4I technology matures. Once anointed in doctrine, levels of command and control tend to remain, even as their practical utility is eroded by the evolution of technology. The joint TBMD chain of command from CINC to shooter needs to be as short as possible—so long as that chain can effectively coordinate the disparate elements of the joint TBMD force structure into an efficient, synergistic whole that puts hot metal on target.

Joint TBMD in Coalition Warfare

The *raison d'être* for robust U.S. theater ballistic missile defense capability, to include forward deployed naval TBMD forces, is the defense of vital American interests overseas. Admiral William Owens has written:

> Sea-based theater-missile defenses, then, should be considered not only in military terms, in which their mobility and flexibility figure heavily, but in their political payoff. They are a prime example of the way advanced military technology with overseas naval forces can provide the kind of deterrence, alliance maintenance, and coalition building the new era calls for.[139]

As seen during the Gulf War, deterrence, alliance maintenance, and coalition building can be fostered by TBMD from all components. In 1991, these contributions came from Army Patriot and Special Forces, Navy TACAIR and SEALs, and Air Force AWACS, JSTARS, ScudCap, and DSP theater early warning. In 2008, all components will be able to contribute significantly to joint U.S. active defense, attack operations, passive defense, and BMC4I capabilities.

However, as these forces build up in theater, the JFMCC must hark back to his own *raison d'être*—his mission in support of the Joint Force Commander's

operational intent. In accordance with the National Military Strategy, that mission, whenever possible, will be carried out in concert with those same alliances and coalitions that U.S. TBMD can do so much to bolster. If theater ballistic missile defense is an essential enabling capability to allow the Joint Force to carry out its mission in support of coalition objectives in a multinational (formerly "combined") operation, then coalition TBMD systems should be integrated to the maximum extent possible into that capability. In order to do so, the JFMCC and his successors as AADC and JFACC will need a basic understanding of evolving foreign TBMD capabilities and the significant barriers to integration which will inevitably exist.

Allied TBMD Capabilities. Again making the allusion to national systems first used in chapter II, the evolution of international TBMD capability is most vigorous in areas where environmental pressure caused by an imminent TBM threat is greatest. Such areas of high selective pressure include northeast Asia and the Middle East.

Israel is a case in point. Surrounded by hostile regional powers since birth, it has developed not only its own nuclear-capable TBM force, but is now embarked on a substantial active defense program to counter the TBM-WMD initiatives of Iran, Syria, and Libya, and the demonstrated capabilities of Iraq. The indigenously developed but U.S.-supported ARROW interceptor program began in 1988 and has now evolved into ACES (ARROW Continuation Experiments), using the ARROW 2 missile.[140] "The U.S., which is providing the majority of funding for ARROW, will use the results of flight trials to reduce the risk associated with national programs such as THAAD."[141]

Faced by a bellicose, impoverished, unstable, TBM-capable North Korea, Japan may soon leverage its technological investment in the AEGIS program into its own substantial naval TBMD capability. "The Japanese Maritime Self Defense Force is indicating a growing interest in equipping their existing . . . and planned . . . AEGIS destroyers with Theater Wide capability for the defense of Japan."[142]

Other nations have either expressed interest in particular aspects of U.S. TBMD capability or already possess "entry level" TBMD systems such as Patriot PAC-2. NATO states will take part in the collective implementation of LINK 16, the designated precursor of the future joint data network. Still others are pursuing cooperative national programs or are planning to buy newly available Russian active defense systems such as the S-300PMU-1 GRUMBLE or SA-12 GLADIATOR/GIANT family.

The proliferation of such capabilities should be seen as a positive trend, for it provides a defensive means of restoring a TBM-perturbed balance of regional

Planning carried out to counter it must thus be comprehensive, flexible, and capable of execution through both joint *and* multinational operations. Even without all the facts, planning and preparation for the TBMD battle must evolve along with the threat, for the evolution of that threat over the next ten years is not in doubt—it is *certain.*

TBMD and the Maritime Component Commander

The ages-old utility of deployed naval forces rests on two simple facts: naval forces are versatile, and naval forces are present. No matter how great a particular capability may be, it is of little use to a CINC if it is not present in theater when needed. Assuming that the traditional nature of their employment will continue through 2008, naval forces will be present, available for crisis-response orders from the regional CINCs. These forces are planned, programmed, and budgeted to receive significant TBMD capability by 2008.

