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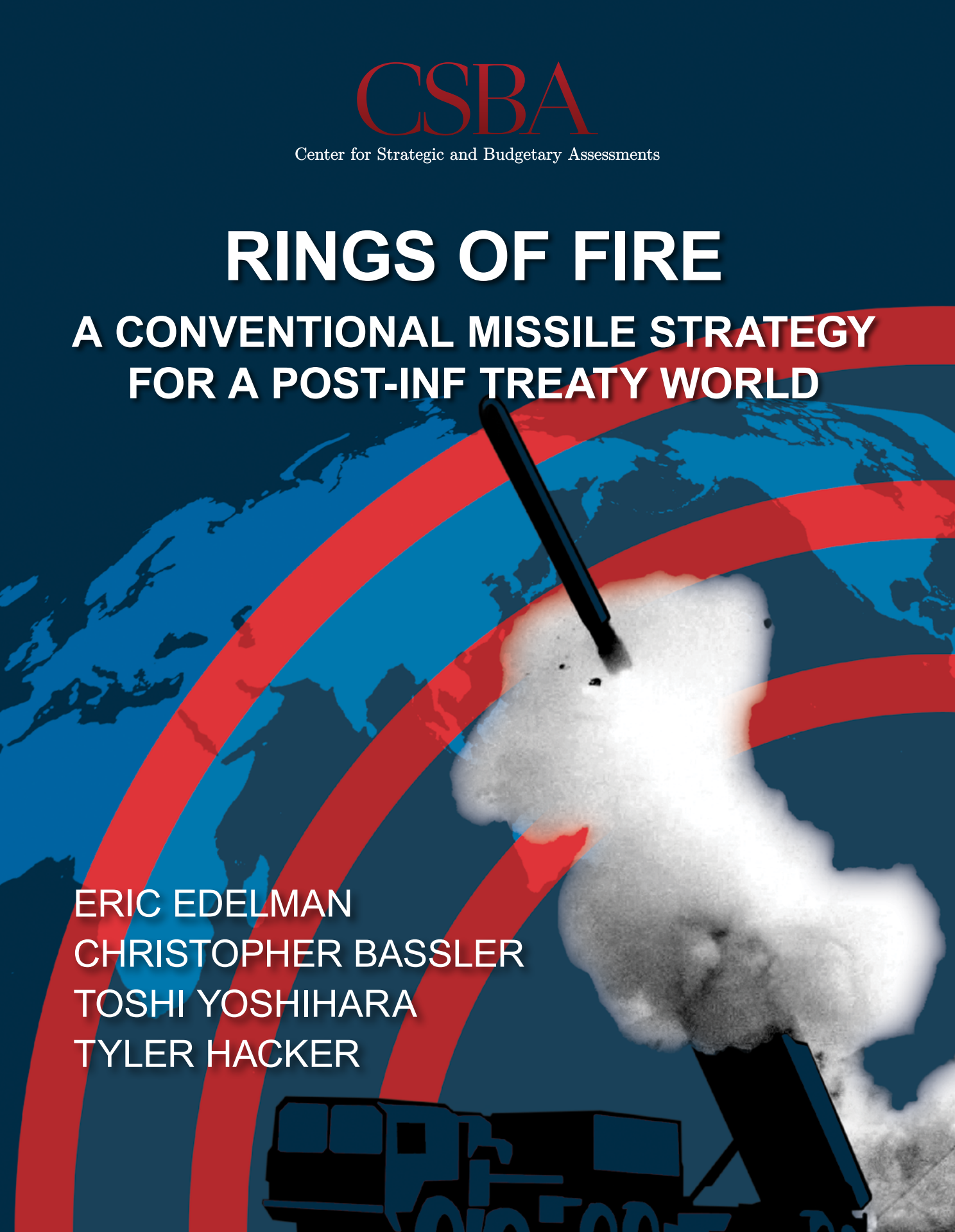
RINGS OF FIRE

A CONVENTIONAL MISSILE STRATEGY FOR A POST-INF TREATY WORLD



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ABOUT THE CENTER FOR STRATEGIC AND BUDGETARY ASSESSMENTS (CSBA)

The Center for Strategic and Budgetary Assessments is an independent, nonpartisan policy research institute established to promote innovative thinking and debate about national security strategy and investment options. CSBA's analysis focuses on key questions related to existing and emerging threats to U.S. national security, and its goal is to enable policymakers to make informed decisions on matters of strategy, security policy, and resource allocation.

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Contents

FIGURES

TABLES

Executive Summary

Since its withdrawal from the Intermediate-Range Nuclear Forces (INF) Treaty in 2019, the United States has been free to develop new medium and intermediate-range conventional missiles to strengthen its conventional deterrence posture. The military services have tested and fielded a variety of systems that could bolster their long-range strike capabilities and proposed still others. To date, however, Washington lacks a clear path for how the various service initiatives might contribute collectively to a broader precision-strike complex. The many missile programs, development options, employment concepts, and deployment locations and their multiple combinations call for a purposeful plan that advances a coherent, long-term missile strategy.

The increasingly unfavorable missile balance in the Indo-Pacific and Europe, furthermore, should inject a sense of urgency among policymakers to pursue a comprehensive missile strategy. Washington's compliance with the Treaty beginning in 1987 led to sharp asymmetries in military power between the United States and its great power rivals, China and Russia. Even as the United States conformed strictly to the Treaty's constraints for over three decades, China, unfettered by the Treaty, amassed more than 1,250 ground-launched ballistic and cruise missiles within treaty-proscribed ranges. Before the U.S. withdrawal from the Treaty, Russia's development of the SSC-8 (9M729) ground-launched cruise missile violated the Treaty and indicated Moscow's growing focus on long-range ground-based fires. In the meantime, the U.S. military became dependent on a limited number of naval platforms and an even smaller number of long-range aircraft to provide the bulk of its long-range strike capacity. This dependence and its associated limitations remain largely in place.

This study furnishes a conceptual framework to help policymakers align the many lines of effort on theater-range ground-based missiles, right the missile imbalance in critical theaters, and lay the foundation of a U.S.-led missile strategy in the Indo-Pacific and European theaters. Specifically, this report assesses available missile options along with their key tradeoffs, sketches missile postures that would be well-suited to the unique demands of the European and Asian theaters, proposes possible divisions of labor between the United States and its allies and partners, and examines concepts, techniques, and technologies that make the best use of exquisite long-range missiles. Such a structured approach

is intended to help policymakers develop a sustainable strategy that is not driven by specific programs and capabilities. It is also designed to inform investment choices in the near term to ensure that the United States and its allies retain maximum flexibility when deciding how and where to field missiles in the future.

This monograph distills the strategic and geographic realities in Asia and Europe into a "three rings" construct to shape a regionally-tailored missile strategy. The study is premised on a basic yet essential geospatial idea about land powers and sea powers. Continental powers such as China and Russia close the distance between themselves and their targets through missile range. By contrast, distant maritime powers, such as the United States, close the distance by missile launch location. As a result, potential basing locations for U.S. ground-based missiles are best envisioned as a series of concentric rings originating in the home territory of an adversary and gradually emanating outward. These rings reveal a host of potential deployment locations within three primary bands in the Indo-Pacific and European theaters: the inner, middle, and outer rings.

Territories within the inner ring could host short-range missile systems with ranges up to 1,000 kilometers (km). In the Indo-Pacific, this innermost ring includes the stretch of islands from Japan to the Philippines, while in Europe, it encompasses many NATO states on the Alliance's eastern front. The middle ring would accommodate medium-range systems with ranges from 1,000 to 3,000 km. Although few pieces of real estate in the Indo-Pacific have the right set of political and geographic conditions to accommodate medium-range weapons, in the European theater, this ring covers the complete geography of the European continent and the United Kingdom. Finally, locations in the outer ring would require intermediate-range missiles with ranges between 3,000 and 5,500 km. In the Indo-Pacific, these ranges include Diego Garcia, northern Australia, Palau, the U.S. territories of Guam and the Commonwealth of Northern Marianas Islands, and the Aleutian Islands of Alaska. Applying the three rings framework to Asia and Europe yields significant findings and actionable recommendations, which are summarized below.

Key Findings

Current U.S. investments in ground-based missiles show that most existing and developmental programs are intended for the inner ring with ranges under 1,000 km. Although some U.S. Army and Marine Corps programs are expected to cover the low end of ranges in the middle ring, no intermediate-range missile program currently exists that could be deployed to the outer ring. The current portfolio constrains U.S. forces to using ground-based fires to strike targets in the peripheries of adversary territory and limits the number of potential missile deployment locations, particularly in the Indo-Pacific. U.S. allies and partners in both the Indo-Pacific and Europe are similarly focused on short-range capabilities, which is unsurprising given their proximity to regional adversaries. In short, for both the United States and its allies, the inner ring is currently the "low-hanging fruit" of ground-based fires—the option of technological, programmatic, and political convenience.

In the Indo-Pacific, Japan and the Philippines are the most logical hosts of short and medium-range weapons. The main islands of Japan and the Philippines, including Kyushu, Honshu, Hokkaido, Luzon, and Mindanao, provide strategic depth along the north-south axis. The archipelagic landscape of both countries would allow allied militaries to disperse missile launchers across broad swathes of the inner ring, increasing the number of targets Beijing would have to find, track, and engage. At the same time, the two local frontline states could contribute to the U.S.-led missile strategy. Japan already fields its own land-based maritime strike systems while the Philippines is procuring ground-based anti-ship cruise missiles. These systems, possibly combined with U.S. assets on Japanese and Philippine territories, would create a defensive chain that could prevent Chinese naval vessels from achieving operational aims in the region or transiting from the East and South China seas to the greater Pacific Ocean.

The operational utility of medium-range systems is more limited in the Indo-Pacific than in Europe. Medium-range missiles could threaten Russia from throughout the open geography of continental Europe and the United Kingdom. By contrast, the archipelagic character of the Western Pacific limits the middle ring deployment options to a few main islands of Japan and the Philippines. This geographic asymmetry suggests that significant U.S. investments in additional medium-range missiles that are more suitable for Europe may not be the best use of scarce resources, especially since the Indo-Pacific has emerged as the priority theater where the missile imbalance is most severe. Geospatial constraints would thus be a critical factor in shaping decisions to privilege or disfavor certain missile systems.

There may be significant operational and strategic dividends for the United States to deploy intermediate-range missiles in the middle and outer rings. Intermediate-range missiles possess the reach to cover the vast distances of the Indo-Pacific. If deployed in Europe, they would give commanders the means to hold at risk distant targets that their short and medium-range counterparts cannot reach. As dual-theater weapons, they could be effectively utilized in both Asia and Europe to serve as visible signs of commitment to U.S. allies and partners, provide an increased persistence and volume of fires, and offer an additional layer of signaling capabilities. Most notably, intermediate-range missiles could be based on U.S. territory, such as Alaska and Guam. Deployment on U.S. territory would relieve Washington of the diplomatic capital needed to negotiate overseas access while giving commanders the kinds of operational flexibility that might not be available to them on foreign soil.

Recommendations

A U.S.-led missile strategy should avoid creating additional redundancy between U.S. and allied capabilities on the inner ring, especially regarding further deployment of U.S. short-range missiles. Given that short-range weapons are the focus of current U.S. investment, and many allies and partners are already fielding

similar missiles, there is an opportunity to integrate these weapons into a U.S.-led ground-based fires strategy. Thus, the key challenge for an inner ring missiles strategy is *integrating* the volume of diverse U.S. and allied weapons under a coherent set of plans.

An inner ring missile strategy should coordinate and differentiate roles and missions between military services and the United States and its allies. Mission type, system type, and missile location are all potential avenues for segmenting and coordinating inner ring fires. A well-organized inner ring plan should leverage the unique virtues of short-range missiles. Their reduced flight times to intended targets make short-range weapons ideal for threatening time-sensitive mobile targets in high-clutter environments.

Owing to the lack of middle ring deployment locations in the Indo-Pacific, the United States would be best served by favoring the development of intermediate-range systems over medium-range missiles. If there is sufficient demand and a compelling operational requirement, the United States should leave medium-range missiles to European allies to develop and procure for integration into an allied missile strategy. Accordingly, a missile strategy should encourage U.S. allies in Europe to invest in these capabilities, possibly through the sale of a ground-based Tomahawk cruise missile or the Precision Strike Missile. The United States could play a role in the development of such systems through co-development, the sharing of kill chain elements, or selected technology assistance for key components.

An outer ring missile strategy should incorporate plans for the possible deployment of intermediate-range missiles in U.S. territories such as Guam and Alaska. Unencumbered by the need to reach basing or access agreements with allies and partners or by the vicissitudes of local politics in host nations, Washington would enjoy greater freedom of action. Moreover, these long-range weapons based in U.S. territories would still allow commanders to pose a persistent threat against targets in China and eastern Russia. Using U.S.-based intermediate-range missiles as a conventional strike reserve would alter the strategic balance in a prolonged conflict, perhaps providing additional leverage in conflict termination, arms control negotiations, or during simultaneous conflicts in both the Indo-Pacific and European theaters.

Given that the expected cost of intermediate-range missiles will limit the arsenal size, the United States should pursue systems, technologies, and capabilities that maximize the missiles' range advantage and capacity to deliver more munitions. For the Indo-Pacific, the U.S. military should develop intermediate-range weapons that utilize conventional multiple independent reentry vehicles (MIRVs) and maneuverable reentry vehicles (MARVs) to multiply the number of independent, maneuverable precision-guided effects they can deliver. If fielded in Europe, these intermediate-range forces could utilize their "range bonus" to hold at risk targets located deep in the interior of adversary territories. The range and the volume of precision-strike firepower could force a rival to disperse its assets or invest in more or better missile defenses, thereby levying costs that the opponent would otherwise prefer not to pay.

The United States should consider arrangements to co-develop intermediate-range missiles with close allies, especially in cases where institutional mechanisms for cooperation already exist. For example, the longstanding tight relationships between the United States, Australia, and the United Kingdom—recently augmented by AUKUS—could serve as a strong foundation for allied collaboration. The case for such cooperation is especially compelling because Australia and the United Kingdom would be ideal nations for hosting intermediate-range missiles in their respective theaters. Intermediate-range weapons hosted or fielded by these allies would increase the number of weapons available and spread them across broader areas in the strategic depths of the Indo-Pacific and European theaters.

The United States must pursue a coherent missile strategy to guide system procurement, deployment, and employment. The United States cannot unthinkingly rerun its Cold War playbook. Today's ground-based missile strategy must be tailored to the unique geographic, political, strategic, technological, and coalitional circumstances of the current Indo-Pacific and European theaters. By presenting the three rings framework as a tool for defense planners and diplomats to think through the missile options available to the United States and its allies, this study is the first step toward the development of a conventional ground-based missile strategy that closes the strike gap between the United States and its adversaries.

CHAPTER 1

Introduction

On August 2, 2019, the United States formally departed the Intermediate-Range Nuclear Forces (INF) Treaty, which prohibited Washington and Moscow from testing or fielding surface-to-surface ballistic and cruise missiles with ranges between 500 and 5,500 kilometers. This exit capped a withdrawal process that had begun six months earlier and can be traced back to Russia's deployment of a missile (the 9M729 or SSC-8 *Screwdriver*) that violated the treaty's limits.[1]

Critics of the INF Treaty's demise have decried the abandonment of a milestone arms control agreement and have expressed fears that the withdrawal presages a new arms race. Others, however, have argued that the withdrawal opens the way for the United States to strengthen deterrence in both Europe and Asia.[2] In addition to Russia's violation, China—which was not bound by the INF Treaty—has amassed more than 1,250 ground-launched ballistic missiles

1 For the background see Amy F. Woolf, *Russian Compliance with the Intermediate Range Nuclear Forces (INF) Treaty: Background and Issues for Congress* (Washington, DC: Congressional Research Service), updated August 2, 2019, https://sgp.fas.org/crs/nuke/R43832.pdf. Russia (and the Soviet Union before it) have had a long history of skirting the requirements of arms control agreements. On the history of Russian non-compliance see Mark Schneider, "Russian Violations of Its Arms Control Obligations," *Comparative Strategy*, 31:4, pp. 331–352; Mark Schneider, "Russia Cheats," *Air Force Magazine*, 98:7, pp. 38–42. Russian violations were also reported in a series of Congressionally mandated arms control compliance reports by the Department of State. The reports can be accessed at https://2009-2017.state.gov/t/avc/rls/rpt/2016/index.htm. On the effort in the UN's First Committee, see the U.S.-Russian Joint Statement at https://www.un.org/press/en/2007/gadis3352.doc.htm.

2 For criticism of U.S. withdrawal see, Katrina vanden Heuvel, "Trump Is Igniting a Perilous New Nuclear Arms Race," *Washington Post*, February 5, 2019; Ulrich Kuhn, "Between a Rock and A Hard Place: Europe in a Post-INF World," *Nonproliferation Review*, 26:1-2, pp. 155–166; for a persuasive rejoinder that stresses the benefits in East Asia see Alexander Lanoszka, "The INF Treaty: Pulling Out in Time, *Strategic Studies Quarterly*, 13:2, pp. 48–67.

(GLBMs) and ground-launched cruise missiles (GLCMs) within treaty-proscribed ranges.[3] Meanwhile, U.S. compliance with the INF Treaty has left Washington with only short-range surface-to-surface missiles like the 300-kilometer-range MGM-140 Army Tactical Missile System (ATACMS), whose range limits its ability to conduct standoff conventional strikes, along with intercontinental-range Minuteman III ballistic missiles, which are reserved for strategic nuclear deterrence.

As a result of this mid-range capability gap, the United States has come to depend on a limited number of naval platforms and an even smaller number of long-range aircraft to provide the bulk of its long-range strike capacity. Many of these air- and sea-based platforms are increasingly vulnerable to adversary anti-access/area denial (A2/AD) systems even while employing standoff munitions. To provide a significant volume of fire, the United States relies on short-range strike aircraft, which make up the preponderance of the U.S. inventory but must operate from vulnerable airbases to sustain high sortie rates.

With the INF Treaty no longer in effect, Washington now has the option of developing new medium and intermediate-range conventional missiles to strengthen its conventional deterrence posture and long-range precision strike capabilities in critical theaters. Ground-based fires remain the strike option with the greatest persistence, even as a complement to other maritime and air-launched options. The purpose of this monograph, therefore, is to explain why—and offer a framework for how—it might do so.

End of an Era

What explains the end of the INF Treaty? Russian officials had long expressed concern to American counterparts about the range limitations on its ballistic and cruise missile capabilities.[4] In particular, they pointed to the acquisition of even larger inventories of medium and intermediate-range missiles by countries along Russia's periphery. Russian decision-makers undoubtedly had some concerns about ballistic missile programs in China, Pakistan, and Iran, but also seem to have been prompted by a desire to strengthen the country's military capabilities vis-à-vis NATO given its relative decline in conventional force capabilities.[5]

3 For example, in the 2020 report, DoD noted "Land-based conventional ballistic and cruise missiles: The PRC has more than 1,250 ground-launched ballistic missiles (GLBMs) and ground-launched cruise missiles (GLCMs) with ranges between 500 and 5,500 kilometers. The United States currently fields one type of conventional GLBM with a range of 70 to 300 kilometers and no GLCMs." Office of the Secretary of Defense, "Military and Security Developments Involving the People's Republic of China, 2020, Annual Report to Congress," September 2020, p. 2, https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

4 Then Russian Defense Minister Sergei Ivanov had raised the issue with Secretary of Defense Rumsfeld in 2005. Hubert Wetzel, Demetri Sevastopulo, and Guy Dinmore, "Russia Confronts U.S. on Nuclear Arms Pact," *Financial Times*, March 8, 2005.

5 This also coincides with the difficulties each of these states, especially China and Russia, have had developing and fielding air and sea-based systems in significant numbers.

U.S. officials sought to reach some resolution with their Russian counterparts, despite deep reluctance to upset the status quo and publicize Russia's violations. These attempts were rebuffed. The growing disquiet among U.S. officials about Russian non-compliance ultimately led the United States to brief NATO allies on the issue.

In the Pentagon, analysts quietly began studying what new capabilities the United States might need to develop to offset Russian and Chinese advantages gained by deploying these systems. As Secretary of Defense Ashton Carter noted in 2015:

> I believe that any U.S. responses should be designed to make the United States and our allies and partners more secure by negating any advantage Russia might gain from deploying an INF-prohibited system. The range of options we should look at from the Defense Department could include active defenses to counter intermediate-range ground-launched cruise missiles; counterforce capabilities to prevent intermediate-range ground-launched cruise missile attacks; and countervailing strike capabilities to enhance U.S. or allied forces. U.S. responses must make clear to Russia that if it does not return to compliance our responses will make them less secure than they are today.[6]

In 2016 Congress authorized the Department of Defense (DoD) to study and plan development of possible military options, and in 2018 it mandated the Department to develop a program of record to develop a new ground-launched cruise missile and authorized funding for associated research.[7]

The potential development of conventional medium or intermediate-range missiles was not limited to offsetting Russian advantages in Europe. Analysts increasingly argued that China's advantages in the Indo-Pacific region might prompt the United States to develop the capability for countervailing long-range fires to offset the Chinese buildup of medium-range ballistic missiles (MRBM). After more than a decade of focusing on counterterrorism, the United States began to "pivot" towards East Asia, and great power competition with China became its top priority.[8] This shift, in concert with concerns about Russian non-compliance,

6 U.S. Senate Committee on Armed Services, "Advance Policy Questions for the Honorable Ashton Carter, Nominee to be Secretary of Defense," pp. 78–79, https://www.armed-services.senate.gov/imo/media/doc/Carter_APQs_02-04-15.pdf.

7 For a complete timeline of Congressional actions see Congressional Research Service, "U.S. Withdrawal from the INF Treaty: What's Next," CRS In Focus, updated January 2, 2020, https://fas.org/sgp/crs/nuke/IF11051.pdf.

8 Mark E. Manyin, Stephen Daggett, Ben Dolven, Susan V. Lawrence et al., *Pivot to the Pacific? The Obama Administration's "Rebalancing" Toward Asia* (Washington, DC: Congressional Research Service, 2012), https://sgp.fas.org/crs/natsec/R42448.pdf.

explains the Trump Administration's decision to withdraw from the INF Treaty in February 2019.[9]

Purpose and Scope

Much current analysis of the post-INF Treaty environment focuses on the platforms or approaches the military services may take to field ground-based missiles. The existing literature lacks significant analysis of a coherent, sustainable, long-term U.S. missile strategy that incorporates the various programs, capabilities, services, and allies. This study seeks to fill this analytical gap and expand upon themes introduced in two previous CSBA studies on conventional strike portfolios in a post-INF environment: *Leveling the Playing Field: Reintroducing U.S.-Theater Range Missiles in a Post-INF World* and *Tightening the Chain: Implementing a Strategy of Maritime Pressure in the Western Pacific*.[10]

The purpose of this monograph is to provide the building blocks of a new U.S.-led ground-based missile strategy. Policymakers need a construct to examine the available options for ground-based missiles and deployment locations. This study will establish such a framework by distilling strategic asymmetries and geographic realities into a "three rings" construct. The monograph will conclude by utilizing this construct to provide insights into a missile strategy that leverages geography, politics, and technology to take advantage of opportunities along each of the three rings.

Rather than recommending specific missile deployment locations, this framework is intended to illuminate the complete set of options available to policymakers, along with the key tradeoffs associated with each option. Allied threat perceptions and political attitudes can and will change—sometimes gradually over time, and sometimes rapidly after unexpected events or the sudden clarification of adversary intentions.[11] Ground-based missile

9 Much of the early discussion of the potential utility of long range, ground-based fires in the Indo-Pacific context were associated with analysts at CSBA, see for instance, Jim Thomas, "Why the U.S. Army Needs Missiles: A New Mission to Save the Service," *Foreign Affairs*, 92:3, pp. 137–144; Evan B. Montgomery, "Time for American Land-Based Missile Forces to Counter China," *The National Interest*, October 14, 2014; and Evan B. Montgomery, "Managing China's Missile Threat: Future Options To Preserve Forward Defense," Testimony Before the U.S.-China Economic and Security Review Commission Hearing on "China's Offensive Missile Forces: Implications for the United States," April 1, 2015.

10 Jacob Cohn, Timothy A. Walton, Adam Lemon, and Toshi Yoshihara, *Leveling the Playing Field: Reintroducing U.S. Theater-Range Missiles in a Post-INF World* (Washington, DC: Center for Strategic and Budgetary Assessments, 2019), https://csbaonline.org/research/publications/leveling-the-playing-field-reintroducing-us-theater-range-missiles-in-a-post-INF-world; and Thomas G. Mahnken, Travis Sharp, Billy Fabian, and Peter Kouretsos, *Tightening the Chain: Implementing a Strategy of Maritime Pressure in the Western Pacific* (Washington, DC: Center for Strategic and Budgetary Assessments, 2019), https://csbaonline.org/research/publications/implementing-a-strategy-of-maritime-pressure-in-the-western-pacific.

11 Several examples of gradual and rapid shifts in allied threat perceptions and attitudes toward hosting U.S. forces will be examined in Chapter 4. Global perceptions following the Russian expansion of the Ukraine conflict in February 2022 illustrate this as well.

programs can be technologically complex and require time to develop, test, and produce.[12] When future missile deployment opportunities arise, decision-makers will have to choose from previously developed technologies and systems. Policymakers need a framework to derive a strategy and make investment choices in the near term to give the United States and its allies maximum flexibility when deciding how and where to field ground-based missile systems in the near future.

The proposed conventional missile strategy would be oriented primarily toward the Indo-Pacific theater and secondarily toward the European theater. That is, our analysis focuses on the geography and missile options in the Indo-Pacific, and then considers the implications of these factors in Europe.

Prioritizing theater demands is necessary because resources are limited, and the choices made today will shape and constrain the options available tomorrow. For instance, Washington's Cold War focus on the European theater led the U.S. military to procure an inventory of short-range strike aircraft ideal for a geographically smaller theater containing many airfields. Unfortunately, this portfolio of strike delivery platforms is ill-suited for the vast distances of the Indo-Pacific. An "Indo-Pacific first, Europe second" approach avoids a complete reversal of this pitfall while still prioritizing resources to confront today's most pressing threats in both theaters.[13]

Outline

This monograph proceeds in three parts. First, it outlines the reasoning and structure of the three rings framework. It then provides an overview and assessment of current U.S. and allied investments in ground-based theater-range missile systems. Finally, it utilizes the three rings framework to generate key insights pertaining to each ring and form the foundations of a U.S.-led ground-based missile strategy.

Chapter 2 examines the strategic geography of the Indo-Pacific and European theaters and describes the three rings framework. In contrast to Chinese and Russian strategies based on concentric rings of missile ranges extending outward from their homelands, a U.S.-led ground-based strategy can be conceived of as concentric rings of locations from which missiles can reach the Chinese and Russian homelands, their naval forces, and their offshore positions. This concept, when paired with the existing set of defined missile ranges (short-range, medium-range, and intermediate-range), allows for the identification of three primary rings of territory: inner, middle, and outer.

12 Although perhaps less difficult than aircraft or naval systems, in part explaining why Russia and China have emphasized the ground component of their respective strike portfolios.

13 This study will consider conventional missiles only. Nuclear systems or missiles specifically designed to be dual-capable are outside the scope of this report.

Chapter 3 outlines the current range of U.S. and allied operational and developmental missile programs. The overview reveals that the current weight of U.S. ground-based missile investments is centered on short-range platforms suitable only for employment in the inner ring. This section concludes by assessing the limitations and risks of this inner-ring-focused approach.

Finally, Chapter 4 applies the three rings framework to arrive at the building blocks of a missile strategy that leverages geography, politics, and technology to harness the opportunities along each of the three rings. This analysis reveals several fundamental tasks and insights for a U.S.-led ground-based missile strategy, including integrating and creating a division of labor for a diverse inventory of short-range weapons, U.S. support to select allied efforts to develop medium-range weapons, pursuing co-development of intermediate-range weapons, and leveraging technologies and designs that maximize the effects of low-density intermediate-range missiles in both the Indo-Pacific and European theaters.

CHAPTER 2

The Three Rings

In the post-INF Treaty world, ground-based theater-range missiles offer the United States several distinct advantages over air- and sea-based strike options. Properly employed ground-based missiles would serve as visible signs of commitment to U.S. allies and partners and would give U.S. and allied commanders additional volume of fires, increased persistence of fires, and an additional layer of signaling capabilities.

Nevertheless, the United States must confront two key challenges while constructing a strategy to develop and deploy ground-based missiles. The first difficulty is the enormous number of technical, operational, and political variables involved in analyzing various missile and deployment options. Range and deployment location are two key variables, albeit with differing levels of importance between a distant power like the United States and a local continental power like China or Russia. The second challenge is the limited fiscal and diplomatic resources available to field ground-based missile systems. Inevitably, these platforms will compete for funding against delivery platforms in other domains and for political capital against other diplomatic efforts with allies and partners. These difficulties further necessitate a thorough analytical framework to evaluate options and develop a missile strategy.

The three rings framework defined in this chapter is an ideal-type construct rather than a finished proposal or strategy. It is meant to illustrate the logic of a missile strategy based on the intersection of available real estate and missile capabilities. Rather than prescribe specific deployment locations, this construct provides a basis to appraise the value and feasibility of the inner, middle, and outer rings. Such an appraisal highlights force development, deployment, and employment tradeoffs and points the way to a viable missile strategy, which will be fully explored in Chapter 4. This construct is intended to help policymakers and planners organize their thinking, prioritize resources, harness diplomatic capital, derive a missile strategy, and develop relevant operational concepts. From this construct, it is possible to discern the likely shape of a U.S.-led ground-based missile strategy in the years ahead.

The Importance of Ground-Based Theater-Range Missiles

For a strategy centered on ground-based fires to make fiscal and strategic sense, such weapons must provide capabilities that other strike platforms do not. CSBA previously explored the unique advantages of conventional theater-range missiles in *Leveling the Playing Field*.[14] In short, ground-launched ballistic, cruise, and boost-glide weapons hold substantial operational and strategic value to the United States and its allies for four primary reasons.

First, ground-based systems have unique attributes relative to air and sea-launched weapons that allow them to complement these other capabilities. For instance, they can provide a persistent presence in contested theaters and project power forward into an adversary's weapons engagement zone (WEZ), an area within reach of an opponent's firepower. This characteristic contrasts with sea and air platforms, which can only remain on station temporarily to deliver their payloads before leaving to rearm and refuel.[15] Persistence also enables promptness, making ground-based systems ideal for engaging time-sensitive targets that might otherwise require a constant rotation of aircraft on station, ready to strike when the target presents itself. These rotations are particularly resource-intensive in theaters where long distances to the target require aerial refueling support. In addition, aircraft and ships with long-range fires capabilities (as well as supporting platforms such as tankers) may be vulnerable to enemy anti-access networks as they move to and within contested areas. Ground-based missiles may have to exit hide sites before firing and relocate after firing but can still offer commanders a more persistent strike option without many of the employment considerations required by air and seaborne delivery platforms.[16]

Second, given these attributes, ground-launched missiles can complicate adversary operational planning. Besides their persistence, ground-based firing platforms can be difficult to find and destroy. High mobility transporter erector launchers (TELs) can quickly move between multiple hide sites, making them difficult to detect and track prior to a missile

14 *Leveling the Playing Field*, pp. 17–26.

15 Defense Science Board, "Study on Countering Anti-access Systems with Longer Range and Standoff Capabilities: Assault Breaker II (Executive Summary)," June 2018, p. 10, https://dsb.cto.mil/reports/2010s/LRE%20Executive%20Summary__Final.pdf.

16 This does not mean that ground-based missiles are invulnerable to threats such as counter-battery fires from an adversaries' own ground, sea, and air-based missiles. Nevertheless, ground-based platforms already in theater would be well-positioned to deliver rapid precision-fires to support U.S. and allied operations. Such prompt, responsive strikes are important during crises when time is a sensitive element of U.S. defense strategy to prevent Chinese and Russian forces from moving quickly to seize objectives and deny U.S. and allied forces in contested areas. Ground-launched missiles can also hold adversaries' own missiles at risk, providing a visible deterrent overwatch for sea and air-based platforms as they arrive on-scene to reinforce U.S. and allied forces in contested areas. Adversaries may hesitate to place mobile ground-based missiles in launch locations within striking range of U.S. and allied missiles, making conflict areas less contested for friendly forces and negating adversary strike advantages.

launch.[17] These hide sites can be hardened to increase survivability and the size of the munition required to attack them. Faced with persistent, prompt, and survivable conventional strike assets, potential opponents may be driven to invest more in passive and active defenses. Ground-based systems will cause an adversary to incur even further costs should they choose to develop offensive counterstrike capabilities against TELs or other parts of the missile kill chain.[18]

Third, the immediate presence of ground-based missiles in allied territory signals U.S. commitment and strengthens the credibility of U.S. deterrence, given that the allies can make such a presence conspicuously visible to allied publics. This advantage sets ground-based assets apart from maritime assets such as cruise missile-armed submarines that must stay hidden and undetected. Although these U.S. and allied ground-based missiles could become targets for the adversaries' initial or counter-battery fires and may endanger nearby civilian populations, they can also hold at risk the adversaries' assets. Furthermore, many potential missile deployment locations are already likely targets of adversary strikes. This fact provides an opening for partners to join the United States in hosting and deploying new missiles to deter future enemy strikes on allied homelands. The chance that U.S. allies could align even further with Washington because of concerns about preemptive enemy strikes may influence the adversary's risk calculus as well.

Finally, high-intensity conflicts in the Indo-Pacific or Europe are likely to feature high rates of attrition of both platforms and munitions. In such a situation, it makes sense to invest in both an increased quantity and a more diverse portfolio of strike options that are collectively able to generate a large volume of sustained firepower.

An Asymmetries-Based Approach to Strategy

To fully reap the benefit of any U.S. or allied ground-based missiles, the United States needs a coherent strategy around which to procure and field these systems. A starting point for devising such a strategy is to consider the fundamental asymmetries in a competition between a continental power, like China or Russia, and an insular power like the United States. For a continental power that employs ground-based missiles for defensive and coercive purposes, the *range* of its strike systems is the leading factor. It must build a missile

17 For a thorough exploration of the difficulty of targeting mobile TELs, see Alan J. Vick, Richard M. Moore, Bruce R. Pirnie, and John Stillion, *Aerospace Operations Against Elusive Ground Targets* (Santa Monica, CA: RAND, 2001), https://www.rand.org/pubs/monograph_reports/MR1398.html.

18 For example, in the Gulf War, hunting Iraqi ballistic missile TELs consumed "as much as 25 percent of F-15E and LANTIRN equipped F-16 sorties in the war." Despite this consumption of aircraft, not a single TEL was destroyed by aircraft. Gregory Wilson, "A Time-Critical Targeting Roadmap," Air Command and Staff College, Air University, April 2002, p. 5, available at https://apps.dtic.mil/sti/pdfs/ADA420658.pdf; Defense Science Board, "Future Strategic Strike Forces," Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, February 2004, p. 6–4, https://dsb.cto.mil/reports/2000s/ADA421606.pdf.

arsenal that possesses sufficient range to reach various targets along its periphery and allows it to exploit its own strategic depth.

This pattern is clearly discernable in China's missile development, which proceeded over the past several decades unconstrained by the INF Treaty. It first built medium-range missiles to target Japan, and then proceeded to build longer-range weapons capable of reaching more distant U.S. regional bases in Guam, the Philippines and extending further to Hawaii and Alaska. Finally, Chinese developers achieved the range necessary to target the continental United States.[19] This missile build-up, by which China progressively built out concentric rings of missile ranges emanating from the homeland, has been dictated in part by cost, technical feasibility, operational requirements, and geography.[20]

The mainstays of China's medium/intermediate-range missile inventories are the DF-17, DF-21, and DF-26 missiles, with maximum ranges of up to 2,500 km, 2,150 km, and 4,000 km, respectively. As shown in Figure 1, these missiles threaten both U.S. and allied surface vessels and military installations within the first island chain, with the DF-26 capable of reaching as far as Andersen Air Force Base in Guam along the second island chain.

China has also invested in GLCM capabilities such as the CJ-100 missile and procured additional GLCM launchers, all with intermediate ranges. According to the DoD, Beijing's missile arsenal now includes more than 1,250 ground-based cruise and ballistic missiles with ranges spanning from 500 to 5,500 km.[21] In addition, many of these platforms are dual-capable, i.e., they can carry both nuclear and conventional warheads. Overall, the increase in the number of People's Liberation Army Rocket Forces (PLARF) intermediate-range ballistic missile (IRBM) and GLCM launchers has corresponded with a decrease in the quantity of short-range ballistic missile (SRBM) launchers. This trend indicates Beijing's growing reliance on longer-range capabilities and its expectation that a future conflict in the region will be decided by its ability to hold U.S. and allied forces at risk using these missiles.[22]

Similarly, the development of the SSC-8 (9M729) GLCM, with a maximum range of 2,500 km, indicates Russia's growing focus on long-range offensive fires. In March 2018, Russian President Vladimir Putin declared that the country was developing new missile platforms such as a more maneuverable, long-range, nuclear-powered cruise missile and a new, nuclear-armed, submarine-launched long-range missile. In addition, Russia has forward

19 The increased range of these systems will also allow China to target large parts of Europe.

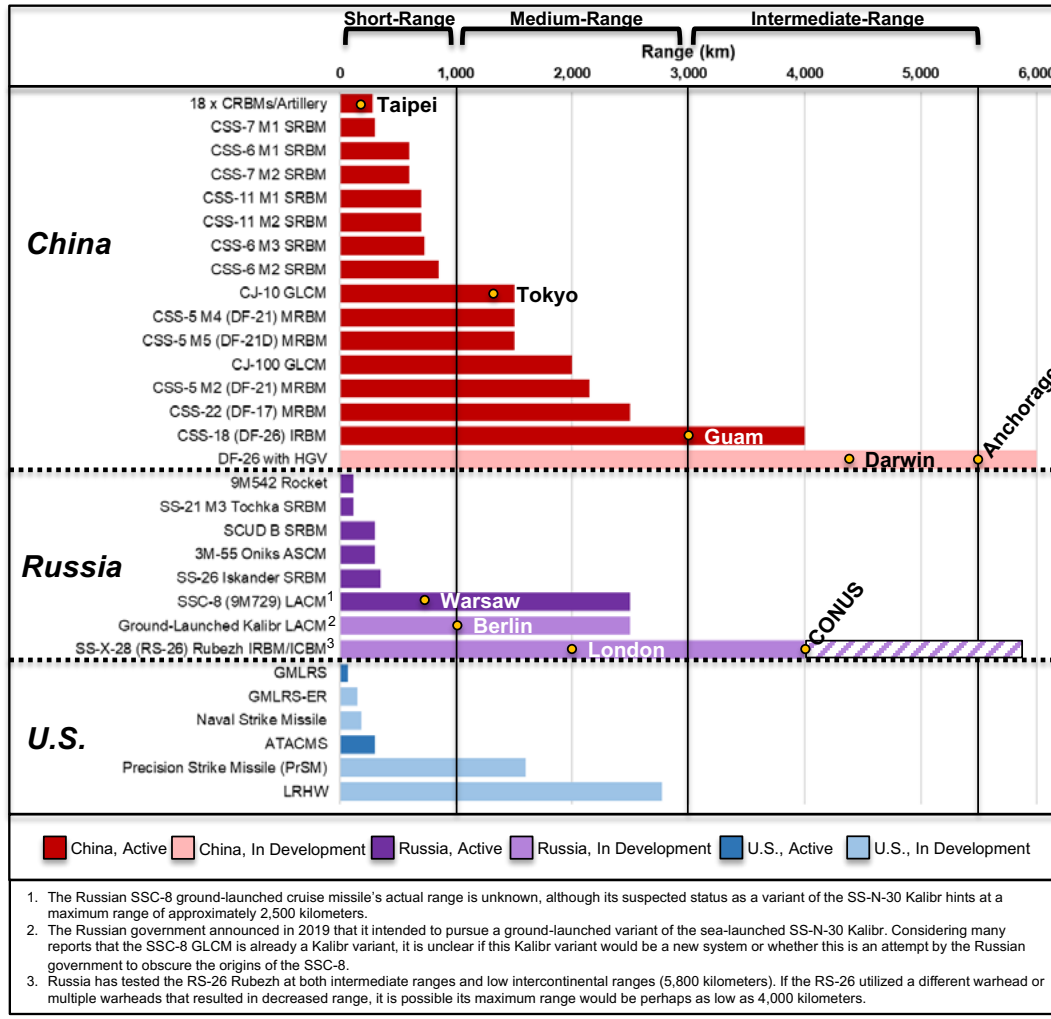
20 The complete sequence of Chinese ballistic missile development is explored in John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," *International Security* 17, no. 2, pp. 5–40.

21 Office of the Secretary of Defense, "Military and Security Developments Involving the People's Republic of China 2020," September 2020, p. ii, https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

22 Beijing may also use these systems as part of nuclear saber-rattling efforts early in a crisis. For example, see Evan Montgomery and Toshi Yoshihara, "Leaderless, Cut Off, and Alone: The Risks to Taiwan in the Wake of Ukraine," *War on the Rocks*, April 5, 2022, https://warontherocks.com/2022/04/leaderless-cut-off-and-alone-the-risks-to-taiwan-in-the-wake-of-ukraine/.

deployed missiles close to NATO's eastern front in the enclave of Kaliningrad, including Iskander SRBMs.[23] As local powers, both Russia and China aim to increase the range of their respective missile inventories to threaten a larger number of targets in Europe and the Indo-Pacific.

FIGURE 1: RANGES OF CHINESE, RUSSIAN, AND U.S. CONVENTIONAL GROUND-BASED MISSILES



1. The Russian SSC-8 ground-launched cruise missile's actual range is unknown, although its suspected status as a variant of the SS-N-30 Kalibr hints at a maximum range of approximately 2,500 kilometers.
2. The Russian government announced in 2019 that it intended to pursue a ground-launched variant of the sea-launched SS-N-30 Kalibr. Considering many reports that the SSC-8 GLCM is already a Kalibr variant, it is unclear if this Kalibr variant would be a new system or whether this is an attempt by the Russian government to obscure the origins of the SSC-8.
3. Russia has tested the RS-26 Rubezh at both intermediate ranges and low intercontinental ranges (5,800 kilometers). If the RS-26 utilized a different warhead or multiple warheads that resulted in decreased range, it is possible its maximum range would be perhaps as low as 4,000 kilometers.

Source: Created by CSBA, based on previous data from *Leveling the Playing Field* and the National Air and Space Intelligence Center's 2020 report on the *Ballistic and Cruise Missile Threat*, available at https://irp.fas.org/threat/missile/bm-2020.pdf.

Rather than range, *location* is the leading strategic factor for an insular power, such as the United States, that employs its own theater-range missiles to support an expeditionary

23 For a thorough review of the reasons Russia may have had for violating the Treaty, see Michael Fitzsimmons, "Russian Strategy and the End of the INF Treaty," Survival, 60:6, 119–136.

regional strategy. An insular power cannot simply replicate the missile strategy of a local continental power to contest a faraway region. For example, the PLARF's force structure would not be suitable for deployment in the continental United States because the bulk of its systems lack the range to reach any of the regional threats the United States faces. At the same time, the United States cannot rely exclusively on long-range systems fielded in its homeland as a launchpad for its ground-based missile strategy. Building large quantities of very long-range conventional missiles at scale for deployment on home territory, located far from theaters of interest, is simply too costly and impractical. Although modern precision guidance enables pinpoint accuracy independent of range, the cost of a missile system is still very much related to its range.[24] Moreover, such missile types, particularly those crossing the threshold of intercontinental ranges, raise a host of concerns and political redlines related to crisis instability and escalation control in the age of nuclear overhang.

Instead, the United States should seek to deploy missiles as close to the local power as possible. Some of these locations may be on U.S. territory, such as Guam, which is still quite far from China, but most of the territory suitable for missile deployment belongs to U.S. allies and partners. Some may be very close to the adversary, such as Taiwan, Japan, and the Baltic States, while others may be relatively distant, such as Australia and the United Kingdom. These states also contend with a variety of strategic and domestic political barriers to hosting such missiles. As a result, political accessibility to friendly countries is a major determinant of U.S. missile strategy.

Ultimately, all missile options are constrained by the geostrategic principle that a continental power closes the distance between itself and the target by range while an insular power closes the distance between itself and the target by location. Simply put, Chinese and Russian missiles "range out" from their homelands, while U.S. and allied missiles "range in" to targets within Chinese and Russian territory. This asymmetry is a vital foundation to consider in any U.S. ground-based missile strategy.

Using Strategic Geography to Define the Rings of Fire

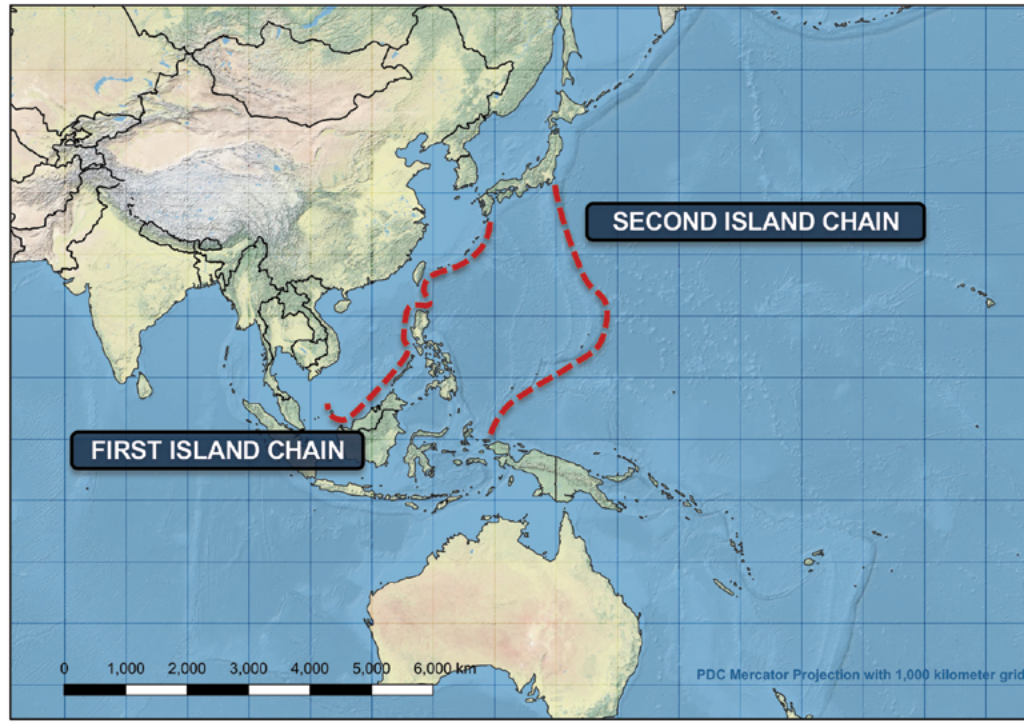
With this principle in mind, the second step in constructing a framework for a ground-based missile strategy is a holistic examination of the strategic geography of the Indo-Pacific and European theaters. Geography plays a prominent and enduring role in formulating any precision-fires strategy and demands the consideration of several factors. Vast distances across theaters force policymakers to consider how weapons of various ranges could extend deterrence across an entire region of operations. Most importantly, the geographic makeup

24 Barry D. Watts, *The Evolution of Precision Strike* (Washington, DC: Center for Strategic and Budgetary Assessments, 2013), p. 20, https://csbaonline.org/research/publications/the-evolution-of-precision-strike#:~:text=In%20The%20Evolution%20of%20the,affect%20vital%20U.S.%20Security%20interests; Mark Gunzinger and Bryan Clark, *Sustaining America's Precision Strike Advantage* (Washington, DC: Center for Strategic and Budgetary Assessments, 2015, pp. 24–25, https://csbaonline.org/research/publications/sustaining-americas-precision-strike-advantage.

of theaters, whether the archipelagic littorals of the Indo-Pacific or the contiguous landmass of Europe, determines the availability of basing sites for ground-launched missiles.