A naval officer can observe the evolution of the TBM threat; he can track the national response through the planning, programming, and budgeting system; and he can watch how Navy TBMD systems fare in the POM (program objective memorandum). He should begin to look at this emerging operational challenge, and frame questions (when will SM2 Block IVA reach IOC?) for which he may get answers, and others (when will Iranian Scud chemical submunition warheads reach IOC?) for which he will not. The evolution of TBM-WMD systems presents such an unprecedented challenge that the number of questions on any flag officer's "I want to know" list will always exceed the available answers, well past 2008.

This study has not attempted to provide answers to the major questions likely to confront the Joint Force Maritime Component Commander executing the TBMD mission in 2008. To do so would be intellectually presumptuous and factually dishonest—because the answers are not out there. Even if they were, the conditions bounding any given operational situation are unique and mutable. For a given contingency in 2008, what countries will be involved? What U.S. interests will be threatened? If a joint force is committed, what will be the CINC's goals, and what, therefore, will be the JFC's missions and the resources dedicated to accomplishing them? Under what political constraints will the NCA, the CINC, and the JFC have to operate?

That said, though, this study is premised on the assumption that it is worthwhile for the naval officer to think about this problem, to reflect upon what he knows and what he does not know, in order to better frame the decisions he may have to make eventually in a foreseeable U.S. response to an

imminent threat. Rather than looking for specific answers to nebulous questions, this study has attempted to establish first principles—areas of concentration such as logistics; command, control, and intelligence; warfighting; and rules of engagement. The naval officer might best focus his intellect on these aspects of the theater ballistic missile defense problem he may face in the future as naval forces under his command operate in a deterrent posture, escalate to the first U.S. forces involved in a TBM-WMD regional conflict, and "hold open the door" for the follow-on TBMD capabilities of the joint force.

During the process of research, reflection, and preparation of *Theater Ballistic Missile Defense from the Sea: Issues for the Maritime Component Commander*, three themes became prominent. They are the keys to understanding what the Joint Force Maritime Component Commander will find of value when he is preparing to deploy in 2008; they also are the keys that any other officer in the chain of command who is responsible for countering the TBM-WMD threat must understand. These themes are:

- The challenge of conflicting missions and limited means.
- The reality of hard choices.
- The fact that theater ballistic missile defense is one mission enabling many, rather than an end in itself.

Conflicting Missions, Limited Means. When making his initial reckoning of what is known and what is unknown, the Joint Force Maritime Component Commander must consider the nature of the threat, the nature of the mission responding to it, and the operational intent of the NCA, the CINC, and the Joint Force Commander. The nature of the threat will determine how the JFMCC would wish to apportion his TBMD forces, and, given the limited means available to him, the scope of the mission will tell him whether or not he will be able to do so. The operational intent of the national and theater-level commanders will indicate how much or how little freedom the JFMCC can expect to have in carrying out actions that support that intent.

So, for example, if the immediate goal of the NCA centers on coalition-building prior to contemplation of offensive operations, then TBMD efforts are likely to be politically driven, dedicated to highly visible protection of friendly regional population centers on the CINC's defended assets list. These actions will be closely controlled from above. Conversely, once the operational focus shifts to preparations for the offensive, the JFMCC may have more freedom of action—but also a far greater number of tasks to be accomplished with his limited maritime component assets. In addition to TBMD, his forces may be called upon to carry out many naval missions in theater, perhaps including sea

control, embargo enforcement, MPS escort, mine warfare, littoral USW, and finally strike and amphibious power projection in support of offensive operations.

The overarching constraint of limited means must inform the JFMCC's every decision. While by no means unique to the TBMD mission, this constraint will be more acutely felt due to the dreadful consequences of even a single failure. A clear grasp of the CINC's operational intent will allow an initial triage of missions, what must be done now versus what can wait; but even then the tyranny of numbers and the challenge of distance may force an apportionment of assets that is more thin than doctrine demands. Escorts may have to be pulled away from the carrier in order to guard the DAL. A Navy Area DDG, its SM2 Block IVA interceptors expended, may have to transit without rearming to a vital TLAM launch basket when the primary Tomahawk shooter suffers an equipment casualty. An NTW cruiser may have to remain on-station despite falling more and more into a critical fuel state. This inevitable collision of limited means with conflicting missions implies that while doctrine can be a guide, any presumptive answer will have to be scrutinized with regard to the mission and the particularities of the actual situation. Every decision will be a compromise, and every compromise implies hard choices.