Geography also contributes to strategic threat perceptions. Chinese and Western analysts have both used the first and second island chain concepts to describe the sense of containment that Beijing perceives as it faces the bilateral hub-and-spoke system of U.S. alliances in Asia and the various U.S military installations surrounding China.[25] As displayed in Figure 2, these concepts have typically focused on viewing the Western Pacific in a flat and lateral fashion, from east to west, or vice-versa. This same lateral view is also applied to the European theater, stretching from Western Europe to the Russian heartland. These limited two-dimensional, east-west views of the Indo-Pacific and European theaters are not optimal for fully analyzing the capabilities and ranges of modern ground-based missile systems.

FIGURE 2: TYPICAL MAP OF THE INDO-PACIFIC THEATER, INCLUDING THE FIRST AND SECOND ISLAND CHAINS



Source: Graphic created by CSBA using map data courtesy of naturalearthdata.com.

The formulation of a comprehensive, holistic fires strategy necessitates going beyond this two-dimensional lateral perspective and adopting an omnidirectional, 360-degree view

25 See Toshi Yoshihara and James R. Holmes, *Red Star Over the Pacific, Second Edition: China's Rise and the Challenge to U.S. Maritime Strategy* (Annapolis, MD: Naval Institute Press, 2018).

of strategic geography. This perspective reveals geography that provides greater depth and flexibility when considering missile ranges and deployment locations. For example, defense planners in the Indo-Pacific could extend the island chain concepts to encompass the Indian Ocean as well, opening the possibility of new fires locations and justifying a more comprehensive Indo-Pacific outlook.[26] The potential of missiles along China's entire land and maritime periphery—not just along the South and East China Seas—would change Beijing's risk calculus and force it to contend with threat vectors from multiple directions. Likewise, viewing the theaters on a three-dimensional globe, as shown in Figure 3, reveals the true nature of north-south distances by removing the distortion of a flat map, such as the Mercator Projection used in Figure 2. The same principles apply to Russia and the European theater.

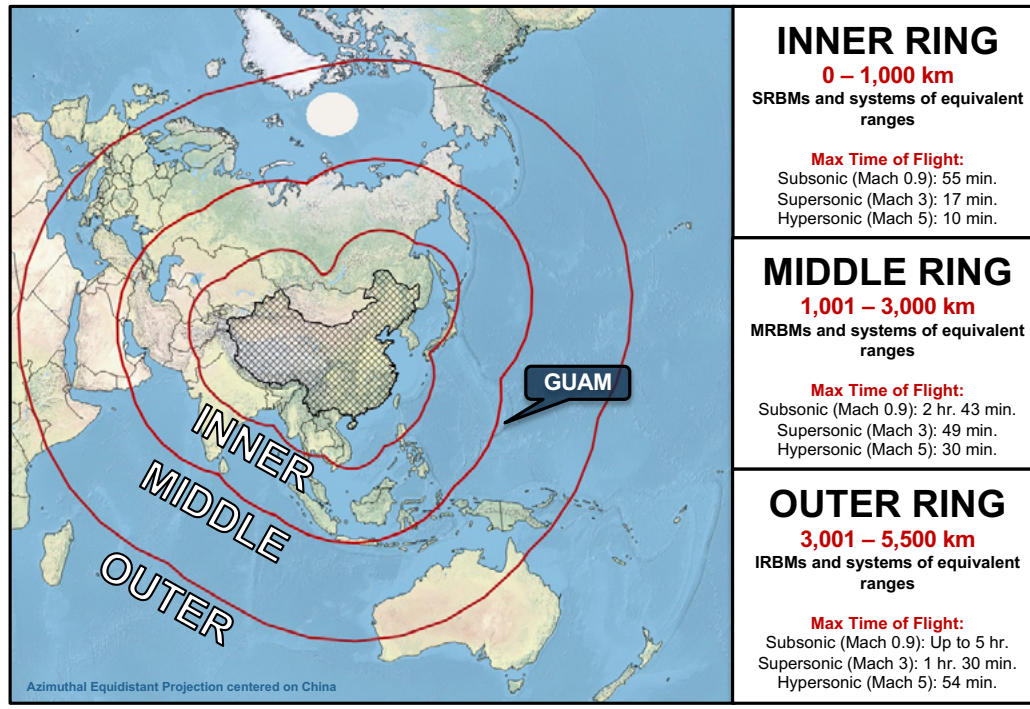
To depict Chinese and Russian missiles "ranging out" and U.S. weapons "ranging in," these global views of the Indo-Pacific and European theater are best complemented by concentric range rings originating in the home territory of an adversary and gradually emanating outward. Coupling this view of the theaters with concentric range rings reveals a host of geographic relationships and potential missile deployment locations at all ranges.

Three Rings Emerge

The final step in formulating our analytical framework is determining the set of range rings best suited for the examination of missile options. To maintain consistency across the post-INF missile portfolio debate, the most appropriate set of rings corresponds to the ranges of the existing classes of conventional missiles: short-range, medium-range, and intermediate-range. This categorization results in a three-tiered series of concentric range rings originating in the central territory of China and Russia, where the majority of potential targets for U.S. missiles reside. The first inner ring corresponds with the maximum range of short-range missiles and extends up to 1,000 kilometers (km) from an adversary's homeland. The second middle ring encompasses medium-range missiles and reaches from 1,000 km out to 3,000 km. The third outer ring covers distances between 3,000 and 5,500 km and would require intermediate-range missiles to reach targets in China or Russia. Systems within each of these range rings could be ballistic or cruise missiles or boost-glide vehicles.

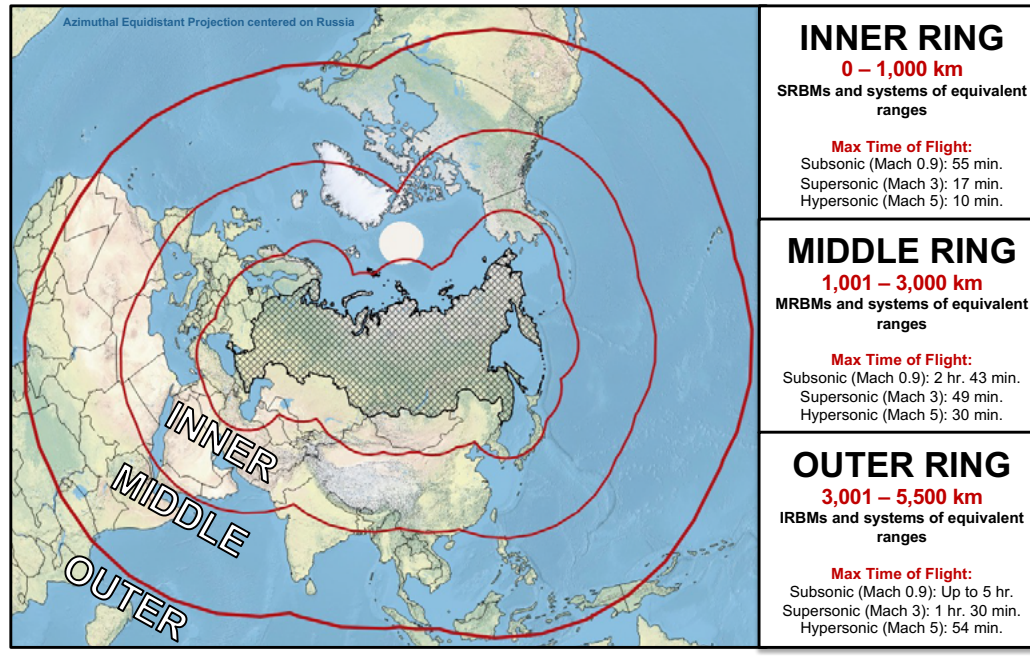
26 One example of this more expansive definition of the first and second island chains is shown on the map proposed by former USN Pacific Fleet Commander Scott Swift. See Kevin Rudd, "Can China and the United States Avoid War?" *Proceedings*, U.S. Naval Institute, December 2018, available at https://www.usni.org/magazines/proceedings/2018/december/can-china-and-united-states-avoid-war.

FIGURE 3: THE APPROXIMATED THREE RINGS IN THE INDO-PACIFIC THEATER.



Source: Graphic created by CSBA using map data courtesy of naturalearthdata.com.

FIGURE 4: THE APPROXIMATED THREE RINGS IN THE EUROPEAN THEATER



Source: Graphic created by CSBA using map data courtesy of naturalearthdata.com.

The framework, depicted in Figures 3 and 4, reflects the geostrategic reality that as a distant offshore power, *any U.S. missile strategy will be driven by launch points, in contrast to adversary strategies that are driven by target location.* Frontline allies would host short and medium-range missiles, while those more distant from China and Russia could host medium and intermediate-range missiles. The likely deployment locations would be determined by the proximity of allies to the intended opponent and the closeness of their political relationship with the United States. The nearer to the opponent and the closer political ties are to the United States, the better. And, clearly, the more locations and friendly ties with potential hosts of quality locations, the better.

Territories within the inner ring, which are at greatest risk to Chinese and Russian counterfire due to their proximity, would host short-range (up to 1,000 km) systems. The middle ring would accommodate medium-range (from 1,000 to 3,000 km) systems. Missile speed and flight time would become more important as we consider missiles stationed further from adversaries. For example, a missile flying at Mach 2 would take about 49 minutes to travel 2,000 km, whereas a subsonic missile flying at Mach 0.9 would take one hour and 48 minutes to travel the same distance. Finally, the outer ring would require IRBMs with ranges between 3,000 and 5,500 km.

This three-ring missile construct, comprising theater-range conventional missiles, would be tailored to the local circumstances of the Indo-Pacific or European theaters, respectively. A medium-range missile could be deployed in the inner ring, while an intermediate-range missile could be deployed in the middle ring, allowing U.S. forces to reach deeper into Chinese and Russian territory.

The Three Rings in the Indo-Pacific

In the context of the Indo-Pacific, this study considers missiles that can hit the Chinese mainland, PLA naval forces operating in the Western Pacific and the Indian Ocean, and offshore territories, such as artificial geographic features and the Chinese-occupied Spratly Islands in the South China Sea. For a U.S.-led missile strategy in the Indo-Pacific, two features peculiar to the theater would determine the shape of the missile forces and their deployment: the theater's maritime character and the lack of useful geography (which provides strategic depth for ground-based missile forces) when compared to the European theater of operations. The most plausible real estate for missile deployment is located within the inner ring along a thin strip of islands stretching from Japan down to the Philippines. The next set of plausible locations is mostly in the outer ring and encompasses Alaska, Guam, Australia, and Diego Garcia.[27] Except for Guam, intermediate-range missiles would be needed to reach China or the near seas from those locations. Hawaii and the lower

27 Based on range alone, some locations in Europe may also have strategic utility for western China.

forty-eight contiguous United States would require conventional ICBMs, which are outside the scope of this framework.

The first and second island chains are separated by open ocean. For example, more than 2,700 kilometers of the Philippine Sea separate Taiwan's east coast from Guam. Notably, possible deployment locations fall off sharply as one moves away from the first island chain. A 300-kilometer-range SRBM would be more than sufficient to hit China from Taiwan, and an 800-kilometer-range SRBM would be capable of reaching China from Okinawa, Luzon, and Kyushu. Medium-range missiles could range China from the Japanese islands of Honshu, Hokkaido, and the Philippine island of Mindanao. Moving further east, 3000+ kilometer-range intermediate-range missiles would be needed to attack the mainland coast or the near seas from Guam. From Alaska, Australia, and Diego Garcia, 5,000+ km-range missiles would be needed to threaten northeast China, southern China, and southwestern China, respectively. Anti-ship versions of these missiles would be able to hold PLA naval forces operating inside their range arcs at risk. Ground-based land-attack missiles on Mindanao and Australia could also threaten artificial geographic features and the Chinese-occupied Spratly Islands in the South China Sea.

The Indo-Pacific Inner Ring

Given the geography, the inner ring in the Indo-Pacific region would primarily consist of the main Japanese islands and the numerous smaller islands across the Ryukyus, exploiting the country's archipelagic environment to base missile systems in a chain stretching out across the East China Sea.[28] For political reasons, Tokyo would most likely concentrate on anti-ship cruise missiles (ASCMs) and naval targets as part of a defensive posture designed to prevent PLA Navy (PLAN) vessels from threatening Japanese territory and maritime interests in the region or from using the seas surrounding Japan to achieve operational aims.

Other inner ring locations could potentially include the Philippines, Taiwan, and parts of Northern India. The Philippines' archipelagic environment, like Japan's, also provides numerous basing opportunities for missiles and could allow Philippine forces to range PLAN surface combatants transiting from the South China Sea to the greater Pacific Ocean. The archipelagic landscape of both countries also disperses missile launchers across broad swathes of the inner ring, increasing the number of targets Beijing would have to find, track, and engage.

28 Jeffrey W. Hornung, *Japan's Potential Contributions in an East China Sea Contingency (*Santa Monica, CA: RAND Corporation, 2020), p. xiv, https://www.rand.org/pubs/research_reports/RRA314-1.html#download.

Although Taiwan, India, and Vietnam are not U.S allies, they could be considered parts of the inner ring under certain conditions.[29] Taiwan's growing arsenal of ASCMs plays a role in the defense of the island against a PLA incursion and provides a critical central link in the north-south perimeter of the first island chain. Since these missiles will target PLAN vessels regardless of U.S. direction or posture, they can be regarded as an indirect but important supporting part of any U.S. fires strategy.

Northern India could also serve as an inner ring location if tensions between Beijing and New Delhi encourage India to invest in ground missiles to hold parts of Southwestern China at risk.[30] India could also consider the stationing of ASCMs in the Andaman-Nicobar Islands to cover the western end of the Malacca Strait and target PLAN vessels operating near the Indian Ocean region.[31] India's deployment of missiles close to the Sino-Indian border and Indian Ocean might constitute the southern segment of the inner ring, and could be a significant, albeit indirect, contribution to a wider Indo-Pacific missile strategy.

The Indo-Pacific Middle Ring

The geography of the Indo-Pacific limits the number of middle ring locations available to deploy medium-range ground-based fires. Ranges from 1,000-3,000 km expand the list of possible locations for ground-based missiles to include Japanese islands beyond the Ryukyus, such as Honshu and Hokkaido. Likewise, Mindanao and other southern Philippine islands could range maritime targets in the South China Sea or ground targets in southern China. Medium-range systems would also expand the number of potential deployment locations in India. However, the middle ring in the Indo-Pacific does not yield additional nations of interest for inclusion in a missile strategy. Instead, medium-range missiles would greatly expand the potential launch locations and target areas of nations already included in the inner ring.

The Indo-Pacific Outer Ring

The outer ring in the Indo-Pacific, from 3,000-5,500 km, includes several key locations for intermediate-range weapons. Beginning in the south, IRBMs based in northern Australia could reach targets in all of southern China, extending as far north as Shanghai. Australia's location in the outer ring presents a significant strategic opportunity. As a close ally,

29 Vietnam is reportedly interested in purchasing BrahMos anti-ship missiles from India, likely over concerns about continued PLAN activities in the South China Sea. Rajeswari Pillai Rajagopalan, "The Strategic Logic Behind India's Sale of BrahMos Missiles to the Philippines," *The Diplomat*, January 21, 2022, https://thediplomat.com/2022/01/the-strategic-logic-behind-indias-sale-of-brahmos-missiles-to-the-philippines/.

30 For a more thorough examination of the Sino-Indian rivalry and U.S.-India partnership, see Evan Braden Montgomery, "Competitive Strategies against Continental Powers: The Geopolitics of Sino-American Relations, *Journal of Strategic Studies*, 36:1, p. 76–100.

31 Evan Braden Montgomery, "India's Anti-Access Trump Card," *The Diplomat*, June 6, 2013, https://thediplomat.com/2013/06/indias-anti-access-trump-card/.

Australia can be integrated into U.S. kill chains. The recent AUKUS agreement and other developments in U.S.–Australian defense cooperation provide existing frameworks and mechanisms that could lay the path for future collaboration work on the development and operations of ground-based missiles.

Moving north along the second island chain, the next possible basing location is in the Caroline Islands in nations such as Palau.[32] Most significantly, the U.S. territories of Guam and the Commonwealth of the Northern Mariana Islands (CNMI) could range most targets in China east of the Gobi Desert and Tibetan Plateau. U.S. missiles in the Marianas would be a direct counter to the Chinese DF-26 IRBM, often dubbed the "Guam Killer," although many of these islands are small in size and would limit the concealment or distribution of missile systems. Finally, the northern outer ring includes Alaska's Aleutian Islands. Although basing on some of the eastern Aleutians would limit IRBMs to reaching northeastern China, western islands such as Atka, Adak, Tanaga, and Attu could threaten targets throughout northern China. From the south, intermediate-range weapons in Diego Garcia could range Chinese targets on an arc extending from Xinjiang to Hainan.[33]

This initial examination of the three rings in the Indo-Pacific yields several insights. First, Japan and the Philippines are the strategic terrain in a theater that lacks large landmasses. Their territory provides some strategic depth running north and south on the first island chain. Therefore, these nations would be the most logical hosts for short and medium-range weapons. Second, although the inner and outer rings contain a host of conceivable missile locations, the Indo-Pacific middle ring falls mostly in the open ocean between the first and second island chains. The theater's geography sharply bifurcates the range of suitable missile systems in this theater. Short-range missiles and intermediate-range missiles enjoy far more potential basing locations than medium-range missiles in the Indo-Pacific.

The Three Rings in Europe

In the European theater, this study considers missiles that can threaten the Russian homeland, including its Far East territories, as well as naval forces operating in the Baltic Sea, Black Sea, Barents Sea, and the Eastern Mediterranean. Europe's inner ring primarily consists of NATO's current eastern front: Poland, Romania, the Baltic States, and Norway, with Sweden and Finland likely to be added soon. The middle ring further expands to include the nations of Western Europe and the United Kingdom. The outer ring includes the

32 The island nation of Palau has already agreed to host a U.S. over-the-horizon radar site and has been the recipient of funds to improve its Anguar airfield. See Derek Grossman, "America Is Betting Big on the Second Island Chain," *The RAND Blog*, September 8, 2020, https://www.rand.org/blog/2020/09/america-is-betting-big-on-the-second-island-chain.html; Joseph Trevithick, "This Is the Pentagon's $27 Billion Master to Deter China in the Pacific," *The Drive*, March 5, 2021, https://www.thedrive.com/the-war-zone/39610/this-is-the-pentagons-27-billion-master-plan-to-deter-china-in-the-pacific.

33 Based purely on range, some locations in Europe could also reach key locations in western China with intermediate-range weapons.

entire continent of Europe and some areas of North Africa, the Middle East, and the North American Arctic.

The European Inner Ring

The European theater's inner ring deployment options would primarily consist of NATO members on the alliance's eastern front, such as the Baltic States, Poland, Romania, Norway, and prospectively Sweden and Finland. U.S. and NATO forces based in some of these countries could employ surface-to-surface missiles to target Russian frontline military bases, assembly areas, armored formations, missile batteries, integrated air defense systems (IADS), and logistics chokepoints. It is likely that some of these countries may accept additional precision-fires assets in their territories due to their proximity to Russia and their vulnerability to a rapid ground incursion. Missile units based in these locations would also have to account for Russian forces located in Kaliningrad, which already represent a significant concentration of Russian missiles, air defense systems, and other military assets squeezed between frontline NATO members.[34]

Whereas ground-to-ground missiles could focus on both Russian forces in Kaliningrad and along the border with Eastern Europe, anti-ship missiles could seek to deny Russian naval forces freedom of maneuver in the European littorals. ASCMs in the Baltic States, Poland, and Romania could hold Russian forces throughout the Baltic and Black seas at risk. In the north, ground-based anti-ship missiles in Norway could supplement that nation's ship-based missiles to provide persistent coverage of Russian naval activity near Murmansk and the Arctic Ocean. Swedish and Finnish territory is ideal for both ASCMs and surface-to-surface missiles.

The European Middle Ring

The middle ring has more utility in continental Europe than the Indo-Pacific. Medium-range missiles expand the range of potential hosts from nations on NATO's front to allies throughout central and western Europe. Denmark, Germany, Czechia, Italy, Greece, the Netherlands, Belgium, France, and Spain could all host missiles capable of ranging targets in western Russia. These locations could provide additional depth to a missile strategy, and some of these nations previously hosted U.S. medium-range GLCMs or Pershing missiles. Although many of these nations' attitudes toward hosting missiles have changed since the Cold War, recent Russian aggression against Ukraine may further shift the security and political environment in Europe.

Most importantly, the European middle ring includes the United Kingdom. Washington maintains its special relationship with London, which formerly accommodated U.S.

34 Reuters Staff, "Russia deploys Iskander nuclear-capable missiles to Kaliningrad: RIA," *Reuters*, February 5, 2018, available at https://www.reuters.com/article/us-russia-nato-missiles/russia-deploys-iskander-nuclear-capable-missiles-to-kaliningrad-ria-idUSKBN1FP21Y.

nuclear-equipped GLCMs during the Cold War. As a close ally, the United Kingdom is a prime candidate for integrating kill chains and sharing missile technology. The recent AUKUS security pact signed between the United States, the United Kingdom, and Australia could also pave the way for future trilateral development of missile systems.

The European Outer Ring

IRBMs could be placed anywhere in Europe and range a variety of targets in Russia. The outer ring in the European theater contains a number of additional countries unsuitable or unlikely to host U.S. missiles—including Portugal, Iceland, and the nations in North Africa and the Middle East. IRBMs oriented toward China in India would also be capable of reaching Russia, however unlikely this possibility is in the near future. Canada's Labrador and Nunavut regions could host intermediate-range missiles able to strike Russian military facilities from Murmansk and Polyarny in the north to Voronezh in the south. This study notes these locations as possibilities in order to thoroughly assess multi-directional approaches along the outer ring, but does not further explore their feasibility, due to current political and diplomatic constraints. Instead, the most likely hosts of intermediate-range weapons remain NATO allies in continental Europe.

Across the three rings, the European theater contains many potential missile hosts. Nations such as Poland, Norway, Sweden, or Finland could host both land-attack and anti-ship missiles, while others are land-locked and only suitable for certain types of weapon systems. Nevertheless, most basing opportunities in Europe reside in the inner and middle rings. Although IRBMs could be placed in the European inner or middle rings, the European outer ring is of less utility due to the likelihood of political and diplomatic constraints.

Comparing the Rings Across Theaters

An initial examination of the three rings in the Indo-Pacific and European theaters reveals some fundamental similarities and differences.

Similarities Between the Indo-Pacific and European Theaters

Beginning with similarities, both theaters contain locations within the middle and outer rings that could host intermediate-range missiles. These territories include the United Kingdom in Europe and Diego Garcia, Australia, Guam, and Alaska in the Indo-Pacific. Missiles of this range could present opportunities for joint missile development with close allies like Australia and the United Kingdom, possibly under AUKUS. Furthermore, opportunities may exist to deploy short-range or medium-range missiles that possess an ideal range for both Asia and Europe. These possibilities will be explored further in chapter 4.

In both the Indo-Pacific and Europe, geography requires the United States to rely on local missiles from allies or to forward deploy American weapons on allied or friendly soil. This forward-based missile posture, in turn, places a premium on diplomacy and alliance

management. Put another way, short-range missiles may be the most cost-effective way to field a missile force, but they come with a high politico-diplomatic price tag. Without reliable access to allied territories, the usability of a short-range arsenal, even if effective, could be hobbled by political considerations.[35] Short-range systems that are cheaper require access to foreign soil, thus raising the political costs. Long-range systems launched from U.S. soil would be more expensive but would incur lower diplomatic costs.

Differences Between the Indo-Pacific and European Theaters

Regarding differences, Europe possesses strategic depth for ground-based systems that is simply absent in the Indo-Pacific. This depth runs in all directions but is particularly significant from east to west. This contrasts with the Pacific, where the limited strategic depth is more abundant running from north to south. Short- and medium-range missiles could be placed in a far greater number of locations in Europe to increase deterrence and generate combat power. Additionally, when considering maritime targets, Europe offers more diverse and strategic natural chokepoints such as Norway toward the Barents Sea and Denmark, Sweden, and Finland facing the Baltic Sea.

Another major difference between the theaters is the nature of the United States' relationships with the inner, middle, and outer ring nations. In Europe, the U.S. leads NATO, a multilateral alliance with an integrated military structure and well-established venues for consultation and joint decision-making with allies. These institutionalized mechanisms served the United States and the Alliance well in the dual-track decision of the Cold War and the subsequent negotiations with the Soviet Union. In Asia, by contrast, the United States maintains a series of bilateral security and defense relationships. Some, but not all, of these agreements include a guarantee to defend the ally if attacked. This "hub and spoke" system (sometimes known as the "San Francisco system" in reference to the site of the conference where the U.S.-Japan Mutual Security Treaty was signed in 1951) makes the United States the principal connective tissue among Asian allies and partners but without the kind of multilateral coordination mechanisms that have existed in Europe since 1949.

These differences leave the United States with a dilemma when considering the value of missile systems of various ranges. Both the Indo-Pacific and European theaters contain many locations along the inner ring to deploy short-range missiles, making these weapons sensible investments with a high degree of flexibility and deployment options. Moving farther out, however, there is a difference between the two theaters and their requirements for longer-range missiles. The medium-range systems ideal for the open terrain of continental Europe are less useful in the maritime environment of the Indo-Pacific, whereas intermediate-range missiles are required to reach the Chinese mainland from outer ring locations. As a result of this differing geography, the United States needs a holistic missile

35 *Leveling the Playing Field* previously discussed the use of allied territories to host ground-based missiles. See *Leveling the Playing Field*, p. 30.

strategy that leverages technologies, weapon systems, and deployment locations that create the most advantage across the three rings against both adversaries. With the Indo-Pacific as its priority theater, the United States should explore developing longer-range systems suited for both theaters. Longer-range systems can always be fired over shorter distances. The next chapter will review current American and allied ground-based missile programs, with an eye toward investments in medium and intermediate-range systems.

CHAPTER 3

Current Missile Capabilities and Investments in the Three Rings

The U.S. departure from the INF Treaty frees the United States to pursue different long-range precision fires options. *Leveling the Playing Field* outlined several notional programs for the long-range-fires initiative, but with Congress and the armed services already working to procure these systems, this section will provide an update on the state of U.S. and allied missile programs.[36] This survey of ground-based missile systems throughout the three rings reveals heavy investment in short-range weapons for the inner ring but little investment in the development of intermediate-range systems.

Strike Portfolio Specifications

Before reviewing missile programs, it is necessary to examine the characteristics of ground-based missile systems the United States might choose to include in its strike portfolio. The previous chapter outlined the different threat environments in the Indo-Pacific and European theaters, including the strategic geography and types of targets that U.S. and allied forces would have to face in contested spaces. These components define the type of strike portfolio that Washington could develop in the next several years to deter and defeat aggression in these theaters. Strike assets are defined by at least five major characteristics: 1) delivery platform, 2) range, 3) speed, 4) intended target, and 5) area of effect.

Delivery platform refers to the ground, sea, or air systems that carry and fire the missiles. Ground platforms can be fixed or mobile. Fixed missile sites can be hardened to withstand first strike or counterbattery fires. Mobile launchers can be mounted on trucks, trailers,

36 *Leveling the Playing Field*, pp. 33–39.

or railcars and are often soft targets that rely on camouflage, concealment, deception, and mobility to survive. Range is a critical determinant in both the cost of a missile system and which ring of the new framework it should be based. Likewise, speed and maneuverability are linked to cost and can affect the missile's suitability for certain targets and ability to evade adversary defenses. Increased speed reduces a missile's flight time, making it more responsive and better suited to striking mobile and elusive targets.

Missile function, such as anti-ship or ground-to-ground, determines the types of targets it can reach and hold at risk. Function largely determines key missile components such as the guidance system, flight characteristics, warhead type, and associated survivability features. Another critical dimension is the effects radius of the weapon itself, categorized as either precision or area effect. Precision effect missiles attack specific targets, are normally guided by radar or satellite, and typically have the greatest effects against fixed targets. Missiles with submunitions for multiple targets or a larger area of effect cover mobile targets spread out across a wider target zone and are most useful in situations when the target's exact location is unknown. Modern area effect missiles typically have enhanced autonomous functions, use varied imaging capabilities to identify their targets, and can often loiter for a limited period in a combat space until a target is found and they are directed to strike.[37]

The optimal strike portfolio in each theater of the three rings framework should aim to incorporate a diverse mix of delivery platforms and missiles to best cover all possible types of targets and achieve a deterrent effect across the major domains. Procuring a diverse mix of missile capabilities would reduce the risk presented by geopolitical and military uncertainties in each theater and require a wider array of adversary efforts to develop countermeasures. Defense planners should also consider how missiles currently in development could be modified to extend their ranges or encompass additional target types beyond their planned function. In this way, certain strike options could cover multiple target types and missions, increasing the lethality of these assets and their operational versatility.

Integrating Ground-Based Assets into a System of Systems Approach

It is important to note that although this study outlines ground-based strike options for evaluation in a U.S. post-INF missile framework, missiles alone will be insufficient to shift the military balance of power in favor of the United States and its allies in either the Indo-Pacific or European theaters. Long-range precision fires exist alongside other platforms and weapons to provide commanders a wide array of strike options to deter adversary aggression in contested theaters and, if necessary, defeat hostile forces should conflict erupt. Post-INF Treaty missiles should not be treated as a "silver bullet" that immediately resolves the challenge of enemy anti-access warfare in theaters. Rather, defense policymakers must consider

37 For a definition of enhanced autonomous or "human in the loop" functions and U.S. policies toward such weapons, see Kelley M. Sayler, *Defense Primer: U.S. Policy on Lethal Autonomous Weapon Systems* (Washington, DC: Congressional Research Service), updated December 1, 2020, https://sgp.fas.org/crs/natsec/IF11150.pdf.

how these new missiles open opportunities for new operational concepts and work in concert with other defense resources as part of a broader integrated strategy. These concepts and the building blocks of such a strategy will be explored in chapter 4. When utilizing the three rings framework, missiles themselves should not just be viewed as independent assets acting in isolation but instead be taken as part of a composite, holistic strike architecture contributing to joint operations and responses.

In this way, missiles are just one aspect of a broader system of systems approach to long-range strike. A system of systems refers to a range of independently useful systems working as part of a larger system to provide unique capabilities.[38] Missiles provide the effect, but a broader system of systems approach includes all of the multi-domain elements of the fires kill chain as well as all available strike assets to generate a dynamic, flexible, theater-wide response.[39] This kill chain includes the mobile or fixed sites that missiles are fired from as well as the aircraft, ships, and submarines delivering missiles via other domains. A variety of sensors is also needed to ensure each missile is guided and tracked from its launch point, through its flight, to when it strikes the target. These sensors include a variety of ISR platforms like aerial drones, unmanned vessels, and remote-sensing satellites, which would relay information to C2 centers in contested theaters. Target detection could also be facilitated by forward-deployed ground units such as the Marine Littoral Regiment (MLR) or the Army's Multi-Domain Task Force (MDTF). Battle networks and command and control systems are another vital aspect of this kill chain. Intelligence must be processed and evaluated by battle commanders in C2 centers, and strike decisions must be relayed to the appropriate delivery asset or controlling unit. Follow-on strike verification by other ISR assets would confirm target destruction or spur further requests for adjustment of fires.[40] Ensuring that the missile and sensors are well coordinated across a large battlefield is a

38 The DoD defines a system of systems (SoS) as "a set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities" and a family of systems (FoS) is defined as "a set of systems that provide similar capabilities through different approaches to achieve similar or complementary effects." Director, Systems and Software Engineering, "Systems Engineering Guide for Systems of Systems," Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, August 2008, p. 4, https://acqnotes.com/wp-content/uploads/2014/09/DoD-Systems-Engineering-Guide-for-Systems-of-Systems-Aug-2008.pdf.

39 Many CSBA studies have examined kill chain and battle network evolution over the past several decades. For more information, see Barry D. Watts, *The Evolution of Precision Strike* (Washington, DC: CSBA, 2013), https://csbaonline.org/research/publications/the-evolution-of-precision-strike; Robert Martinage, *Toward a New Offset Strategy* (Washington, DC: CSBA, 2014), available at https://csbaonline.org/research/publications/toward-a-new-offset-strategy-exploiting-u-s-long-term-advantages-to-restore#:~:text=A%20new%20Offset%20Strategy%20must,emergence%20of%20A2%2FAD%20threats; Andrew F. Krepinevich, *Maritime Competition in a Mature Precision-Strike Regime* (Washington, DC: CSBA, 2015), https://csbaonline.org/research/publications/maritime-competition-in-a-mature-precision-strike-regime; and John Stillion and Bryan Clark, *What it Takes to Win: Succeeding in 21st Century Battle Network Competitions* (Washington, DC: CSBA, 2015), https://csbaonline.org/research/publications/what-it-takes-to-win-succeeding-in-21st-century-battle-network-competitions.

40 Existing technologies also enable a missile system to organically carry its own battle-damage assessment (BDA) capability. For unclassified but dated examples, see John T. Rauch, Jr., *Assessing Airpower's Effects: Capabilities and Limitations of Real-Time Battle Damage Assessment* (Maxwell Air Force Base, AL: Air University, 2002), pp. 44–46, https://apps.dtic.mil/sti/pdfs/ADA420587.pdf.

complex undertaking, but such coordination is essential to the tactical coherence and effectiveness of a missile strategy. A complete examination of the entire missile kill chain is beyond the scope of this study, but a broader ground-based missile strategy must consider the full system of systems required to enable long-range precision fires.

U.S. Ground-Based Missile Programs

Current ground-based systems in the U.S. Army and U.S. Marine Corps are very limited. The Army fields a mix of M270 Multiple Launch Rocket Systems (MLRS) and M142 High Mobility Artillery Rocket Systems (HIMARS). These launchers share several munitions options, from legacy unguided rockets to the MGM-140 Army Tactical Missile System (ATACMS). The ATACMS was developed in the 1980s and was employed in Operations Desert Storm and Iraqi Freedom.[41] Current ATACMS have a roughly 300 km range, which limits their operational utility, particularly in the Indo-Pacific theater.[42] Other MLRS and HIMARS munitions, such as the Guided MLRS munition, or GMLRS, are tactical in nature and feature ranges of 70 to 150 kilometers.[43] The U.S. Marine Corps, which also fields the M142 HIMARS, relies on the GMLRS as its primary rocket munition.

FIGURE 5: U.S. ARMY MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) AND HIGH MOBILITY ARTILLERY ROCKET SYSTEM (HIMARS)

Source: Left photo by Maj. Joseph Bush, 41st Field Artillery Brigade, February 24, 2021, https://www.dvidshub.net/image/6532319/falcons-first-mlrs-live-fire; Right photo by Lance Cpl. Christian Ayers, 3rd Marine Division, March 13, 2019, https://www.dvidshub.net/image/5179446/himars-embakation.

41 Missile Threat, "MGM-140 Army Tactical Missile System (ATACMS)," Center for Strategic and International Studies, July 31, 2021, https://missilethreat.csis.org/missile/atacms/.

42 Lockheed Martin, "Army Tactical Missile System Block IA Unitary," https://www.lockheedmartin.com/en-us/products/army-tactical-missile-system-block-ia-unitary-atacms.html.

43 For more information on GMLRS variants, see Lockheed Martin, "GMLRS: The Precision Fires Go-To Round," https://www.lockheedmartin.com/en-us/products/guided-mlrs-unitary-rocket.html.

With ATACMS' maximum range of 300 kilometers, presently fielded ground-based fires systems lack the capability required to be optimally employed within the three rings construct. These weapons' ranges fall short against two important measures. First, they are significantly outranged by both Chinese and Russian systems. As discussed in chapter 2, China possesses conventional ballistic and cruise missiles with ranges between 4,000 and 5,500 km, and Russia fields GLCMs with a range of 2,500 km. Second, a maximum range of 300 km severely limits the utility of existing ground-based fires systems in the Indo-Pacific, where even the inner ring requires ranges of 800+ km. Insufficient range currently leaves the U.S. military with only air and sea-based strike options in its primary theater of focus.

U.S. Missile Systems in Development

Recognizing these shortfalls, both the U.S. Army and Marine Corps have several long-range fires programs aimed to increase the range of the services' ground-based weapons. The Army is currently developing the Precision Strike Missile (PrSM), a ballistic missile to succeed the ATACMS, and is attempting to gradually increase PrSM's maximum range to around 1,600 km and above.[44] The first increment of PrSM is to be fielded by late 2023 and will be fired from both the MLRS and HIMARS and will primarily cover ground targets, making them an ideal strike option for the European theater.[45] However, development efforts also seek to produce a second increment anti-ship variant of the PrSM with a multi-mode seeker, providing an opportunity for use in the Indo-Pacific theater.[46] Depending on PrSM's final maximum range, the system might function as a principal option for the inner ring and middle ring of both theaters, covering much of the specified distances outlined in that area (0 to 3,000 km).

Another major Army initiative is the Long-Range Hypersonic Weapon (LRHW), or *Dark Eagle*, a ground-launched hypersonic boost-glide body capable of traveling at speeds of Mach 5 and maneuvering through unpredictable flight trajectories. The LRHW is expected

44 Sydney J. Freedberg, Jr., "Can Army Triple PrSM's Missile's Range?" *Breaking Defense*, April 2, 2021, https://breakingdefense.com/2021/04/can-army-triple-prsm-missile-range/. The Army seeks to configure PrSM to strike targets at "mid-range capability," which refers to ranges that span between 1,600 and 1,800 km. This report briefly discusses the Army's separate Mid-Range Capability program, which also seeks to produce a new strike asset that falls within these ranges as well. For more information on the mid-range discussions, see also Sydney J. Freedberg Jr., "Arms Asks Hill for New Mid-Range Missile $$$ ASAP: Thurgood," *Breaking Defense*, October 14, 2020, https://breakingdefense.com/2020/10/army-asks-hill-for-new-mid-range-missile-asap-thurgood/.

45 The M270 was first fielded in the 1980s and several variants of the system exist. The U.S. Army currently fields the M270A1 variant, which includes modern features such as GPS self-location. The A1 variant, however, lacks the fire control capabilities to employ the PrSM. The Army is working to upgrade mothballed Cold War-era M270A0 vehicles to the A2 standard to fire the PrSM. Production is set to begin this fiscal year, but until these upgrades are complete, only the HIMARS will be capable of employing the PrSM. Ethan Sterenfeld, "New Army Multiple Launch Rocket System to be built in FY-22," *Inside Defense*, October 20, 2021, https://insidedefense.com/daily-news/new-army-multiple-launch-rocket-system-be-built-fy-22.

46 The second increment PrSM is slated to reach early operational capability in fiscal year 2027. Andrew Eversden, "The Army Could Get Its Next-gen Precision Strike Missiles in FY27," *Breaking Defense*, May 3, 2022, https://breakingdefense.com/2022/05/the-army-could-get-its-next-gen-precision-strike-missiles-in-fy27/.

to reach distances of 2,775 km and beyond, making it an attractive option for the middle ring.[47] Given their cost and complexity, LRHW munitions are likely to be relatively scarce assets. As a result, it is possible they could be reserved for holding at risk high-value targets.

The third major Army missile effort involves adapting pre-existing weapon systems to establish a "mid-range capability" (MRC) that can serve as a substitute for long-range precision fires until the other development programs reach completion. MRC seeks to field modified ground-launched Tomahawks and the Standard Missile-6 (SM-6), usually considered to be naval strike weapons, that can hit targets at ranges between 500 to 1,500 km.[48] As such, the MRC could be regarded as both an inner and middle ring option. The SM-6 flies at supersonic speeds and primarily covers surface targets, while subsonic Tomahawks, depending on their configuration, have low-altitude terrain-skimming flight profiles to accomplish anti-ship and land-attack missions as well. These missions give the Army flexibility to conduct operations against land and sea targets with the MRC.[49] This capability demonstrates a situation where the Army does not necessarily have to build a new missile program from the ground up and can leverage pre-established technology to achieve desired effects.

The U.S. Marine Corps also has expressed interest in expanding its long-range precision fires capabilities and would play a crucial role in deploying and using these weapons in the Indo-Pacific theater. Several options exist for the Marine Corps to pursue in the long-term, with most missiles oriented around the anti-ship mission. The USMC is currently testing and fielding the Naval Strike Missile (NSM) as its primary anti-ship munition. The NSM is a subsonic cruise missile with a range of about 185 km and can be fired from a joint light tactical vehicle (JLTV) as part of the Navy/Marine Expeditionary Ship Interdiction System (NMESIS), giving the missile a mobile capability.[50] Additional testing seeks to use unmanned JLTVs to fire these munitions in what is known as Remotely Operated Ground Unit Expeditionary Fires (ROGUE-Fires).[51] In addition to attacking targets at sea, the NSM also has a secondary land-attack function. Given the NSM's short range, it would only be an inner ring option for Marines in the Indo-Pacific theater.

47 Ethan Sterenfeld, "Army Hypersonic Missile To Fly 'At Least' 2,775 km," *Inside Defense*, May 13, 2021, https://insidedefense.com/insider/army-hypersonic-missile-fly-least-2775km.

48 Patrick Tucker, "US Army Aims to Convert Navy Missiles for Remote-Launched Strikes," *Defense One*, November 13, 2020, https://www.defenseone.com/technology/2020/11/army-aims-convert-navy-missiles-remote-launched-strikes/170040/.

49 Of course, conducting strikes against maritime targets will also necessitate joining Army missile systems with sensors and battle networks capable of finding, tracking, and targeting vessels at sea.

50 The NSM's range is commonly cited as "greater than 100 nautical miles," or about 185 km. *Janes* places the NSM's range at 200 km. See Raytheon Missiles & Defense, "Naval Strike Missile," https://www.raytheonmissilesanddefense.com/what-we-do/naval-warfare/advanced-strike-weapons/naval-strike-missile; Janes IHS Market, "Naval Strike Missile (NSM)," last updated April 14, 2022.

51 For more information and images about NSM, see Joseph Trevithick, "The Marines' New Unmanned Ship Killing Missile Launcher Truck Breaks Cover," *The Drive*, April 29, 2021, https://www.thedrive.com/the-war-zone/40390/the-marines-new-unmanned-ship-killing-missile-launcher-truck-breaks-cover.

FIGURE 6: NAVAL STRIKE MISSILE: SHIP-BASED AND GROUND-BASED

Source: Left photo from Commander, Naval Surface Force, U.S. Pacific Fleet, March 18, 2021, https://www.dvidshub.net/image/6575339/uss-gabrielle-giffords-lcs-10-launches-naval-strike-missile; Right photo by Maj. Nicholas Mannwwiler, U.S. Marine Corps Forces, Pacific, August 16, 2021, available at https://www.dvidshub.net/image/6786822/large-scale-exercise-2021.

The Marine Corps has also sought ground-based Tomahawk cruise missiles as another option in its strike portfolio. The Maritime-Strike Tomahawk (MST), a derivative of the Block V Tomahawk, employs a wide array of sensors and guidance systems to enable the missile to strike moving naval targets. The subsonic MST currently has a maximum range of approximately 1,600 km and would provide another option for the inner or middle rings.[52] Because previous versions of the Tomahawk, such as the BGM-109G GLCM, could travel as far as 2,500 km, it is conceivable that upgrades to the MST could extend its current range to this distance, making it a more viable middle ring option.[53] The main technical obstacle to MST deployment is finding a suitable launcher for the weapon with some degree of expeditionary capability. A previous MST test employed a ground-based MK-41 Vertical Launch System (VLS), but this delivery platform is primarily reserved for cruisers and destroyers.[54] The Marine Corps would have to either modify pre-existing mobile platforms to field the MST or develop an entirely new system altogether if it seeks to incorporate the missile in its portfolio.

Another inner ring option for the Marine Corps would be a ground-based version of the long-range anti-ship missile (LRASM), which has an air-launched range between 560 and

52 Joseph Trevithick, "Marines Set To Be The First To Bring Back Land-Based Tomahawk Missiles Post-INF Treaty," *The Drive*, March 5, 2020, https://www.thedrive.com/the-war-zone/32483/marines-set-to-be-the-first-to-bring-back-land-based-tomahawk-missiles-post-inf-treaty.

53 Missile Defense Project, "Tomahawk," *Missile Threat*, Center for Strategic and International Studies, September 19, 2016, last modified November 4, 2019, https://missilethreat.csis.org/missile/tomahawk/.

54 This test was conducted in August 2019. For more information, see Tyler Rogoway, "Let's Talk About The Post-INF Treaty U.S. Test Of A Ground-Launched Tomahawk Missile," *The Drive*, August 19, 2019, https://www.thedrive.com/the-war-zone/29477/lets-talk-about-the-post-inf-treaty-u-s-test-of-a-ground-launched-tomahawk-missile.

930 km.[55] The LRASM was originally an air and sea-launched subsonic cruise missile, but its maneuverability, stealth, and target recognition capabilities make it an attractive option for development into a ground-based variant as well.[56] Similar to the MST, the Marines would also have to find a suitable launch platform to field a ground-variant of the LRASM.

Given that the Army's MRC program is also interested in ground-based anti-ship missiles and has identified the Tomahawk and SM-6 as potential candidates, an opportunity for collaboration exists between both services. Both the Army and Marine Corps could invest in a joint program that adopts existing missiles for the anti-ship and land-attack missions and thus field a deployable strike option that could benefit both services and apply to major theaters of operations for the United States. A Tomahawk-based platform such as the MST or MRC with a range of 2,500 km could be an attractive option for deployment along the inner and middle rings.

TABLE 1: CURRENT U.S. GROUND-BASED MISSILE PROGRAMS

Program	Service	Range (km)	Expected Fielding Date	Ring
NSM	*USMC*	*185+*	*2023–24*	*Inner*
ATACMS	Army	300+	Since 1980s	Inner
PrSM	*Army*	*up to 1,600*	*2023*	*Inner/Middle*
MST	*USMC*	*1,600**	*2023*	*Inner/Middle*
MRC	*Army*	*500 to 1,500+*	*2023*	*Inner/Middle*
LRHW	*Army*	*up to 2,775*	*2023***	*Middle*

Italicized programs are currently in development and have not reached initial operational capacity.

* With previous iterations of the Tomahawk having ranges up to 2,500 km, it is conceivable that the MST's range could be significantly extended.

** Equipment for the first LRHW batteries was delivered to Army units in 2021, but missile delivery is not expected to be completed until fiscal year 2023. See Jen Judson, "'Dark Eagle' Has Landed: US Army Finishes Equipping First Unit with Hypersonic Capability – Minus the Missiles," *Defense News*, October 7, 2021, https://www.defensenews.com/breaking-news/2021/10/07/dark-eagle-has-landed-us-army-finishes-equipping-first-unit-with-hypersonic-capability-minus-the-missiles/.