Reality of Hard Choices. The hard choices faced by the Joint Force Maritime Component Commander will involve more than mission priority and unit tasking. The JFMCC must understand the essential nature of the TBMD mission so well that he can take a vigorous and articulate stand on fundamental issues of command and control. With centralized planning and decentralized execution as his goal, he must balance the need for defensive effectiveness with the requirement for efficiency driven by his limited interceptor inventory—and make a choice.

For instance, as AADC, he must decide how much of the Theater Wide engagement coordination function he will leave to his subordinate commanders and the automated BMC4I architecture, and how much he will reserve for himself and his staff. The process of making this hard choice must be timely, responsive—and iterative. The TBMD battle will be fast, fluid, and ever-changing. Thus, the ability of the JFMCC, as Area Air Defense Commander, to observe, orient, decide, and act must be at least as fast—and always ongoing. The level of engagement coordination may require fine-tuning from day to day, hour to hour, or even minute to minute. The JFMCC must appreciate this situation and be able to impose his will upon it.

Hard choices also imply acceptance of risk. Constrained by limited means, the JFMCC may be able to defer some missions. Others he will plainly and simply have to carry out.

Indeed, the matter of calculated risk permeates realistic planning for TBMD, from logistical questions of acceptable fuel states and marginal rearming ports to political compromises between force protection and foreign population defense. Thus, if the ascent-phase NTW mission is deemed essential by the NCA, but not enough AEGIS ships are available to support forward-positioned TAG teams, then the JFMCC may acknowledge the TAG concept—yet press on with an NTW ship sent in harm's way, at best with a non-AEGIS consort but perhaps, at worst, alone.

Political factors bear directly on hard choices regarding rules of engagement. The JFMCC has a duty to his subordinate commanders to press for ROE that increase their freedom of action and decrease the risk to their ships, aircraft, and crews. He also has a duty up the chain of command. The JFMCC must display the nicest respect for the responsibilities of senior civilian and military authorities, doing his utmost to understand the policies, objectives, and instructions his force is being used to implement, assuring that those authorities are informed to their complete satisfaction of any aspect of his force's operations and plans. Thus, with regard to the more offensive tasks of TBMD, such as attack operations, the JFMCC will specify the tactical and operational advantages thus offered, but place those concerns with due regard for their subordination to overall national policy. His aim must be to assure that the "catalytic" use of naval power truly supports national policy, helping to resolve conflict rather than accelerating or exacerbating it.

Finally, when directed by the Joint Force Commander, the JFMCC must be able to make the hard choice to relinquish the TBMD battle to the commander of another component. To do so effectively, he must have made other choices in preparation for the transition, beginning with a decision to plan his TBMD fight jointly. To the greatest extent possible, planning methods, language, and execution should adhere to commonly held joint standards. Otherwise, the TBMD battle cannot be handed off expeditiously as the fight moves inland from the littoral. The JFMCC must make the hard choice early to eschew the naval tradition of improvisation and bring his likely relief into the process as early as possible, "training" him, in effect, for a seamless turnover.

One Mission Enabling Many. The importance of that turnover from component to component, of the transition from afloat to ashore, is representative of the very essence of theater ballistic missile defense. Though this mission may well begin under the purview of the maritime component, it belongs to all components, for, like the threat which it counters, TBMD

transcends traditional boundaries. It is one mission that enables many and can therefore never be considered in isolation.

The pace of current research and development, the major funding that must be apportioned among competing systems, and the detailed media coverage of defense industry developments all tend to focus the attention of officers upon TBMD as an end in itself. It is indeed a unique mission—but it does not stand alone. TBMD is a tool that allows other missions to proceed toward the strategic objective—remembering that (to use one example) "from the point of view of Israeli, Saudi, or other coalition leaders and populations, any attempt to distinguish . . . threats and defenses as either 'theater' or 'strategic' is in effect to create a distinction without a difference."[147]

To that end, the officer charged with TBMD planning and execution for any component should maintain a clear operational vision. He must see TBMD as an enabling mission in support of the CINC's operational intent and the NCA's strategic goals. He must acknowledge it as being inherently a joint mission.