The overview of the Army and Marine Corps precision-fires portfolios indicates that the majority of existing and developmental strike options would be suitable candidates for the inner ring. The current array of programs is expected to provide U.S. forces with a diverse

55 The LRASM's range varies in open sources from 560 km to nearly 930 km. David B. Larter, "Pentagon's Weapons Tester Gives Update on Navy's New Long-range Anti-ship Missile," *Defense News*, January 14, 2021, https://www.defensenews.com/naval/2021/01/14/the-pentagons-weapons-tester-has-an-update-on-the-navys-new-long-range-anti-ship-missile/; Janes IHS Market, "AGM-158C Long-Range Anti-Ship Missile (LRASM)," last updated December 15, 2021.

56 Lockheed Martin and Thales Australia have already begun developing the LRASM Surface Launch (LRASM SL). Xavier Vavasseur, "Lockheed Martin and Thales Team Up For LRASM Surface Launch Variant," *Naval News*, April 22, 2021, https://www.navalnews.com/naval-news/2021/04/lockheed-martin-and-thales-team-up-for-lrasm-surface-launch-variant/; Peter Ong, "Land-Based Anti-Ship Missiles and The U.S. Marine Corps: Options Available," *Naval News*, September 27, 2020, https://www.navalnews.com/naval-news/2020/09/land-based-anti-ship-missiles-and-the-u-s-marine-corps-options-available/.

range of ground-based strike options possessing different speeds and trajectories. However, fewer options exist for the middle ring, and no intermediate-ranged conventional options are in development for the outer ring. The small number of medium-range options in development would have ranges considerably less than 3,000 km, further limiting their potential as effective middle ring options. This portfolio constrains U.S. forces to striking targets in the peripheries of adversary territory and limits the number of potential deployment locations, particularly in the Indo-Pacific. The exception is the Tomahawk-based MRC or MST, which could be a useful middle ring option if its range is extended to match previous Tomahawk variants.

Allied Ground-Based Missile Programs in the Indo-Pacific

Allied capabilities and investments in the Indo-Pacific theater are similarly focused on short-range capabilities, which makes sense given these nations' proximity to China. In the maritime strike realm, Japan has fielded the Type 88 anti-ship cruise missile since 1988.[57] The Japan Ground Self-Defense Force improved its anti-ship capabilities in 2012 by upgrading the Type 88 to the Type 12 and increasing the missile's range from 180 to 200 km, among other targeting and guidance improvements. Although the Type 12's range remains relatively short, Tokyo has unveiled plans to extend the range of these missiles to 900 km with an eventual goal of 1,500 km.[58] Such an increase would greatly expand the system's potential deployment locations within Japan and could threaten PLAN vessels throughout the Yellow, East China, and Philippine seas.

Further south along the first island chain, the Philippines is fast-tracking the purchase of three batteries of Indian BrahMos ASCMs with a range of 290 km.[59] These supersonic missiles will provide greater anti-ship coverage near the South China Sea, providing part of a lower link to the chain established by Japan in the north.[60] The Philippines has also

57 *Janes*, "Weapons: Naval – Type 88 (SSM-1); Type 12; Type 90 (SSM-1B); SSM-2," updated January 7, 2021.

58 Yoshihiro Inaba, "Japan to Greatly Extend Range of Type 12 Anti-Ship Missiles, Modify It for F-15J," *Naval News*, January 21, 2021, https://www.navalnews.com/naval-news/2021/01/japan-to-greatly-extend-range-of-type-12-anti-ship-missiles-modify-it-for-f-15j/.

59 The Philippines is purchasing an export variant of the BrahMos with a reduced range of 290 km. Indonesia and Vietnam are also reported to be in various stages of procuring the BrahMos, but for equipping warships rather than ground-based launchers. Mike Yeo, "Philippines Signs Deal for BrahMos Supersonic Anti-ship Missile," *Defense News*, January 28, 2022, https://www.defensenews.com/global/asia-pacific/2022/01/28/philippines-signs-deal-for-brahmos-supersonic-anti-ship-missile/; Sebastian Strangio, "Indonesia on the Cusp of BrahMos Missile Purchase: Report," *The Diplomat*, July 22, 2022, https://thediplomat.com/2022/07/indonesia-on-the-cusp-of-brahmos-missile-purchase-report/; Sebastien Roblin, "Despite China's Dissatisfaction, Russia Sells BrahMos Missile to India," *The National Interest*, January 4, 2022, https://nationalinterest.org/blog/reboot/despite-chinas-dissatisfaction-russia-sells-brahmos-missile-india-198925?page=0%2C1.

60 For more on an anti-ship missile "chain" in the Indo-Pacific, as well as their potential role in a blockade of China, see Terrence K. Kelly, Anthony Atler, Todd Nichols, and Lloyd Thrall, *Employing Land-Based Anti-Ship Missiles in the Western Pacific* (Santa Monica, CA: RAND, 2013), https://www.rand.org/content/dam/rand/pubs/technical_reports/TR1300/TR1321/RAND_TR1321.pdf.

expressed an interest in eventually procuring HIMARS, which could be used to hold the Spratly Islands at risk.[61]

As the critical central link in the north-south chain between Japan and the Philippines, Taiwan's Hsiung Feng family of ASCMs has ranges between 150 and 200 km.[62] Taiwan is also purchasing ground-based Harpoon ASCMs from the United States.[63] Although Taiwan is not a formal U.S. treaty ally, it can be regarded as an indirect part of any U.S. fires strategy because these missiles will target PLAN vessels regardless of U.S. direction or posture. For land-attack, Taiwan is purchasing a small number of ATACMS and is thought to field the Tien Chi, an SRBM with a 120 km range, on forward island positions within striking distance of the Chinese mainland.[64] More notably, Taiwan's land-attack cruise missile, the Hsiung Sheng, is assessed to have a range of up to 1,200 km.[65] These missiles reportedly come in two variants—a unitary warhead to strike hardened C2 nodes, and an area effect variant to destroy airfields.[66]

On the Asian continent, South Korea possesses a variety of short-range ground-based missiles. In addition to the ATACMS, the Republic of Korea (ROK) Army fields the Hyunmoo-3 series of GLCMs. First deployed in 2009, the Hyunmoo-3B is fired from a road-mobile TEL and has a range of 1,000 km.[67] The submarine-launched variant, the Hyunmoo-3C, has a range of 1,500 km, and a supersonic variant with a range of 3,000 km is reportedly in development.[68] These weapons could eventually be fired from ground-based launchers.

61 Zhenhua Lu, "US and Philippines Said to be in Talks on Rocket System to Deter Beijing's 'Militarisation' in South China Sea," *South China Morning Post*, April 2, 2019, https://www.scmp.com/news/china/diplomacy/article/3004372/us-philippines-said-be-talks-rocket-system-deter-beijings?module=perpetual_scroll_0&pgtype=article&campaign=3004372.

62 Michael Hunzeker and Alexander Lanoszka, "Taiwan Wants More Missiles. That's Not a Bad Thing," *Defense One*, March 24, 2021, https://www.defenseone.com/ideas/2021/03/taiwan-wants-more-missiles-s-not-bad-thing/172887/. Hunzeker and Lanoszka state that the United States could encourage Taiwan to build up its missile capabilities or provide technical advice and support on the construction of these systems. However, Washington would have to stipulate that missiles produced with U.S. guidance could only be employed in self-defense per the conditions of the Taiwan Relations Act.

63 Kelvin Chen, "Taiwan Finalizes Missile Systems Deal with US," *Taiwan News*, June 17, 2021, https://www.taiwannews.com.tw/en/news/4225531.

64 Chen, "Taiwan Finalizes Missile Systems Deal with US;" and *Missile Threat*, "Tien Chi," Center for Strategic and International Studies, updated March 31, 2021, available at https://missilethreat.csis.org/missile/tien-chi/.

65 The Hsiung Feng is also known as the Yun Feng. Taiwan is reportedly seeking to extend the missile's range to 2,000 km. See Keoni Everington, "Taiwan's upgraded 'Cloud Peak' missiles could reach Beijing," *Taiwan News*, January 25, 2018, https://www.taiwannews.com.tw/en/news/3349525.

66 Yimou Lee and Ben Blanchard, "Taiwan Details New Advanced Missile and Drone Attack Capabilities," *Reuters*, April 21, 2022, https://www.reuters.com/world/asia-pacific/taiwan-details-new-advanced-missile-drone-attack-capabilities-2022-04-22/.

67 *Missile Threat*, "Hyunmoo-3," Center for Strategic and International Studies, updated April 2, 2021, https://missilethreat.csis.org/missile/hyunmoo-3-abc/.

68 Ibid.

India, although not a U.S. ally, is currently the only non-adversary in the Indo-Pacific with intermediate-range capabilities. The aforementioned BrahMos cruise missile is a joint venture between India and Russia and combines supersonic speed with a 300 to 500 km range.[69] A hypersonic upgrade of the BrahMos is currently under development.[70] India is also developing an indigenous LACM that resembles a Tomahawk and is expected to have a range of 1,000 km.[71] In ballistic missiles, India has long fielded the Prithvi series of dual-capable SRBMs and the Agni series of dual-capable rail-mobile MRBMs and IRBMs. Further developments of the Agni IRBM will be road-mobile and are expected to increase the missile's maximum range to 4,000 km.[72]

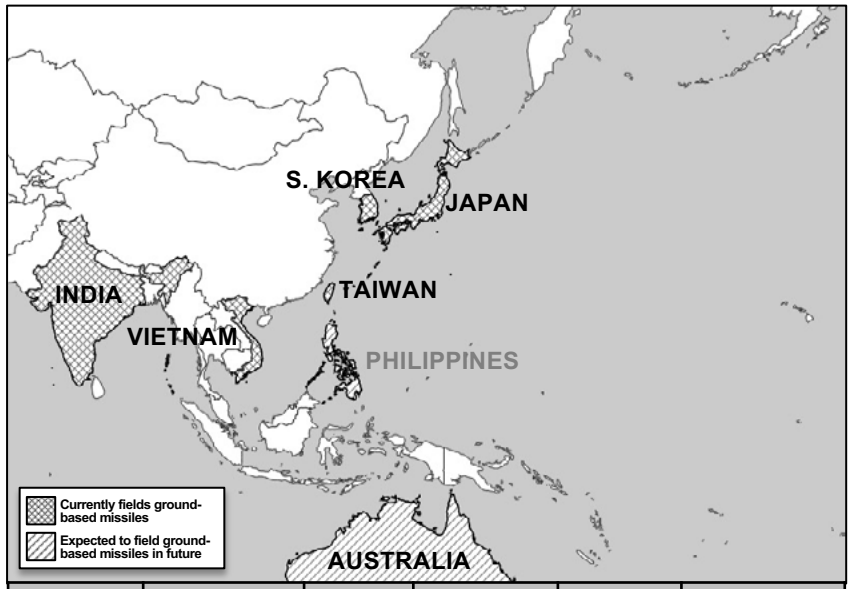
69 *Missile Threat*, "BrahMos," Center for Strategic and International Studies, updated August 2, 2021, https://missilethreat.csis.org/missile/brahmos/.

70 Kelsey Davenport, "India Tests Hypersonic Missile," Arms Control Association, October 2020, https://www.armscontrol.org/act/2020-10/news/india-tests-hypersonic-missile.

71 Shishir Gupta, "Nirbhay cruise missile test-fired; indigenous engine a success, say officials," *Hindustan Times*, August 11, 2021, https://www.hindustantimes.com/india-news/nirbhay-cruise-missile-test-fired-drdo-says-indigenous-engine-a-success-101628656458294.html.

72 *Missile Threat*, "Agni-IV," Center for Strategic and International Studies, updated July 31, 2021, https://missilethreat.csis.org/missile/agni-4/.

FIGURE 7: CURRENT GROUND-BASED MISSILE PROGRAMS IN THE INDO-PACIFIC



NATION	SYSTEM	TYPE	RANGE (km)	SPEED	STATUS
Australia	*ATACMS*	*SRBM*	*300*	*Supersonic*	*Purchasing*
India	Prithvi-II	SRBM	350	Supersonic	Active
	Agni-I	SRBM	700	Supersonic	Active
	Agni-II	MRBM	2,000	Supersonic	Active
	Agni-III	IRBM	3,500	Supersonic	Active
	Agni-IV	*IRBM*	*4,000*	*Supersonic*	*Developmental*
	Nirbhay	*GLCM*	*1,000*	*Subsonic*	*Developmental*
	BrahMos	ASCM	300-500	Supersonic	Active
Japan	Type 88	ASCM	180	Subsonic	Active
	Type 12	ASCM	200+	Subsonic	Active
	Future Type 12	*ASCM*	*Up to 1,500*	*Subsonic*	*Developmental*
Philippines	*BrahMos (export)*	*ASCM*	*290*	*Supersonic*	*Purchasing*
S. Korea	ATACMS	SRBM	300	Supersonic	Active
	Hyunmoo-3	GLCM	1,000	Subsonic	Active
Taiwan	Tien Chi	SRBM	120	Supersonic	Active
	ATACMS	*SRBM*	*300*	*Supersonic*	*Purchasing*
	Hsiung Feng II	ASCM	120	Subsonic	Active
	Harpoon	*ASCM*	*125*	*Subsonic*	*Purchasing*
	Hsiung Feng III	ASCM	150	Supersonic	Active
	Hsiung Sheng	*GLCM*	*1,200*	*Supersonic*	*Developmental*
Vietnam	P-800 Yakhont	ASCM	300	Supersonic	Active
Italicized systems are currently being developed or procured, but are not currently fielded.					

Source: Created by CSBA using map data courtesy of naturalearthdata.com.

Allied Ground-Based Missile Programs in Europe

Ground-based missiles in Europe are even more centered on short-range systems, with fewer efforts to expand the striking range of allied militaries. The United Kingdom, France, Germany, Italy, Greece, Finland, Turkey, and Romania actively field some variant of the MLRS or HIMARS, but not all of these nations utilize the ATACMS, instead relying on rockets with ranges less than 150 km.[73] Poland is currently building a HIMARS battalion that could eventually fire the PrSM and other short-range missiles.[74] In the Baltics, Lithuania and Estonia are accelerating their purchase of MLRS launchers to target Russian ground forces.[75] The British Army already intends to purchase the Precision Strike Missile, which may open the door to future procurements of extended-range PrSMs or other medium-range systems.[76] The Turkish Army also fields the J-600T Yildirim I and II SRBMs with ranges of 150 km and 300 km, respectively.[77]

For maritime strike, Romania intends to field truck-mounted Naval Strike Missiles (NSMs) with a range of 185 km that could hold the Russian Black Sea fleet at risk.[78] ASCMs in Poland and the Baltic states would threaten Russian naval forces throughout the confined passages of the Baltic Sea. Already, Poland fields two squadrons of NSMs and Estonia plans to purchase Israeli Blue Spear anti-ship missiles capable of ranging 290 km.[79] Sweden and Finland both possess short-range ground-based ASCMs for coastal defense.[80]

73 Tim Ripley, "UK Launches MLRS Project," *Janes*, April 1, 2021, https://www.janes.com/defence-news/news-detail/uk-launches-mlrs-project; KMW, "MLRS Improved – Multiple Launch Rocket System," https://www.kmweg.com/systems-products/tracked-vehicles/artillery/mars-ii-mlrs-e/; Lockheed Martine, "Lockheed Martin in Greece," https://www.lockheedmartin.com/en-gr/index.html; *VPK News*, "Finland to Acquire Long-range Guided Missiles ER GMLRS," February 2, 2021, https://vpk.name/en/486871_finland-to-acquire-long-range-guided-missiles-er-gmlrs.html; *Flight Global*, "Turkey Will Join USA in Fielding Army Tactical Missile System," November 5, 1996, https://www.flightglobal.com/turkey-will-join-usa-in-fielding-army-tactical-missile-system/4428.article; and Defense Brief Editorial, "Romania Receives HIMARS Rocket Launcher Systems from the US," *Defense Brief*, February 26, 2021, https://defbrief.com/2021/02/26/romania-receives-himars-rocket-launcher-systems-from-the-us/.

74 Jaroslaw Adamowski, "Poland to Sign $414 Million Deal for Rocket Launchers," *Defense News*, February 11, 2019, https://www.defensenews.com/global/europe/2019/02/11/poland-to-sign-414-million-deal-for-rocket-launchers/.

75 Jaroslaw Adamowski, "Lithuania accelerates rocket artillery buy amid Russian military buildup," *Defense News*, January 12, 2022, https://www.defensenews.com/global/europe/2022/01/12/lithuania-accelerates-rocket-artillery-buy-amid-russian-military-buildup/.

76 Dylan Malyasov, "United Kingdom might join the US Army's precision strike missile program," *Defence Blog*, February 2, 2022, https://defence-blog.com/united-kingdom-might-join-the-us-armys-precision-strike-missile-program/.

77 Nuclear Threat Initiative, "Turkey Overview," March 31, 2021, https://www.nti.org/analysis/articles/turkey-overview/.

78 Xavier Vavasseur, "Romania Becomes Latest Naval Strike Missile Customer," *Naval News*, May 20, 2021, https://www.navalnews.com/naval-news/2021/05/romania-becomes-latest-naval-strike-missile-customer/.

79 *Defence24*, "Poland to Acquire Second Coastal Missile Squadron," December 22, 2014, https://defence24.com/poland-to-acquire-second-coastal-missile-squadron; and Seth J. Frantzman, "Estonia Buys Blue Spear Missiles for Coastal Defense," *Defense News*, October 8, 2021, https://www.defensenews.com/global/europe/2021/10/08/estonia-buys-blue-spear-missiles-for-coastal-defense/.

80 *Naval Technology*, "RBS 15 Gungnir Next-Generation Anti-Ship Missile System," January 4, 2021, https://www.naval-technology.com/projects/rbs-15-gungnir-next-generation-anti-ship-missile/; and Fergus Kelly, "Finland to acquire Israel's Gabriel anti-ship missile system," *The Defense Post*, July 6, 2018, https://www.thedefensepost.com/2018/07/06/finland-acquire-israel-gabriel-anti-ship-missiles/.

FIGURE 8: CURRENT GROUND-BASED MISSILE PROGRAMS IN EUROPE

NATION	SYSTEM	TYPE	RANGE (km)	SPEED	STATUS
Croatia	RBS-15	ASCM	70	Subsonic	Active
Estonia	*HIMARS*	--	--	--	*Purchasing*
	Blue Spear	*ASCM*	*290*	*Subsonic*	*Purchasing*
Finland	MTO 85M (RBS-15)	ASCM	100	Subsonic	Active
Greece	ATACMS	SRBM	300	Supersonic	Active
	Exocet	ASCM	40	Subsonic	Active
Lithuania	*HIMARS*	--	--	--	*Purchasing*
Poland	*ATACMS*	*SRBM*	*300*	*Supersonic*	*Purchasing*
	NSM	ASCM	185	Subsonic	Active
Romania	*ATACMS*	*SRBM*	*300*	*Supersonic*	*Purchasing*
	NSM	*ASCM*	*185*	*Subsonic*	*Purchasing*
Sweden	RBS-15 Mk2	ASCM	100	Subsonic	Active
Turkey	Yildirim I	SRBM	150	Supersonic	Active
	ATACMS Blk I	SRBM	165	Supersonic	Active
	Yildirim II	SRBM	300	Supersonic	Active
Ukraine	Neptune	ASCM	300	Subsonic	Active
U.K.	*PrSM*	*MRBM*	*Up to 1,600*	*Supersonic*	*Purchasing*
Italicized systems are currently being developed or procured, but are not currently fielded.					

Source: Created by CSBA using map data courtesy of naturalearthdata.com.

In sum, Europe's ground-based strike capabilities remain limited in quantity and range, particularly in the land-attack mission. All European militaries are vastly outranged by Russian ground-launched ballistic and cruise missiles. Europe fares better in the maritime domain, where the constricted geography of the Black, Baltic, and North seas increase the relative utility of widely fielded short-range ASCMs.

Assessing American and Allied Capabilities and Investments

How do current U.S. and allied investments in ground-based missiles stack up against the opportunities highlighted by the three rings framework? Washington seeks to reconstitute its ground-based precision-fires forces by the mid-2020s and is already investing in several platforms and weapons for near-term operations. But with most programs having ranges of less than 1,000 km, these assets are mostly short-range and designed to be employed mainly along the inner ring. The efforts of U.S. allies in the Indo-Pacific and Europe are also heavily weighted toward inner ring capabilities. The United States and its allies are focused on the inner ring with limited investment in developing and fielding medium-range and intermediate-range capabilities.

This inner-ring-focused approach to ground-based fires has its own virtues, which will be fully explored in chapter 4. The preponderance of short-range missile systems in the U.S. inventory is the logical result of technical, programmatic, and political factors. First and foremost, the INF Treaty restricted the United States to short-range ground-launched weapons until 2019. Short-range weapons are easier to develop and produce from a technical standpoint, and the United States and its allies have decades of recent experience developing the latest generation of short-range munitions, both ground-launched and air and sea-based. Short-range missiles are typically smaller programs with near-term development timelines that lend themselves well to being co-developed with allied nations. Programmatically, short-range missiles are less expensive. In an acquisition system that favors exquisite, expensive delivery platforms, short-range munitions have enjoyed the programmatic bias against expensive missile projects with long timelines. Their decreased costs also make short-range missiles politically attractive in Washington. Moreover, programs suited for the inner ring often do not entail controversy related to escalation or the dual-capable question that might accompany intermediate-range missiles.

A similar logic applies to U.S. allies focusing their investments on short-range missiles. Many allies reside on the inner ring and can threaten adversary targets without longer-range systems. Likewise, the decreased cost of short-range platforms allows nations with smaller defense budgets to field a strike capability, potentially in higher numbers than more expensive long-range systems. The relative technical simplicity of short-range missiles allows nations with more modest defense industrial bases to indigenously develop, produce, and maintain these weapons. Lastly, it is also likely that the short development timelines of inner ring weapons cater to the sense of urgency in quickly building up anti-access networks to deter Russian and Chinese activities. Short-range weapons allow smaller nations to gain

outsized capability without massive investments in associated battle networks and support infrastructure.[81] In short, for both the United States and its allies, the inner ring is currently the "low-hanging fruit" of ground-based fires—the option of technological, programmatic, and political convenience.

But an inner-ring-focused approach has its limitations and could miss the significant opportunities presented by the middle and outer rings. The root of these limitations is the lengthy development timeline of longer-range missile programs. Building out middle- and outer-ring options would likely entail timelines extending past five years due to the inherent complexity of these weapons. Since Washington still needs to reestablish its conventional medium- and intermediate-range force, it is expected that it would have to build out some completely new systems. In other cases, some technical foundation may exist for a middle- or outer-ring option, but complex engineering and significant adjustments would require more time for the defense industrial base to develop and manufacture a new system. Beyond system development and procurement, the services will require time to establish, train, and experiment with units capable of operating and employing these renewed capabilities.

In order to field medium- or intermediate-range missiles in the near future, the United States must begin developing these weapons now. Only by investing in these programs in the near term can the United States hope to rebuild its ground-based fires capabilities over the long term. Although expedient, an exclusive near-term focus on short-range missiles runs the risk of "crowding out" investments in longer-range systems with long-term payoffs.

The unwillingness of allies to host ground-based missiles is often used as an argument against investing in the development of medium- or intermediate-range systems.[82] This argument is short-sighted. Allied attitudes and threat perceptions can and do change—sometimes gradually over decades, and occasionally very quickly after unexpected events or the sudden clarification of adversary intentions. For example, in a shift in policy, Japan recently announced its potential openness to hosting U.S. ground-based missiles.[83] In Europe, Denmark has recently reversed its long-standing policy prohibiting

81 For example, the Baltic States possess minimal air and maritime platforms. Ground-based anti-ship and land-attack missiles are an investment that provide a significant increase in capability without the costs of purchasing fleets of aircraft or naval vessels.

82 See, for example, Mark Gunzinger, Lukas Autenried, and Bryan Clark, "Understanding the Long-Range Strike Debate," *The Mitchell Institute for Aerospace Studies*, April 2021, https://mitchellaerospacepower.org/wp-content/uploads/2021/05/a2dd91_584d2a721b0f44bab0bf7d25986ea40d.pdf; Jeffrey W. Hornung, *Ground-Based Intermediate-Range Missiles in the Indo-Pacific* (Santa Monica, CA: RAND Corporation, 2022), https://www.rand.org/pubs/research_reports/RRA393-3.html.

83 Alexander Ward and Quint Forgey, "Japan not Closing Door on Hosting American INF Missiles," *Politico*, January 31, 2022, https://www.politico.com/newsletters/national-security-daily/2022/01/31/japan-not-closing-door-on-hosting-american-inf-missiles-00003840.

the hosting of U.S. troops on Danish soil.[84] Even more recently, the Russian expansion of the conflict in Ukraine may significantly alter allied attitudes toward security and defense in both theaters.[85] Future Chinese actions in the South China Sea or Taiwan Strait might similarly lead to a rapid shift in allied attitudes and willingness to invest in or host ground-based missiles.

Historical cases like the introduction of intermediate-range missiles to Europe in the 1980s show that the United States must have systems developed and ready to deploy when allies present these opportunities.[86] In anticipation of the NATO ministers' agreement to send Pershing II missiles to Europe, Secretary of Defense Harold Brown instructed the Army to advance the Pershing's deployment schedule from 16 months to 12 months. This change resulted in the weapon entering production concurrently with flight tests, many of which failed to achieve their stated objectives, leading some to question the system's effectiveness.[87] The United States can avoid similar doubts today by developing and testing intermediate-range missiles well ahead of diplomatic efforts to negotiate hosting and basing agreements.

As this section has shown, the United States is not currently deeply invested in the development and future fielding of medium or intermediate-range weapons. U.S. and allied efforts are instead overweighted toward short-range missiles ideal for deployment in the inner ring. The U.S. military should consider beginning the development of longer-range conventional missiles to leverage the opportunities presented by the middle and outer rings. The next chapter will further explore these opportunities to build the foundation of a ground-based missile strategy that maximizes the utility of these weapons in both the Indo-Pacific and European theaters.

84 *Associated Press*, "Denmark May Allow US Troops on Its Soil, Pact in the Works," February 10, 2022, https://apnews.com/article/united-states-denmark-europe-copenhagen-df114d89de92b9f06eb6ee8416ba276c?utm_source=Sailthru&utm_medium=email&utm_campaign=EBB%2002.11.2022&utm_term=Editorial%20-%20Early%20Bird%20Brief.

85 In addition to shifting the attitudes of European allies, Russia's actions have also prompted discussion in Japan. For example, see former prime minister Shinzo Abe's comments in April 2022 at Shinzo Abe, "Op-Ed: The U.S. Must Make Clear to the World it will Defend Taiwan against Chinese Invasion," *Los Angeles Times*, April 12, 2022, https://www.latimes.com/opinion/story/2022-04-12/china-taiwan-invasion-united-states-policy-ambiguity.

86 The 1980s INF debate and several other historical cases and their lessons will be examined in a companion report by CSBA. See Eric Edelman, Josh Chang, and Tyler Hacker, *Arming America's Allies: Historical Lessons for Implementing a Post-INF Treaty Missile Strategy* (Washington, DC: Center for Strategic and Budgetary Assessments, 2022), https://csbaonline.org/research/publications/arming-americas-allies-historical-lessons-for-implementing-a-post-inf-treaty-missile-strategy.

87 Walter Pincus, "Pershing II, Cruise Missile Production Is Hurried Up," *Washington Post*, November 29, 1981, https://www.washingtonpost.com/archive/politics/1981/11/29/pershing-ii-cruise-missile-production-is-hurried-up/4c6b1e2f-823a-40d1-84ce-03800339490d/; White Sands Missile Range Museum, "ABC News Report on Deployment of Pershing II in Europe, 1984," posted on YouTube, April 16, 2021, https://www.youtube.com/watch?v=MrouDvDDMVA; and Comptroller General of the United States, *Most Critical Testing Still Lies Ahead For Missiles In Theater Nuclear Modernization* (Washington, DC: General Accounting Office, 1981), https://www.gao.gov/assets/masad-81-15.pdf.

CHAPTER 4

Toward a Missile Strategy

Previous chapters have defined the three rings framework and shown that the weight of U.S. and allied investment is presently centered on short-range missiles ideal for the inner ring. Although an understandable approach, such a focus comes with its own risks and limitations—namely, crowding out potential investments in medium and intermediate-range capabilities for the middle and outer rings.

This chapter looks toward a future missile strategy. Given the preponderance of U.S. and allied missiles on the inner ring, how should the United States foster a diverse and coordinated set of strike options? What are the merits of longer-range ground-based missiles? How should the United States maximize the utility of longer-range weapons across both the Indo-Pacific and European theaters? Which middle and outer ring nations provide the most potential for co-developing or hosting medium and intermediate-range missiles? The following section further explores each of the three rings to answer these questions and arrive at the building blocks of a U.S.-led ground-based missile strategy.

The Inner Ring

Should current programs be funded through to deployment, by the mid to late 2020s, the United States and its allies will possess a variety of short-range missiles designed for the inner ring. These systems have ranges up to 1,000 km and vary in mission and type from SRBMs to anti-ship missiles to land-attack cruise missiles. Short-range ground-based missiles have unique advantages that a U.S. missile strategy should leverage. Short flight times make them well suited to striking mobile and elusive targets that require timely intelligence and responsive fires. Inner ring ASCMs are ideal against moving maritime targets such as warships, amphibious transport ships, and logistics vessels. For these same reasons, systems in this range are also well suited for use in high-clutter maritime environments like the South China and Baltic seas. Inner ring missiles are also ideal for mobile targets in high-clutter environments in the land-attack role, where they could prioritize other mobile missiles, integrated air defense systems (IADS), grounded aircraft, and large maneuver

formations. Most importantly, the lower cost of many short-range systems allows them to be purchased and expended in larger quantities to provide a *volume* of fires. Missiles in volume would be more likely to penetrate enemy defenses successfully and complicate an adversary's defense plan.[88] These complications could be further increased by integrating ground-based missiles with air and sea-delivered munitions as well as non-kinetic effects. Moreover, inner ring fires could be massed in volume for attacking complex targets or targets spread out over a wide area.

Because the inner ring's geography necessitates the basing of missiles on allied and partner territories, these deployments will benefit from the political flexibility granted by the full range of development and deployment options. Missiles can be designed, produced, and fielded through approaches such as indigenous development, co-development, and allied sovereign use, each of which will be considered in the following section. Ultimately, the preponderance of missiles in the inner ring makes increasing the quantity of available systems a secondary goal to fostering a diverse set of strike options and establishing some division of labor among the U.S. armed services and between the United States and allied nations.

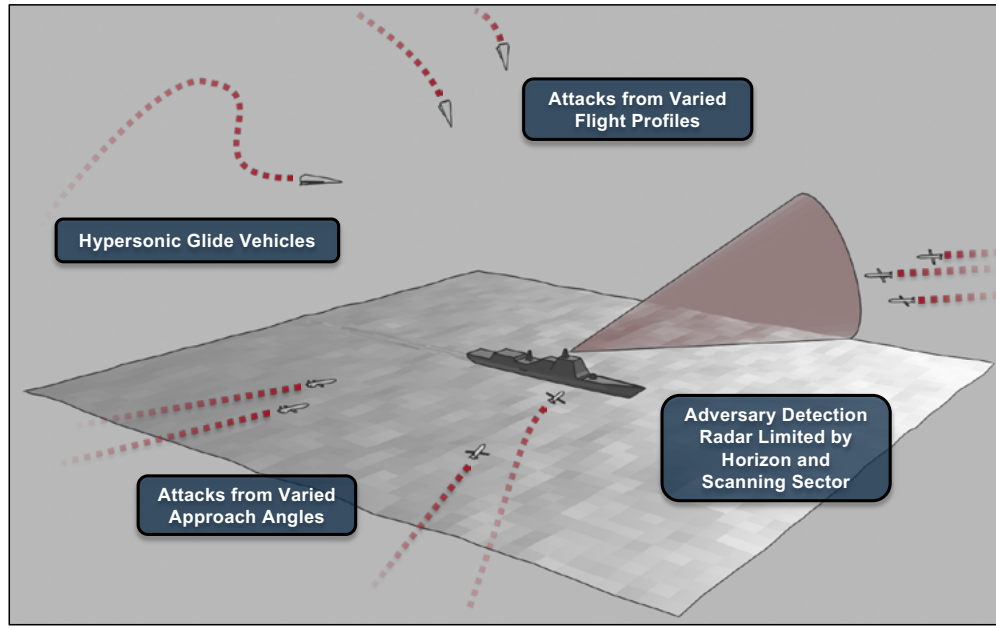
Fostering a Diverse Set of Capabilities in the Inner Ring

A ground-based missile strategy should seek to create a diverse set of inner ring strike options. Commanders should be able to leverage the full range of U.S. and allied missile inventories to tailor the weapon to the mission and target at hand. Some targets might require missiles with specific trajectories, survivability features, countermeasures, or guidance systems. As illustrated in Figure 9, a complex missile attack with a volume of weapons approaching from different territories and along varied flight profiles could degrade and confuse adversary defenses. For example, a simultaneous attack by a Precision Strike Missile traveling at hypersonic speed along a high-angle ballistic trajectory and a Maritime Strike Tomahawk approaching at subsonic speeds along a sea-skimming flight path would be very challenging for an adversary to defeat.[89] For these reasons, an *integrated* set of diverse ground-based strike assets is preferable to an "all eggs in one basket" approach in which the United States and its allies field the same short-range systems.

88 For more information on missile salvo competitions and the dilemmas they present for defense, see Carl Rehberg and Mark Gunzinger, *Air and Missile Defense at a Crossroads: New Concepts and Technologies to Defend America's Overseas* Bases (Washington, DC: Center for Strategic and Budgetary Assessments, 2018), https://csbaonline.org/research/publications/air-and-missile-defense-at-a-crossroads-new-concepts-and-technologies-to-de; Mark Gunzinger and Bryan Clark, *Winning the Salvo Competition: Rebalancing America's Air and Missile Defenses* (Washington, DC: Center for Strategic and Budgetary Assessments, 2016), https://csbaonline.org/research/publications/winning-the-salvo-competition-rebalancing-americas-air-and-missile-defenses.

89 Complex attacks like these take advantage of the limitations of air and missile defense radars. Most adversary defense radars are limited to tracking one sector of approach at a time and would not be able to simultaneously detect and track cruise and ballistic missile threats flying across both high and low approaches.

FIGURE 9: EXAMPLE OF A COMPLEX MISSILE ATTACK AGAINST NAVAL ASSETS ALONG VARYING FLIGHT PROFILES AND ANGLES OF APPROACH



Source: Created by CSBA.

Many nations, including U.S. allies, are already developing and fielding their own ground-based fires platforms. Although these systems tend to be mostly anti-ship weapons, indigenous development and production ensure a varied set of missile capabilities among U.S. allies and partners. Indigenous development gives nations a direct stake in their own defense and remains a politically attractive option that retains the principle of sovereignty. Foreign development and deployment of inner ring platforms also have the potential to free up U.S. defense resources for other investment areas such as longer-range weapons. Indigenously developed systems could provide useful precision-fires substitutes that Washington could rely on without having to develop brand new systems altogether. U.S. partners such as South Korea and Japan have developed missiles, such as the Hyunmoo and Type 12, respectively, that could contribute to a diverse precision-fires strike complex in the inner ring. This approach is not without obstacles, however. A partner's use of indigenously developed weapons may be less open to U.S. concerns and considerations, complicating alliance management and escalation control in a crisis. And of course, these systems are inevitably less interoperable not only with U.S. forces, but also with other allies and partners in a coalition campaign. The primary challenge in this scenario, which will be fully examined in the next section, is coordinating how and when separate U.S. and allied systems would execute long-range precision fires.

With many indigenous missile systems already fielded or in development along the inner ring, the United States must choose between fostering and integrating a range of distinct

indigenous ground-based strike options or focusing its efforts on co-development, allied sovereign use, or U.S. missile deployments. These shared options risk creating a similar, redundant set of like capabilities unsuitable for conducting complex attacks and creating dilemmas for adversary defenses.

Co-development refers to the joint development and production of missiles through shared technology and knowledge, resulting in platforms for use by the forces of both parties. Co-development is attractive for several reasons, and there are already examples of successful cooperation, such as the Standard Missile 3 Block IIA and the Evolved Sea Sparrow Missile (ESSM).[90] First, missile collaboration could help the U.S. defense industrial base and partner industries reduce development costs, harness national comparative advantages, and prevent one partner from having to shoulder the entire technical burden of development. In addition, joint development gives partners a personal stake in their own defense and makes them more willing to host and deploy these missiles upon completion. This option would largely moderate concerns about allied sovereignty since the partners themselves would have a say in the missile's production and would be developing a weapon for use in their own militaries. A jointly developed asset could encourage greater interoperability between U.S. and partner forces and enhance deterrent postures in theaters of competition.

Co-development includes several nuanced approaches, each with benefits and risks. Partner nations could choose the most integrated approach—co-development of the entire missile kill chain to create a more holistic weapon system rather than solely a munition.[91] A current example of this approach is the co-development and integration of ballistic missile defense (BMD) kill chains between the United States and Japan.[92] Another approach is splitting the development of different missile components between the United States and another nation,

90 The Standard Missile 3 Block IIA is a decade-long venture between the United States and Japan. The ESSM was developed by a 10-nation international consortium. See Kevin Ayers, "Expanding Zeus's Shield: A New Approach for Theater Missile Defense in the Asia Pacific Region," Joint Forces Quarterly, 84:1, pp. 24–31; and Ian E. Rinehart, Stephen A. Hildreth, Susan V. Lawrence, Ballistic Missile Defense in the Asia-Pacific Region: Cooperation and Opposition (Washington, DC: Congressional Research Service, April 3, 2015), https://sgp.fas.org/crs/nuke/R43116.pdf. For background on the Evolved Sea Sparrow Missile see United States Navy, "Evolved Seasparrow Missile Block 1 (ESSM) (RIM 162D)," last updated November 15, 2021, https://www.navy.mil/Resources/Fact-Files/Display-FactFiles/Article/2168978/evolved-seasparrow-missile-block-1-essm-rim-162d/.

91 In this arrangement, shared work goes beyond the missile itself and includes associated detection, targeting, and C2 systems.

92 Missile Defense Agency, "U.S., Japan Successfully Conduct First SM-3 Block IIA Intercept Test," Commander, U.S. 7th Fleet, February 6, 2017, https://www.c7f.navy.mil/Media/News/Display/Article/1079063/us-japan-successfully-conduct-first-sm-3-block-iia-intercept-test/; and Commander, Task Force 71/Destroyer Squadron 15, "US Forces, Japan Maritime Self-Defense Force Participate in Resilient Shield 2022," Navy.mil, February 21, 2022, https://www.navy.mil/Press-Office/News-Stories/Article/2941964/us-forces-japan-maritime-self-defense-force-participate-in-resilient-shield-2022/.

such as the SM-3 Block IIA.[93] A further nuance to this method is the co-development of a new payload for use on existing missiles.[94]

Alternatively, the United States and its allies might skip co-development altogether and simply co-produce missiles via licensed production of U.S.-designed systems, which improves supply chain resiliency and could alleviate U.S. logistics requirements.[95] This option could include missiles, TELs, or both, and may be attractive for countries like Japan because it advances the indigenous industrial base and local workforce.[96] Policymakers must match the nuances of co-development with the military and political constraints of the nation at hand.

Allied sovereign use or the deployment of U.S. missile forces are more direct options for increasing strike capacity but would reduce the diversity of capabilities in theater and degrade the potential for complex missile attacks. Allied sovereign use, through foreign military sales (FMS) or arms transfers, means the direct export of U.S. missile platforms to interested allies for use by their own military forces. The major advantage of this approach is that allies may be more willing to accept the deployment of U.S.-produced missiles on their territory if they have full control over them.[97] Allied use of these missiles for territorial defense could contribute to a U.S. missile strategy, but the United States would not have any formal operational control over such systems, leaving open the potential that they would not be available to U.S. commanders in a conflict.[98] These transfers could be bureaucratically

93 Missile Defense Agency, "U.S., Japan Successfully Conduct First SM-3 Block IIA Intercept Test," February 6, 2017, https://www.c7f.navy.mil/Media/News/Display/Article/1079063/us-japan-successfully-conduct-first-sm-3-block-iia-intercept-test/.

94 This option could be a less costly way to quickly increase the range of payload options available to both nations, including non-kinetic effects packages.

95 Licensed production of missiles in foreign countries could remove the United States as a single point of failure in the weapon's supply chain and increase the number of component and subcomponent suppliers. Overseas production in the theaters of interest would reduce U.S. logistics requirements by decreasing the quantity of munitions that would need to be transported into theater. This approach would increase the potential to pool shared munitions for alliance use.

96 An example of licensed production of only a missile launching system is Japan's production of the Mk41 VLS system for naval ships. Aviation Week, "Lockheed Martin, MHI sign MK 41 VLS production contract," April 9, 1999, https://m.aviationweek.com/lockheed-martin-mhi-sign-mk-41-vls-production-contract.

97 Allied publics may perceive a direct transfer or sale as more respectful of their sovereignty, which could expedite the fielding of weapons and avoid lengthy negotiations over base access, deployment, and status of forces.

98 Moreover, allied sovereign use might give U.S. partners greater leverage in joint security consultations and constrain the United States' ability to manage escalation during crises. Friction over when and how allies would employ these strike assets could delay and negate parts of the precision-strike complex in both the Indo-Pacific and European theaters, leaving vulnerable uncovered areas that adversaries could exploit. For more information on the role that U.S. security treaties in Asia have played in crisis management see Victor Cha, *Powerplay: The Origins of the American Alliance System in Asia*, (Princeton, NJ: Princeton University Press, 2016).

difficult and could also raise serious concerns in the United States about "entrapment" by allies in a conflict the United States did not authorize or intend.[99]

Given such considerations, the door may be open to direct U.S. involvement, such as permanent or rotational deployment of U.S. missile forces on allied territory.[100] This option would give Washington the greatest amount of flexibility and control over how and when these weapons are employed but could face significant political obstacles to achieving territorial access and basing. U.S. and allied policymakers would have to negotiate to base missiles in the first place, outline rules of engagement, and make joint decisions on the threshold for utilizing military force. Fortunately, a variety of options exist to lower the barrier to U.S. basing and missile agreements. Permanent basing of U.S. missiles in allied territory may be the most persistent and reassuring option, but rotational and contingency deployments may be more politically digestible. "Heel-to-toe" rotational deployments of personnel and/or equipment escape some of the stigma and infrastructure of permanent deployments.[101] Contingency arrangements expedite missile deployment during periods of instability through pre-arranged agreements and allow the United States additional options and flexibility in crises. Lastly, the United States should ensure a high degree of expeditionary capability in at least some of the missile systems it fields. This attribute would ensure the missiles are rapidly deployable in scenarios where no agreement can be reached with a host nation ahead of a crisis.

The United States must balance the various benefits of co-development, allied sovereign use, and U.S. missile deployments with the need to foster diverse capabilities on the inner ring. On the one hand, co-development may result in additional, more capable, and interoperable systems fielded more quickly. It may also strengthen the United States' hand in determining how missiles are employed as part of a theater-wide strategy. However, widespread co-development or deployment of U.S. missiles may also reduce the diversity of strike options available to theater commanders. Rather than a large volume of distinct indigenous systems with a range of different capabilities, the United States risks oversaturating the inner ring with one or two co-developed platforms. Ultimately, this is the task of a missile strategy for

99 For an explanation of the MTCR, see Bureau of International Security and Nonproliferation, "Missile Technology Control Regime (MTCR) Frequently Asked Questions," U.S. Department of State, https://www.state.gov/remarks-and-releases-bureau-of-international-security-and-nonproliferation/missile-technology-control-regime-mtcr-frequently-asked-questions/. For the potential of "entrapment" see Glenn H. Snyder, "The Security Dilemma in Alliance Politics," *World Politics*, 36:4, pp. 461–495.

100 One example of the permanent stationing of sea-based missiles abroad is the presence of U.S. Navy Aegis-equipped destroyers in Rota, Spain, to support BMD. North Atlantic Treaty Organization, "First of four US Navy ships to support NATO Ballistic Missile Defense arrives in Spain," last updated February 13, 2014, https://www.nato.int/cps/en/natolive/news_106997.htm.

101 "Heel-to-toe" rotational deployments typically involve a new unit arriving and establishing firing capabilities before the old unit disestablishes its firing capabilities—ensuring that capabilities remain constant throughout the transition between firing units. For an in-depth study comparing the pros and cons of rotational deployments versus permanent forward stationing, see John R. Deni, *Rotational Deployments vs. Forward Stationing: How Can the Army Achieve Assurance and Deterrence Efficiently and Effectively?* (Carlisle, PA: U.S. Army War College Press, 2017), https://press.armywarcollege.edu/monographs/408/.

the inner ring: balancing diversity with capability—with the supreme goal of *integrating* the various weapons into a coherent U.S.-led precision-strike complex.[102]

Integration is a multi-faceted task that will require efforts along several lines. One path to fostering a balanced inner ring strike portfolio might be the sharing of certain technologies or the co-development of specific missile components (such as propulsion or guidance systems) to maintain a varied set of capabilities, albeit with the benefits and interoperability afforded by U.S. missile technology. Another starting point for integration is enhancing collaboration or integration of kill chains and sensors.[103] The United States could provide inner ring nations with targeting intelligence from satellites and ISR platforms that these nations lack. Targeting collaboration, although often a challenge due to varying data formats and classification levels, would help decrease the costs of employing these often expensive platforms for inner ring nations and could help encourage the integration of these systems into a coherent U.S.-led strategy. In this manner, the United States could increase and integrate the capabilities of indigenous platforms to maintain a diverse set of inner ring capabilities without redundant development and fielding of additional U.S. short-range ground-based missiles.

Creating a Division of Labor in the Inner Ring

Assuming a U.S.-led missile strategy fosters a diverse, integrated ground-based strike portfolio on the inner ring, the challenge becomes wrangling and coordinating the volume of fires available from a wide range of current and future systems into a coherent strategy. As the United States crafts its theater-range missile strategy, it must establish a division of labor that leverages the inner ring's quantity of systems, diverse range of capabilities, and large set of potential targets. First, the United States must delineate inner ring roles and missions between its own military services. Second, it must coordinate its efforts with its allies and partners along the inner ring.

Beginning with the armed services, the U.S. Army and Marine Corps' incorporation of long-range precision fires in their warfighting doctrine adds the ground services to a mission area that has predominantly been handled by the Air Force and Navy. The convergence of

102 Naval Striking and Support Forces NATO (STRIKEFORNATO) is one example of an organization that performs this task in the maritime domain for NATO. Ground-based anti-ship missiles could be organized under this command or a U.S. command such as U.S. Army Europe (USAREUR). No parallel to STRIKEFORNATO exists in the Indo-Pacific, but such efforts could be organized under III Marine Expeditionary Force (MEF) or U.S. Army Pacific (USARPAC).

103 CSBA thoroughly explores the integration of ISR assets and kill chains with allies and partners in Thomas G. Mahnken, Travis Sharp, Christopher Bassler, and Bryan W. Durkee, *Implementing Deterrence by Detection: Innovative Capabilities, Processes, and Organizations for Situational Awareness in the Indo-Pacific Region* (Washington, DC: CSBA, 2021), https://csbaonline.org/research/publications/implementing-deterrence-by-detection-innovative-capabilities-processes-and-organizations-for-situational-awareness-in-the-indo-pacific-region.

all four services in this arena raises concerns about redundancy in capabilities.[104] Rather than viewing each domain's role as an insulated section separate from the others, defense planners should envision operational arrangements that integrate the services' contributions as they work in tandem with one another. These teaming arrangements should leverage each service's strengths to enable one domain to exploit openings created by another's fires. Deployed missiles would not be called on to engage and destroy every single possible target. Rather joint commanders in the field would have to selectively choose when and where ground-based missiles should be utilized in a given situation. Ground-launched strikes could complement, reinforce, or finish strikes carried out by other platforms.