As such, TBMD in 2008 will depend on the unifying and coordinating power of BMC4I. Only upon the supporting plinth of battle management command, control, communications, computers, and intelligence can the TBMD pillars postulated for the future stand. Without netted planning, netted data, and netted composite tracks, joint coordination and execution at the speed required for the TBMD battle will be impossible.

That said, this same officer must beware of technological overconfidence. New systems will work, and work well—but seldom as well as engineers and tacticians hope. For that reason, planners and commanders must hold to the goal of centralized planning with decentralized execution. Such a vision will better survive Clausewitz's "friction," which comprehends why even the most reliable technological systems perform less well under the tremendous pressure of war.

Of course, the pressure of war affects the performance of men as well as machines. What men uniquely perform is high-level reasoning and creative thinking; both of these decline abruptly under stress. It follows, then, that the JFMCC—and everyone in the chain of command above and below him—must bear this in mind as they envision operations against the threat of WMD-armed ballistic missiles. Whether the commander succeeds or fails in countering that threat probably will be determined principally by how well he has prepared himself and his subordinates for so demanding a trial by combat.

This study has been a spotting round, something to begin to get the range on a problem which may require many salvos in the future. If it has been at all

successful, that has been because it marks some of the right issues and identifies important questions. These issues and questions, and many others, will of course require further study.

In a fractious world that often seems to have lost its bearings, theater ballistic missile defense delivered from the sea will give the United States a vital and flexible capability to counter the growing threat of TBMs—and the horrific weapons of mass destruction they can carry. For the naval officer who must actually sail upon that sea and personally defeat an enemy who would use such weapons, this great defensive capability cannot be considered in isolation—

> In war, the defensive exists mainly that
> the offensive may act more freely.
>
> Alfred Thayer Mahan
> *Naval Strategy*, 1911

An extract and adaptation of this paper appeared in the form of an article in the Spring 1997 issue of the *Naval War College Review*.

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Glossary of Abbreviations

AADC	Area air defense commander
AW	Air Warfare
ABL	Airborne laser
ABM	Anti-ballistic missile
ACES	ARROW continuation experiments
ACTD	Advanced concept technology demonstration
AD	Destroyer tender
ADCP	Air defense communications platform
ADG	Active defense group
ALERT	Attack and launch early report to theater
AO	Oiler
AOA	Amphibious objective area
AOE	Fast combat support ship
AOR	Area of responsibility
ARG	Amphibious ready group
AS	Submarine tender
ASAS	Advanced solid axial stage
ASCM	Anti-ship cruise missiles
ATACMS	Army tactical missile system
AWACS	Airborne warning and control system
BDA	Battle damage assessment
BMC4I	Battle management command, control, communications, computers, and intelligence
BMDO	Ballistic Missile Defense Organization
BPI	Boost-phase intercept
BUMBLEBEE	Early USN AW missile program
C2	Command and control
CAP	Combat air patrol
CEC	Cooperative engagement capability
CENTCOM	United States Central Command
CEP	Circular error probable
CG	Guided-missile cruiser
CIC	Combat information center
CINC	Commander in chief
CIWS	Close-in weapon system
CNA	Center for Naval Analyses
CNN	Cable News Network
CO	Commanding officer
COEA	Cost and operational effectiveness analysis

CONOPS	Concept of operations
CONUS	Continental United States (excluding Alaska and Hawaii)
CRC	Control and reporting center
CRP	Controllable/reversible pitch
CVBG	Aircraft carrier battle group
CVN	Aircraft carrier, nuclear-powered
CW	Chemical warfare
DAL	Defended assets list
DDG	Guided-missile destroyer
DE	Directed energy
DIA	Defense Intelligence Agency
DoD	Department of Defense
DSP	Defense Support Program
ECS	Engagement control station
EMCON	Emissions control
ERINT	[Patriot] extended range interceptor
ESSM	Evolved Sea Sparrow missile
EW	Early warning
FPPWP	First preplanned waypoint
FPTOC	Force projection tactical operations center
FROG	Free rocket over ground
FU	Fire units
GALE	Generic area limitation environment
GBR	[THAAD] Ground-based radar
GCCS	Global command and control system
GEM	[Patriot] Guidance enhanced missile
GFCS	Gun fire control system
GPS	Global Positioning System
HARM	High-speed antiradiation missile
HEU	Highly enriched uranium
ICBM	Intercontinental ballistic missile
ICC	Information Coordination Central
INDIGO	TLAM tasking message
IOC	Initial operational capability
IPB	Intelligence preparation of the battle space
IR	Infrared
IRST	Infrared search and track
JCS	Joint Chiefs of Staff
JCTN	Joint composite tracking network
JDN	Joint data network
JFACC	Joint force air component commander
JFC	Joint force commander

JFMCC	Joint force maritime component commander
JMCIS	Joint maritime command information system
JPN	Joint planning network
JSOC	Joint Special Operations Command
JSTARS	Joint surveillance and target attack radar system
JTAGS	Joint tactical ground station
JTIDS	Joint tactical information distribution system
JTMD	Joint theater missile defense
KE	Kinetic energy
KKV	Kinetic-kill vehicle
KW	Kinetic warhead
LAMPS	Light airborne multipurpose system
LS	Launching station
MASINT	Measurement and signals intelligence
MEADS	Medium extended air defense system (formerly CORPS SAM)
MEZ	Missile engagement zone
MIF	Maritime interdiction force
MIW	Mine warfare
MLRS	Multiple launch rocket system
MOPP	Mission-oriented protective posture
MPS	Maritime prepositioning ship
MRBM	Medium-range ballistic missile
MTCR	Missile technology control regime
Nato	North Atlantic Treaty Organization
NAVCENT	Naval Forces, U.S. Central Command
NCA	National Command Authority
NTDC	Non-tactical data collection
NTF	National test facility
NTW	Navy Theater Wide
OOB	Operational order of battle
OODA	Observe, orient, decide, act
PAC	Patriot advanced capability
P_k	Probability of kill
POM	Program objective memorandum
PST	Precision-strike Tomahawk
QR	Quick response
R&D	Research and development
RAS	Replenishment at sea
RCS	Radar cross-section
RF	Radio frequency
ROE	Rules of engagement

RV	Reentry vehicle
SAM	Surface-to-air missile
SATCOM	Satellite communications
SBIRS-LOW	Space-based infrared system-low earth orbit
SBWS	Space-based warning system (DSP + TES)
ScudCap	Scud combat air patrol
SDIO	Strategic Defense Initiative Office
SEALs	Sea, air, land (team)
SLOC	Sea line of communication
SMTS	Space and missile tracking system
SOF	Special operations forces
SRBM	Short-range ballistic missile
STO	Systems test officer
SUW	Surface Warfare
TACAIR	Tactical aircraft
TACDAR	Tactical detection and reporting
TAD	Theater air defense
TADC	Theater air defense commander
TAG	TBMD action group
TAOC	Tactical air operations center
TBM	Theater ballistic missile
TBM-WMD	Theater ballistic missile—weapons of mass destruction
TBMD	Theater ballistic missile defense
TBMD ROE	Theater ballistic missile defense rules of engagement
TDDS	Tactical data distribution system
TEL	Transporter-erector-launcher (for TBM)
TENCAP	Tactical exploitation of national capabilities
TES	Tactical event system
THAAD	Theater high-altitude area defense
TIBS	Tactical information broadcast service
TLAM	Tomahawk land attack missile
TM	Theater missile
TMD	Theater missile defense
TMDA	Theater missile defense advisor
TOC	Tactical operations center
TPFDL	Time-phased force deployment list
TPT	Theater planning tool
TRAP	TRE and related applications (now TDDS)
TRE	Tactical receive equipment
TSC	TOMAHAWK strike coordinator
TVM	Track-via-missile
UAC	Urgent attack commander

UOES	User operational evaluation system
URG	Underway replenishment group
USEUCOM	United States European Command
USSOCOM	United States Special Operations Command
USSPACECOM	United States Space Command
USSTRATCOM	United States Strategic Command
USW	Undersea warfare
VLA	Vertical-launch ASROC
VLS	Vertical launch system
VLS UNREP	Vertical launch system underway replenishment
WMD	Weapons of mass destruction

About the Author

Commander Charles "Chip" Swicker graduated from Dartmouth College in 1977. He then went to sea for five years in large, oceangoing sailing ships, including the clipper schooner *Pride of Baltimore* and the research vessel *Westward*. After receiving his commission from Officer Candidate School in 1982, he served in the *Kidd*-class guided-missile destroyer *Scott*, the nuclear cruiser *Virginia*, and AEGIS cruisers *Philippine Sea* and *Monterey*. Commander Swicker completed his executive officer tour in *Monterey* in the fall of 1997.

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