Defense planners could simultaneously integrate the services' efforts and avoid redundancy by dividing their ground-based fires by mission, system type, or some combination of the two. To separate the services by mission, the U.S. Marine Corps could orient its fires programs toward maritime strike and sea denial missions, whereas the U.S. Army could focus on land-attack missions and targets beyond the littorals. This division would align the services with their traditional tasks and take advantage of each organization's existing kill chain elements. As outlined in chapter 3, the Marine Corps is already fielding several systems designed to employ ground-based fires for maritime strike in the inner ring. This arrangement takes advantage of the existing ties between the Marine Corps and the U.S. Navy, including the integration of their communications, sensors, and logistics networks. The Marine Corps could utilize targeting data and intelligence from Navy vessels, while the Navy would benefit from additional maritime strike coverage in the archipelagic environments of the Indo-Pacific. Short-range missiles could work in tandem with platforms such as surface combatants, attack submarines, and tactical aircraft to eliminate enemy naval vessels and force the adversary to contend with multiple threat vectors.

The Army, by contrast, could employ long-range fires assets in the inner ring, with both short and medium-range capabilities, to strike ground targets deeper in adversary territory. The systems in development under the Army's long-range precision fires program are ideal for this mission. Additionally, the Army benefits from its existing air-ground support relationship with the U.S. Air Force.[105] Air and space-based sensors would contribute to Army kill chains and avoid redundancy. Inner ring missiles for land-attack missions could neutralize enemy IADS on the perimeter to increase options for penetrating aircraft and

104 See Theresa Hitchens, "Long Range Strike Hot Potato Now in OSD Hands," *Breaking Defense*, April 8, 2021, https://breakingdefense.com/2021/04/long-range-strike-hot-potato-now-in-osd-hands/. Inter-service competition for resources and budgeting has raised questions over which armed service will have priority over the long-range precision fires mission. Some defense experts, however, believe that this mission should have multiple options distributed across the different armed services rather than one branch of the military dominating this area exclusively.

105 The Army's Army air-ground system (AAGS) and the Air Force's theater air control system (TACS) are highly integrated as part of the Theater Air-Ground System (TAGS). See Figure II-3 in Joint Chiefs of Staff, *Joint Publication 3–30: Joint Air Operations* (Washington, DC: Department of Defense, September 17, 2021, p. II–11, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_30.pdf.

pave the way for a broader array of air platforms (such as the B-52H, F-15EX, F-16, etc.) to engage additional targets of importance located closer to or within adversary territory.

The services might also divide their roles by the attributes and locations of their ground-based missiles. The Marine Corps could field expeditionary systems capable of operating as "stand-in" assets in contested environments.[106] These platforms would be highly mobile with light footprints and reduced signatures but would be limited in size and range. Expeditionary systems would also be constrained by reduced magazine sizes and limited logistical support. The Army would balance these expeditionary capabilities with more robust forward-deployed systems. Army missiles might be less mobile and easier to detect but would shoot farther and provide large magazines and a robust resupply chain. By dividing service roles along mission or system lines, the United States would limit redundant capabilities and offer theater commanders a flexible range of robust and complementary strike options. As the developmental missile programs in chapter 3 showed, the Army and Marine Corps are already *de facto* pursuing this division of labor through their investments. The services would benefit from going a step further and intentionally enshrining these roles and missions in joint doctrine.

Similarly, the United States can build a division of labor between itself and inner ring allies and partners by delineating missions, targets, or system capabilities. Efforts might be divided by differing missions, because some allies have more experience performing certain missions than others. Traditionally maritime-oriented nations may have more familiarity with coastal defense, maritime strike, and sea denial missions. Japan, for example, has long fielded truck-mounted coastal defense missiles within its force structure. Nordic countries benefit from the same organizational history and experience. Washington should leverage the advantage gained by aligning allied roles with missions they are already familiar with and may have more experience performing than the U.S. military. Moreover, allies are more likely to participate in a U.S.-led missile strategy in which they are filling the roles they desire to and are already institutionally well-suited to perform.

A missile strategy might also delineate efforts between the United States and allies by target type or system capability. Certain targets may be more politically acceptable for allies. Defensively-oriented Japan, for instance, might more readily accept a maritime strike mission against the PLAN than attacking C2 nodes on mainland China. Some targets may also require U.S.-unique capabilities that would prevent their attack by allies and partners. Highly mobile and elusive ground forces are one type of target suited for the U.S. military because only the United States possesses the ISR and C2 capabilities to find, track, and strike these challenging targets. Planners must balance this asymmetry in capability with the advantages of attacking mobile and high-value targets with allied missiles located a short

106 The Marine Corps' Expeditionary Advanced Base Operations (EABO) concept already envisions the creation of such a force. See Headquarters Marine Corps, "Expeditionary Advanced Base Operations," August 2, 2021, https://www.marines.mil/News/News-Display/Article/2708120/expeditionary-advanced-base-operations-eabo/.

range from the target. The short flight times of allied missiles further strengthen the case for integrating allied inner ring systems with U.S. ISR and C2 infrastructure. Additionally, allied missiles in close proximity to an adversary may be the first strike option available in quantity as the United States begins moving its assets into a region at the start of a conflict.

In sum, this analysis of the inner ring has yielded several key insights for policymakers. Inner ring systems have unique virtues due to their short flight times, which make them ideally suited for attacking time-sensitive mobile targets in high-clutter environments. Already, many allies and partners are fielding short-range missiles that could be included in a U.S.-led ground-based fires strategy. Therefore, a missile strategy should avoid creating excess redundancy between U.S. and allied capabilities and should be cautious about further co-development, allied sovereign use, and U.S. missile deployments to the inner ring. The key challenge for an inner ring missile strategy is integrating the volume of diverse U.S. and allied weapons under a coherent set of plans, with a secondary task to coordinate and differentiate roles and missions between military services and the United States and its allies. Mission type, system type, and missile location are potential avenues for segmenting and coordinating inner ring fires.

The Middle Ring

With locations that could accommodate MRBMs and other weapons between 1,000 and 3,000 km in range, the middle ring presents a more difficult geostrategic challenge than the inner ring. Basing and deployment locations are more limited in the Indo-Pacific due to its distinctly maritime character. Europe offers a wider variety of positions where medium-range missiles could be employed to threaten Russian military targets. However, the small number of medium-range systems in development limits near-term options and demands that any new systems come with both a development and procurement cost. Ultimately, policymakers must weigh the added cost of medium-range systems against the limited basing locations in the primary theater of concern, the Indo-Pacific.[107]

Longer flight times make middle ring systems better suited for attacking fixed rather than mobile targets. Medium-range missiles could threaten high-value targets deeper within adversary territory, such as C4ISR nodes, logistics chokepoints, military installations, and ballistic missile launch sites. However, increased range makes medium-range systems significantly more costly than short-range systems.

107 *Leveling the Playing Field* previously estimated an MRBM to be seven to 20 times more expensive than an SRBM and an MRBM battery to be 11 to 25 times more expensive than an SRBM battery. For further cost estimates and comparisons, see *Leveling the Playing Field*, p. 38.

How to Approach the Middle Ring's Limited Utility

The middle ring features an awkward mix of disadvantages that limit its overall utility in a theater-range missile strategy that prioritizes the Indo-Pacific. The lack of suitable territory in the Indo-Pacific middle ring presents limited deployment options. Medium-range missiles are more costly to procure than short-range missiles and also lack the range needed to open additional basing options in the Pacific. Equipping these missiles with technologies to increase their effectiveness or survivability would make them even more expensive.

Of course, medium-range systems could be deployed along the inner ring, where they would use their "range bonus" to threaten targets deeper in adversary territory. The advantages gained by threatening these targets must be weighed against the additional cost of medium-range weapons. Higher prices would likely limit the number of systems that could be fielded and the volume of fires that could be delivered. Many inner-ring allies do not require additional range to threaten adversaries, making them unlikely to pursue medium-range co-development opportunities and saddling Washington with the bulk of development costs. One option for quickly fielding a medium-range missile while avoiding extensive development costs would be a ground-based Tomahawk Block V along the lines of the current MRC and MST programs, but with a range mirroring the previously fielded BGM-109G Gryphon GLCMs. The U.S. military had decades of experience with the Tomahawk, and Block V missiles will be capable of performing anti-ship or land-attack roles. Procurement costs could be further reduced by achieving economies of scale because the Tomahawk Block V will also be employed on naval vessels. Ultimately, the utility of the additional range afforded by a ground-based Tomahawk will have to be weighed against the additional cost per missile. Further cost-sensitivity analysis is critical to better determine the viability of medium-range missiles with a "range bonus" to deploy in the Indo-Pacific.

Medium-range missiles make more sense in the European theater. However, the United States must weigh the utility of developing them against the cost of an additional missile program with limited utility in the Indo-Pacific, the primary theater of concern. A medium-range weapons program ideal for deployment to Europe would compete for resources against short and intermediate-range systems designed for the Pacific.[108] The European theater is also where the United States' inventory of short-range strike aircraft is most useful. Should the United States need to deploy its own missiles to the middle ring nations of Europe, it should send intermediate-range weapons with utility in both theaters rather than accruing the added cost of another ground-based fires program with limited use.

The best option for the European theater's middle ring may be relying on weapons developed and fielded by European allies, possibly with some assistance from the United States. Medium-range missiles are ideal candidates for co-development between the United Kingdom and other NATO members. The United States could contribute to these initiatives,

108 Even the deployment of the Tomahawk system described above to Europe would compete against more useful longer-range systems for personnel, support, and infrastructure.

assuming it can significantly limit its share of program costs. One option is utilizing foreign military sales to equip European allies with the previously described ground-based Tomahawk Block V system. This approach would allow NATO members to field a versatile, proven medium-range missile while avoiding high development and procurement costs for the United States and its allies. Medium-range missiles may also be a cost-effective way for certain NATO allies to build their own ability to pursue a deterrence by punishment strategy.[109] Medium-range missiles procured by Poland, Romania, and the Baltic states would allow them to directly threaten military targets deep in Russia.[110]

In sum, the range of the middle ring is of limited utility in the Indo-Pacific for holding the Chinese mainland at risk due to the lack of basing options and the increased cost of medium-range systems. The United States is best served by pursuing a missile strategy that deprioritizes the development of its own medium-range systems and encourages its allies to field these weapons in Europe, where they can be most effective. Thankfully, the strong relationships between the United States and many of its European and NATO allies provide a firm foundation for including allied weapons in a ground-based fires strategy for the theater.

The Outer Ring

Intermediate-range systems located in the outer ring present the greatest long-term opportunities for exploration as the United States develops a missile strategy. With intermediate-range missiles ranging between 3,000 and 5,500 km, the outer ring distinguishes itself from the other two rings by allowing missiles to be based on U.S. territory. At present, the United States and its allies do not field these conventional weapons, and chapter 3 exposed the lack of investment in developing systems in this range. This capability gap is primarily the result of being constrained by the INF Treaty until 2019, but also because technical, programmatic, political expediencies, and experience favor shorter-range systems.

Moving forward, the costs of intermediate-range weapons will likely limit the number of programs and the quantity of missiles the United States will pursue. Our analysis of the inner ring examined co-development with allied nations as one option to reduce development costs. Due to their increased size and range, however, intermediate-range weapons are likely to remain more expensive to develop and procure than short-range, inner-ring missiles. Their range and guidance systems make these systems complex to operate,

109 Medium-range missiles may be more cost-effective when compared to building robust naval or air forces capable of conducting penetrating strike missions deep into contested territory. Ground-based fires may hold particular value for small nations such as the Baltics that do not currently field significant air or maritime forces, because these nations would need to build the associated support and sustainment infrastructure from the ground up.

110 Depending on the scope of interested nations, the cooperative development, procurement, and maintenance of these systems could even be executed as a NATO initiative with support from the NATO Support and Procurement Agency. See NATO Support and Procurement Agency, "About Us," https://www.nspa.nato.int/about.

maintain, and employ. No matter the exact type, outer-ring systems' high cost and technical expertise will inevitably limit the total quantity of systems fielded.[111]

The high value but low quantity of intermediate-range missiles make the outer ring most demanding of thorough analysis across the total strike portfolio. This study suggests the United States must make the most of these low-density systems with technologies that maximize range advantage and volume of effects.

Maximizing the Utility of Intermediate-Range Systems in the Indo-Pacific

Because of the inherent costs of intermediate-range missiles and the limited number of sizable landmasses in the Indo-Pacific outer ring, intermediate-range missiles would remain a high-value but low-density asset. In this theater, the United States should explore systems and technologies that mitigate this quantitative disadvantage. The DoD can maximize the value of high-value low-density strike assets in three ways: precise targeting of key nodes with unitary warheads, area effects utilizing submunitions or non-kinetic payloads, or multiple independently targetable warheads. This analysis will highlight the pros and cons of each of these options.

First, the United States could pursue enhanced precision capabilities to create a precise, survivable strike asset utilizing unitary warheads. These missiles would rely on extremely accurate guidance systems, hypersonic speeds, and MARVs to conduct pinpoint strikes on the most valuable C2 nodes and vulnerabilities. Munitions of this type would depend on speed and maneuverability to reliably penetrate enemy defenses. "Silver bullet" missiles are attractive, and some of the DoD's current hypersonic development programs likely fall into this category.[112] To achieve crippling effects against adversaries, however, the systems would rely on accurate, detailed, and timely intelligence along with intricate knowledge of enemy C2 and logistics networks. But attaining quality intelligence of this sort has proven difficult for the U.S. military in recent conflicts, even in permissive airspace with persistent ISR.[113]

111 CSBA previously estimated that an IRBM missile would cost between 1.5 and 3.5 times more than an MRBM and an IRBM battery 1.5 to 3 times more than an MRBM battery. These costs make intermediate-range missiles an attractive option if their range is double that of medium-range systems and they enjoy similar advantages in payload weight and size. This chapter will further explore additional approaches for multiplying the effects of large missile payloads below. For additional cost estimates and comparisons, see *Leveling the Playing Field*, p. 38. Outer ring systems, such as IRBMs with multiple warheads, could also be examples of a Networked Force Package (NFP), where additional effects can be achieved for a set increment of cost. For example, see Travis Sharp, Chris Bassler, and Tyler Hacker, "In a Connected Era, We Talk Too Much About Individual Weapons," *Defense One*, June 8, 2022, https://www.defenseone.com/ideas/2022/06/connected-era-we-talk-too-much-about-individual-weapons/367898/.

112 In this case, the Air Force's AGM-183 Air-Launched Rapid Response Weapon (ARRW) or the Army's Long-Range Hypersonic Weapon (LRHW).

113 For example, media investigations have since questioned the accuracy and legitimacy of the intelligence supporting many drone strikes conducted during the Global War on Terror. See Azmat Khan, "Hidden Pentagon Records Reveal Patterns of Failure in Deadly Airstrikes," *New York Times*, December 18, 2021, https://www.nytimes.com/interactive/2021/12/18/us/airstrikes-pentagon-records-civilian-deaths.html.

With a few missiles and payloads, every intelligence error, weapon malfunction, or enemy interception would leave a high-value target undamaged.

Second, intermediate-range weapons could release a large number of submunitions with wide-area effects or loitering capabilities. In practice, these missiles would be a distributed version of the highly-precise payload—spreading their effects over as many targets as possible. They might accomplish this through several technologies, including but not limited to explosive submunitions, loitering submunitions, non-kinetic payloads, or some combination of the three. Explosive submunitions would be ideal for neutralizing large area targets like industrial facilities, military assembly areas, or aircraft grounded at airbases. Loitering submunitions would spread out and scan a large zone, waiting for targets of opportunity to reveal themselves before striking. These systems also enable real-time battle damage assessment to be organically provided by the strike system. Non-kinetic payloads could also loiter, concentrating their effects in one location for a prolonged period or spreading them over an extended area. Wide-area munitions like these might cause physical as well as virtual attrition, which occurs when the threat posed by the munition suppresses, disconnects, diverts, or delays enemy forces and decreases their operational effectiveness.[114] Virtual attrition could be particularly effective if employed in conjunction with other strike assets. For example, the United States has reportedly tested loitering "suicide drones" delivered by a hypersonic delivery vehicle as part of a program called "Vintage Racer," which could also constitute an option for outer ring weapons depending on finalized ranges.[115] However, several factors might hinder the fielding of effective wide-area munitions. Submunitions invoke images of controversial and indiscriminate cluster munitions, but newer technologies have moved beyond this previous employment approach and enable smart submunitions capable of target discrimination and self-destruction.[116] Loitering submunitions would necessitate autonomous target selection and decision-making, which have halted such

114 For a deeper discussion of virtual attrition along with some historical examples, see John Stillion and Bryan Clark, *What it Takes to Win: Succeeding in 21st Century Battle Network Competitions* (Washington, DC: CSBA, 2015), https://csbaonline.org/research/publications/what-it-takes-to-win-succeeding-in-21st-century-battle-network-competitions.

115 Joseph Trevithick, "Pentagon Has Tested a Suicide Drone That Gets to Its Target Area at Hypersonic Speed," *The Drive*, June 8, 2020, https://www.thedrive.com/the-war-zone/33934/pentagon-has-tested-a-suicide-drone-that-gets-to-its-target-area-at-hypersonic-speed.

116 Although the United States has never signed the Convention on Cluster Munitions, many of the nations in the three rings are signatories of the treaty. However, it must be noted that "cluster munitions" as defined in the Convention on Cluster Munitions only includes conventional munitions that are "designed to disperse or release explosive submunitions each weighing less than 20 kilograms." Many intermediate-range missile explosive submunitions would likely exceed 20 kilograms. The convention also excludes munitions that dispense submunitions with electric or electronic effects and "smart" submunitions designed to discriminate between military and civilian targets. These submunitions are more capable that previous conceptions of cluster munitions. For more information, see "Convention on Cluster Munitions," Diplomatic Conference for the Adoption of a Convention on Cluster Munitions, May 30, 2008, https://www.clusterconvention.org/files/convention_text/Convention-ENG.pdf.

programs in the past.[117] Non-kinetic payloads, such as electronic jammers or high-powered microwaves, are rapidly improving in capability, but their currently limited effects may not be valuable enough to justify delivery via intermediate-range missiles.[118]

Finally, intermediate-range missiles in the Indo-Pacific could utilize conventional multiple independent reentry vehicles (MIRVs) and maneuverable reentry vehicles (MARVs) to multiply the number of independent, maneuverable precision-guided warheads they deliver. A MIRV contains multiple warheads that can be directed towards various separate targets, while a MARV can independently track targets and readjust its flight path accordingly to reach them. A conventional MIRV's multiple warhead capacity can bring to bear an increased volume of fire against several targets at once, maximizing the targeting and strike efficiency of theater-range missiles. Conventional MIRVs could potentially address the capacity limitation of smaller numbers of single-use, long-range missiles in the outer ring by equipping these limited systems with more warheads per missile to maximize the overall firepower available from each delivery system. A MARV capability would also be a useful theater-range missile candidate because its maneuverability and guidance systems could better penetrate adversary air defense networks to reach targets. Together, conventional MIRVs and MARVs could be used to combine the best features of precision and area effects.

MIRVs and MARVs are typically associated with the mission of nuclear deterrence, but technical configurations could result in fielding conventional variants to contribute to long-range precision fires.[119] Incorporating these assets in the U.S. precision fires arsenal should not be considered unusual since Russia and China already possess various dual-capable MIRVs and MARVs. China's DF-21, for example, is MARV-capable and could leverage its guidance systems to easily detect and attack U.S. and allied surface combatants.[120] The DF-16 is an

117 Ethical concerns about autonomous loitering munitions led the cancellation of the Low Cost Autonomous Attack System (LOCAAS). The Pentagon is reportedly in the process of revising its policies on autonomous and semi-autonomous weapons. See Barry D. Watts, *The Evolution of Precision Strike* (Washington, DC: Center for Strategic and Budgetary Assessments, 2013), p. 18, https://csbaonline.org/uploads/documents/Evolution-of-Precision-Strike-final-v15.pdf; and Valerie Insinna and Aaron Mehta, "Updated autonomous weapons rules coming for the Pentagon: Exclusive details," *Breaking Defense*, May 26, 2022, https://breakingdefense.com/2022/05/updated-autonomous-weapons-rules-coming-for-the-pentagon-exclusive-details/.

118 One example of a developmental non-kinetic payload is contained within Boeing's Counter-electronics High-powered Microwave Advanced Missile Project (CHAMP), which claims to defeat electronic targets using bursts of energy. For more information, see Boeing, "CHAMP – Lights Out," October 22, 2012, https://www.boeing.com/features/2012/10/bds-champ-10-22-12.page.

119 These efforts may also be in conjunction with renewed efforts for the United States on nuclear missile systems, rolling back previous U.S. de-MIRVing efforts that were not matched by China or Russia. See Eric Edelman and Franklin C. Miller, "Nuclear Weapons and Arms Control: Old Myths and New Realities," *The Dispatch*, May 13, 2022, https://thedispatch.com/p/nuclear-weapons-and-arms-control?s=r.

120 Department of Defense, "Military and Security Developments Involving the People's Republic of China 2020," September 1, 2020, p. 56, https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

SRBM with a conventional strike package and MIRV capability.[121] Russia's Avangard hypersonic glide vehicle (HGV), designed for attachment to an ICBM, is MIRV-capable and can be armed conventionally as well.[122]

Currently, the only U.S. MIRV capability lies with its submarine-launched ballistic missile (SLBM), the UGM-133 Trident II. The United States no longer possesses any MARV-capable weapons. With Russia and China already ahead of the United States in both intermediate-range missiles and MIRV/MARV systems, Washington should view MIRVs and MARVs as important options to increase the effectiveness of conventional intermediate-range missile forces. Though MIRV technologies are no longer standard within the Minuteman III arsenal, the U.S. Air Force tests these capabilities intermittently, at times with multiple re-entry vehicles.[123] The continued, if infrequent, testing of these mature technologies suggests that Washington could quickly re-establish a MIRV or MARV-based intermediate-range missile force if necessary.

The United States could reconstitute its MIRV/MARV force through a few notional options. Previously, the Pershing II IRBM, which had been decommissioned as part of the INF Treaty, contained a MARV capability and its own radio guidance system.[124] CSBA previously identified the Pershing II as a potential basis for a new IRBM in *Leveling the Playing Field*.[125] Defense planners could revive a Pershing III program by investing in technical upgrades to the system to equip it with more modern guidance systems and propulsion and increase the platform's accuracy. Several lines of effort originally associated with the Conventional Prompt Global Strike program, including the common aero vehicle (CAV) and hypersonic technology vehicle (HTV), eventually converged around hypersonic weapons. Thus, another potential option for consideration is any strike asset that leverages HGV technology. U.S. hypersonic weapons across the armed services will rely on a common standard glide vehicle, providing options for capabilities in the future that leverage re-entry vehicles with adjustable trajectories to confuse adversary sensors and missile defenses. DoD should consider combining elements of these hypersonic weapons with MIRV or MARV capabilities,

121 Missile Defense Project, "DF-16 (Dong Feng-16 / CSS-11)," *Missile Threat*, Center for Strategic and International Studies, November 16, 2017, last modified June 23, 2020, https://missilethreat.csis.org/missile/dong-feng-16-css-11/.

122 Missile Defense Advocacy Alliance, "Avangard (Hypersonic Glide Vehicle)," https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/russia/avangard-hypersonic-glide-vehicle/.

123 Joseph Trevithick, "Test Of Minuteman III ICBM With Three Reentry Vehicles Sure Seems Like A Warning To Russia (Updated)," *The Drive*, August 4, 2020, https://www.thedrive.com/the-war-zone/35352/test-of-minuteman-iii-icbm-with-three-reentry-vehicles-sure-seems-like-a-warning-to-russia. In August 2020, the United States conducted a launch test of a Minuteman III equipped with three MIRVs. Though officials did not specify the reason for multiple MIRVs, the presence of these technologies indicates that MIRV-focused capabilities could easily be reconstituted if Washington chooses to focus on these assets.

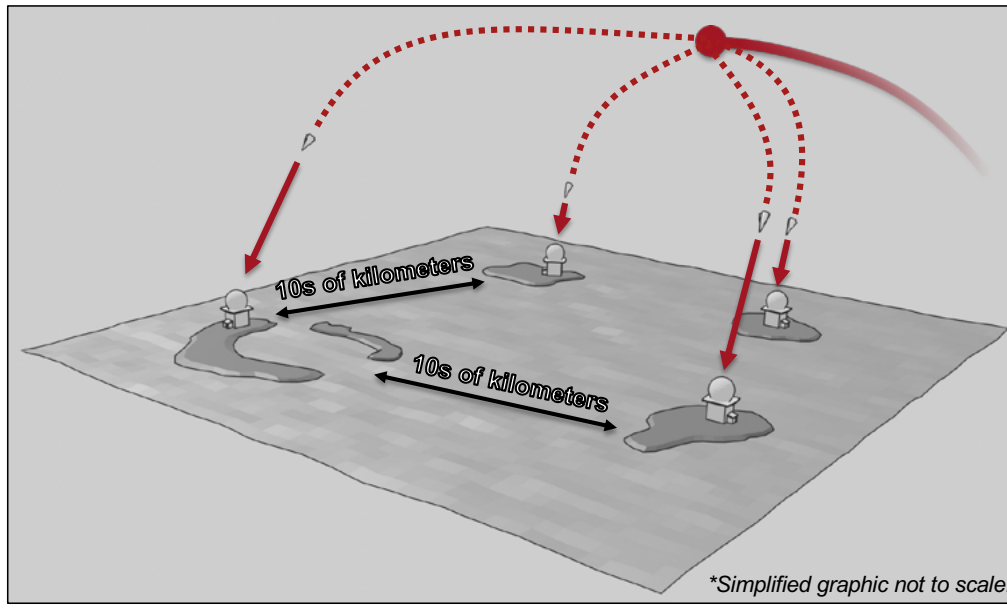
124 Missile Defense Project, "MGM-31B Pershing 2," *Missile Threat*, Center for Strategic and International Studies, February 15, 2017, last modified October 26, 2020, https://missilethreat.csis.org/missile/mgm-31b-pershing-2/; and Philip M. Bofey, "New Generation of Warheads Just Around the Bend," *The New York Times*, February 15, 1983, https://www.nytimes.com/1983/02/15/science/new-generation-of-warheads-just-around-the-bend.html.

125 Leveling the Playing Field, pp. 36–38.

generating new conventional strike configurations as further options for outfitting intermediate-range missiles.

Conventional MIRVs could also combine the features of the previous two options. As illustrated in Figure 10, maneuverable reentry vehicles could spread out over a large geographic area and provide multiple precision strikes.

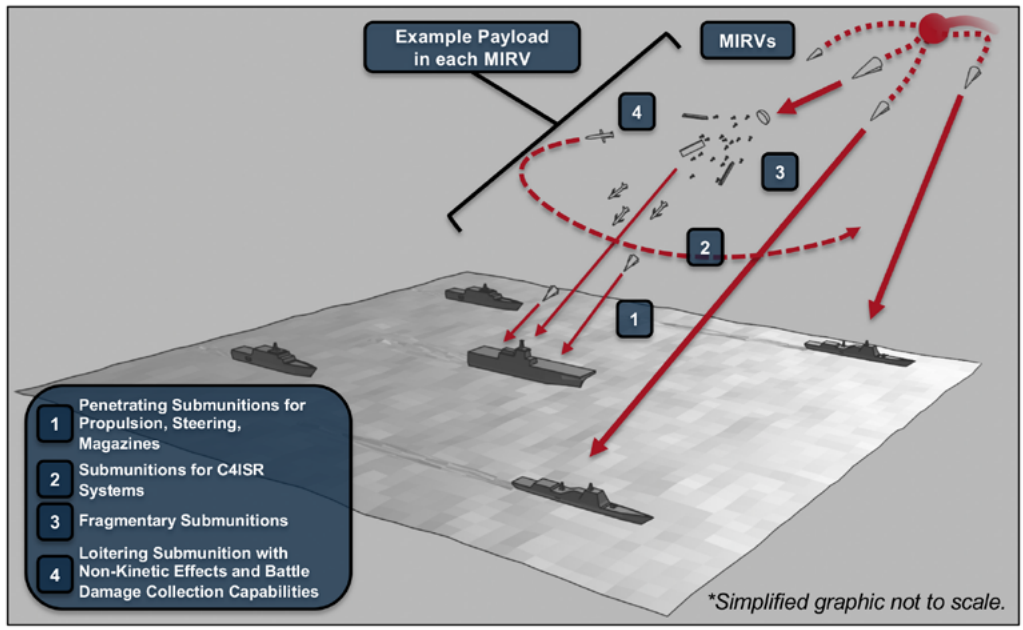
FIGURE 10: EXAMPLE CONVENTIONAL MIRV CONCEPT—MULTIPLE TARGETS SPREAD OVER A LARGE GEOGRAPHIC AREA



Source: Graphic created by CSBA.

Conventional MIRVs might also release another set of submunitions to deliver a range of effects. For example, each reentry vehicle could contain submunitions with a variety of sensor types to track and attack a target. Based on concepts such as Figure 11, a mix of sensor phenomenologies (e.g., radar-guided, anti-radiation, infrared seeking, etc.) would decrease the chance of adversary defenses and countermeasures defeating all submunitions. Loitering submunitions could provide additional non-kinetic effects or collect and transmit damage assessments.

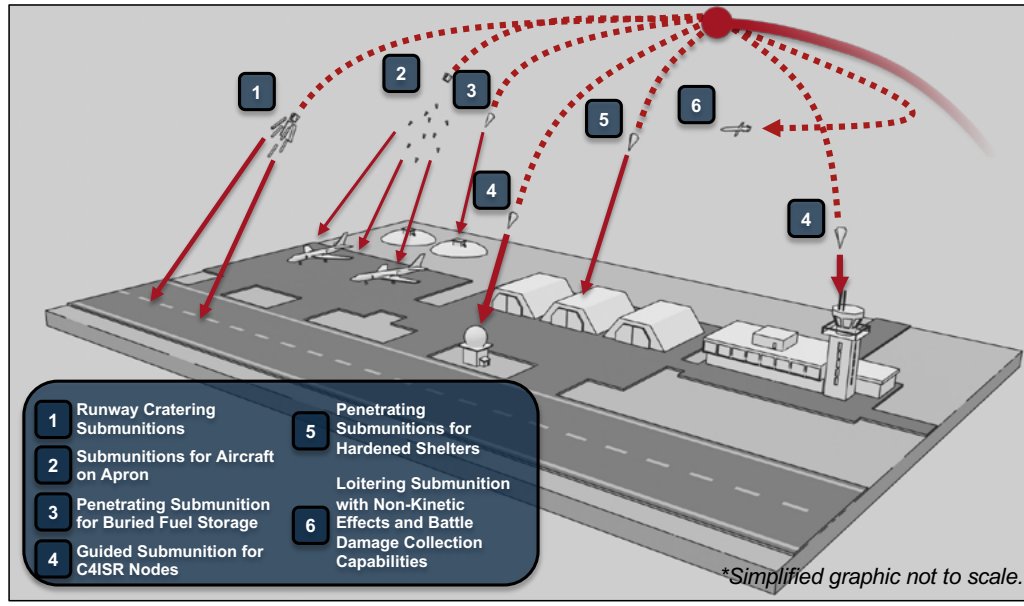
FIGURE 11: EXAMPLE CONVENTIONAL MIRV CONCEPT—MULTIPLE SUBMUNITIONS FOR A SINGLE TARGET TYPE



Source: Graphic created by CSBA.

Conventional MIRV payloads might also be heterogenous, mixing multiple kinds of reentry vehicles or submunitions in a single missile to create multiple dilemmas and drastically increase complexity for the defender. As shown in Figure 12, large targets such as airbases, ports, or military infrastructure complexes could be targeted by conventional MIRVs with varied submunitions designed to use different sensors and payloads to attack a variety of aimpoints within a larger target. Weapons could be developed that utilize some submunitions to suppress targets with wide-area effects before destroying the suppressed targets with precision-guided submunitions. Moreover, conventional MIRVs utilize existing, proven technology. Specialty payloads would require further development, but the United States has long experience building MIRVed and MARVed missiles. For these reasons, conventional MIRVs and MARVs may be the best way to ensure the low number of intermediate-range missiles in the Indo-Pacific achieve the greatest effect.

FIGURE 12: EXAMPLE CONVENTIONAL MIRV CONCEPT—MULTIPLE SUBMUNITIONS FOR MULTIPLE TARGET TYPES



Source: Graphic created by CSBA.

Maximizing the Utility of Intermediate-Range Systems in Europe

The vast distances of the Indo-Pacific impel the United States to develop, purchase, and field intermediate-range weapons that leverage this theater's strategically advantageous outer ring. As outlined, the prospective cost of any intermediate-range missile program would likely push the United States to pursue intermediate-range over medium-range weapons, with investments in the former crowding out resources for the latter. For this reason, this study recommends that the United States encourage its allies in Europe to field medium-range missiles.

A Pacific-focused intermediate-range missile program, however, would also create distinct opportunities for limited intermediate-range deployments in Europe's inner and middle rings. The United Kingdom's geographic location and special relationship with the United States make it an ideal candidate for an intermediate-range missile co-development program that would place U.S. and/or British intermediate-range missiles in the United Kingdom. The United States might also supplement indigenous medium-range missiles on the continent with additional U.S. intermediate-range missiles in key NATO states. With many of these nations in the inner and middle ring potentially fielding their own short and medium-range capabilities, intermediate-range missiles in Europe would require a missile strategy that coordinates and leverages their advantages and unique capabilities and avoids redundancy.

Intermediate-range missiles deployed to Europe's inner and middle rings would possess a "range bonus," with their maximum range of 5,500 km reaching far beyond the majority of military targets in western Russia that are targetable by inner range systems. The United States and NATO could exploit this surplus range in several ways. First, the additional range could be used for MARVs and hypersonic boost-glide vehicles to create more complex flight paths that circumvent or confuse enemy missile defenses. An altered trajectory accompanied by unpredictable maneuvers would increase the missile's survivability and the chance it successfully reaches its target. However, intermediate-range systems with these features will have to overcome technical challenges related to precise maneuvering at high speeds. With conventional payloads, U.S. intermediate-range missiles would still require precision guidance that might inhibit hypersonic maneuvers.[126] Determining complex flight paths that avoid defenses would also require additional planning before launch, which could limit the missile's effectiveness against time-sensitive targets. Most of all, these capabilities would not significantly differentiate these long-range systems from other short-range capabilities on the inner ring.

A second option created by an intermediate-range missile's additional range is the possibility of delivering larger and more numerous payloads. Rather than using the increased fuel and size for additional range, missiles in Europe could be modified with heavier payloads. These weapons might deliver additional reentry vehicles or vehicles with a larger quantity of submunitions. Payload modifications could be especially key to multiplying the effects of these conventional systems. Increased explosive weight would broaden the range of targets that could be attacked, and a larger number of reentry vehicles or submunitions would allow a single missile to attack more targets or have effects over a wider area. Still, these modifications would require additional development and resources that might not be available for the European theater. Moreover, the modified payloads would multiply the volume of effects, but would not significantly differentiate these missiles' capabilities from other European ground-based fires.

Finally, the range bonus could be applied to hold targets deeper in adversary territory at risk. Intermediate-range missiles launched from as far west as the United Kingdom would still be capable of reaching beyond the Ural Mountains into Siberia to the Yenisei River. This targetable area would nearly overlap with the range fan of Pacific-oriented intermediate-range weapons in Alaska, which could also reach targets in Russia's east, under the command of the Far Eastern Military District.[127] Such complete coverage would eliminate the adversary's facilities and sanctuaries and threaten a much larger portion of the Eurasian landmass. By increasing the number of potential targets under this extended range umbrella, intermediate-range missiles could push Russia to spread its existing missile defenses or embark on a costly expansion of its defenses to cover additional territory. Most importantly, these missiles could reach deep targets that other strike platforms in Europe could not. In this

126 Kelley M. Sayler and Amy F. Woolf, *Defense Primer: Hypersonic Boost-Glide Weapons* (Washington, DC: Congressional Research Service, 2021), https://sgp.fas.org/crs/natsec/IF11459.pdf.

127 In this case, "nearly" refers to between 1,000 and 2,000 kilometers. Much of this territory is sparsely populated wilderness in northern Russia.

way, European-based intermediate-range missiles would complement existing and future inner and middle ring capabilities under a U.S.-led missile strategy. For these reasons, utilizing intermediate-range missiles' additional range to strike deep targets stands as the most attractive use of intermediate-range capabilities in the European theater.

Locating Intermediate-Range Systems Across Theaters

Intermediate-range missiles would be valuable strike assets in both the Indo-Pacific and Europe. These opportunities, however, raise the issue of where to locate intermediate-range systems across the theaters. Basing options in the outer ring are simplest because it is the only ring in which the United States can field missiles on its own sovereign territory. Weapons located in Guam and the Marianas would bring a new set of capabilities to the Indo-Pacific, and intermediate-range missiles in Alaska could threaten both Chinese and Russian targets. Basing intermediate-range missiles in U.S. territory merits further examination for two reasons. First, these locations guarantee the missiles' utility and avoid the political and diplomatic difficulties of deploying missiles to allied and partner nations. Even if contemporary political attitudes prevent or delay the deployment of intermediate-range missiles to allied territory, the systems could be placed in the Marianas and Alaska and still provide a unique capability in the Indo-Pacific. Deployments within U.S. territory are not limited in quantity, purpose, or system type. The weapons would be under complete U.S. control and planners would not be forced to contend with other nations' constraints regarding targets or rules of engagement. These missiles would not be subject to diplomatic disputes or alliance disagreements, which would increase their overall deterrence value.

Second, intermediate-range missiles on U.S. soil could constitute a conventional strike "reserve." Should decision-makers be unwilling to launch missile strikes from U.S. territory, these missiles could be kept as a conventional weapon of last resort. Unlike long-range bombers and submarines, ground-based missiles on U.S. territory furthest from adversaries could not be denied access to the theater by enemy forces. Utilizing intermediate-range missiles in this manner could alter the strategic balance in a prolonged conflict, perhaps providing additional leverage in conflict termination or arms control negotiations. Finally, an intermediate-range missile reserve is one way the United States could address the possibility of simultaneous conflict in both the Indo-Pacific and Europe. Even if a European contingency required the United States to redeploy significant forces from the Indo-Pacific, it would maintain a persistent conventional strike capability in both theaters.

Alaska and the Marianas ensure that intermediate-range missiles would be valuable additions to the U.S. conventional strike portfolio. To partner with allies and increase the number and breadth of deployment locations, the United States should also seek to deploy intermediate-range systems outside U.S. territory. These additional deployments would reduce risk by increasing the number of systems and spreading them over a wider area, making the weapons more difficult to destroy and strengthening their deterrence effects. In the Indo-Pacific, Australia is the nation most likely to host or deploy intermediate-range

weapons. Missiles based in northern Australia would enable Australian forces to range targets in southern China as far north as Shanghai. In Europe, intermediate-range missiles in the United Kingdom could reach targets in Russia up to the Ural Mountains and beyond. Australia and the United Kingdom are both front-line players in their respective theaters, but they are also the ally in each theater with the most strategic depth. Mobile intermediate-range missile forces would be far from the Chinese and Russian homelands, making them difficult to target and even more challenging to strike.

To make this opportunity a reality, the United States should pursue an "AUKUS 2.0" deal focused on ground-based fires to foster accelerated collaboration on intermediate-range systems between the United States, the United Kingdom, and Australia. A project like this would reduce costs for the United States and encourage the deployment of long-range missiles by two key allies in the Indo-Pacific outer ring and the European middle ring. Missiles could be co-developed to share components, increase supply chain resiliency, and bolster the defense industrial bases of two close U.S. allies.[128] Moreover, jointly developed missiles could rely on integrated kill chains and targeting systems in order to ensure interoperability between U.S. missiles in Alaska and the Marianas and Australian and U.K. missiles in the Indo-Pacific and Europe. Already, the three nations have announced the joint development of hypersonic missiles under the AUKUS alliance.[129] Aspects of these efforts could be leveraged to include collaboration on intermediate-range missiles featuring the technologies described in this chapter.

Foundation of a U.S.-Led Ground-Based Missile Strategy

This extended analysis of the three rings has identified several important implications for a U.S. missile strategy. The inner ring is the past and current focus of U.S. and allied ground-based missile investments. By the mid to late 2020s, the inner ring will be flush with a preponderance of short-range missile systems capable of anti-ship and land-attack missions. A U.S. missile strategy must integrate this range of systems and create a logical division of labor between the U.S. armed services and the United States and its allies. But a strategy focused on short-range weapons and the inner ring has serious limitations—namely, supplanting investments in the long-term development of longer-range missiles.

Looking outward, the geographic bifurcation of the Indo-Pacific theater between the inner and outer rings means that the middle ring is primarily a concern in Europe. Focusing

128 Both the United Kingdom and Australia are included in the statutorily defined National Technology and Industrial Base (NTIB), which is intended to "support national security objectives of the United States, including supplying military operations; conducting advanced R&D and systems development to ensure technological superiority of the U.S. Armed Forces; securing reliable sources of critical materials; and developing industrial preparedness to support operations in wartime or during a national emergency." Heidi M. Peters, *Defense Primer: The National Technology and Industrial Base* (Washington, DC: Congressional Research Service, 2021), https://sgp.fas.org/crs/natsec/IF11311.pdf.

129 Associated Press, "Australia, the U.K. and the U.S. say they will develop hypersonic missiles," *National Public Radio*, April 6, 2022, https://www.npr.org/2022/04/06/1091194471/australia-u-k-u-s-hypersonic-missiles.

on the Indo-Pacific incentivizes the United States to forgo developing new medium-range systems for Europe, leaving its European allies to develop and procure medium-range missiles for integration into an allied missile strategy. Accordingly, a missile strategy should encourage U.S. allies in Europe to invest in these capabilities, possibly through the sale of a ground-based Tomahawk cruise missile or the PrSM. The United States could play a role in developing such systems through co-development, sharing kill chain elements, or selected technology assistance for key components, so long as such investments do not interfere with intermediate-range missile programs.

Intermediate-range missiles, on the other hand, create new opportunities in both the Indo-Pacific and European theaters, making them valuable pursuits for any future ground-based missile strategy. Intermediate-range systems on U.S. soil are ideal candidates for use as a conventional strike reserve. In a prolonged conflict, intermediate-range missiles maintained for this role could have strategic utility as a persistent strike option and a tool to manage escalation. A conventional strike reserve of intermediate-range missiles could also be one cost-effective option for managing the possibility of simultaneous conflict in both theaters, with outer ring systems comprising a persistent deterrent in one theater while conflict is resolved in another.

Accordingly, the United States should invest in reconstituting an intermediate-range missile force. The costs of intermediate-range systems will likely limit the quantity of missiles that can be fielded and the volume of fires available from intermediate-range missiles, making these high-value but low-density systems. To mitigate this quantitative disadvantage, the DoD should explore systems that utilize various technologies and employment concepts to maximize their utility in their respective theaters. In the Indo-Pacific, these technologies include combinations of wide-area effects, loitering submunitions, and conventional MIRVs and MARVs. Of these options, conventional MIRVs and MARVs present the most value and the fewest technical and ethical challenges. In Europe, the United States and its allies should explore strategies, systems, and employment concepts that exploit the intermediate-range missile range opportunity, such as complex flight paths, expanded payloads, and the ability to strike targets deep in Russian territory. For technical and strategic reasons, striking deeper targets is the most attractive near-term option.[130]

Investing resources in the development of intermediate-range systems has two main implications for ground-based missile development and deployment. First, the United States should be wary of further co-development efforts of short-range missiles with inner-ring allies.[131] Although co-development is an attractive way to reduce development costs and increase the quantity of inner ring capabilities, such efforts could oversaturate the inner

130 Further cost sensitivity analysis is important to determine the exact mix of medium and intermediate-range missiles that should be deployed on the inner and middle rings to take advantage of their "range bonus."

131 One example of an argument for short-range co-development efforts can be found in Jeffrey W. Hornung, *Ground-Based Intermediate-Range Missiles in the Indo-Pacific* (Santa Monica, CA: RAND Corporation, 2022), pp. 35–39, https://www.rand.org/pubs/research_reports/RRA393-3.html.

ring with redundant capabilities. At times, co-development, licensed production, or foreign military sales may be the only approaches to increasing the strike capabilities of a partner or ally. But the United States must weigh these pursuits against the benefits of a diverse portfolio of indigenously-produced ground-based strike options, many of which are already fielded or in development. A varied inventory of short-range missiles gives commanders the highest degree of operational flexibility and would provide the volume of fires necessary to succeed in future salvo competitions. Of course, this diversity also makes integrating these numerous systems into an interoperable precision-strike complex an essential task of any inner ring missile strategy.

Instead, the co-development opportunities with the highest potential reward are found in the middle and outer rings with intermediate-range systems. Given their inherent technical complexity, high costs, and need for political buy-in from potential allied hosts, co-development of these weapons demands further attention from defense planners. A ground-based Tomahawk Block V or the PrSM could be fielded to inner and middle ring allies through foreign military sales to quickly build capability and provide a "range bonus" to nations on the inner ring. The existing AUKUS framework is the ideal vehicle for collaboration on intermediate-range systems between the United States, Australia, and the United Kingdom, perhaps through the co-development of a conventional intermediate-range missile.

Second, a U.S.-led missile strategy should seriously consider the tradeoffs of different outer ring deployment locations. Intermediate-range missiles could be placed on U.S. territory without diplomatic negotiation, would be under full control of the U.S. military, and would not be subject to any additional operational or political constraints. Missiles in Alaska, Guam, and the Marianas would be a persistent conventional strike option capable of threatening targets in China and eastern Russia without regard to basing or access agreements, political vicissitudes, or the need to form specific coalitions for this capability. These locations, however, would require missiles near the top of the intermediate range and would still be somewhat limited in reach, particularly in Russia.

Australia and the United Kingdom would be ideal nations for hosting intermediate-range systems, particularly if co-development efforts are successful. Intermediate-range missiles hosted or fielded by these allies would increase the number of weapons fielded and spread them across broader areas in the strategic depths of the Indo-Pacific and European theaters. Furthermore, the close relationship between the United States, Australia, and the United Kingdom is an ideal foundation for inclusion in a missile strategy. These principles, arrived at through a detailed assessment of the three rings, form the building blocks of a U.S.-led ground-based missile strategy.

CHAPTER 5

Conclusion

The post-INF Treaty world is a drastically different security environment than the late Cold War standoff that led to the signing of the Treaty in the late 1980s. The United States no longer faces a single principal adversary or a situation that enables it to focus its capabilities on the geography of a primary theater. Russia and China's normalization of dual-capable MRBMs and IRBMs with MIRV and MARV capabilities demonstrates that Washington cannot depend only on its existing strike portfolio to counter these assets.[132]

This monograph provides a framework that narrows and prioritizes the United States' ground-based missile options in order to help policymakers make better use of scarce resources. The findings from this study, if implemented, would improve U.S. coordination with allies and advance Washington's negotiating position on politically sensitive questions about basing and access. Chapter three's assessment of current U.S. and allied missile portfolios and programs in development shows that they will likely saturate the inner ring with an abundance of short-range strike options. The United States and its allies and partners are fielding a variety of short-range missile systems that will create a diverse set of strike options on the inner ring. A U.S.-led missile strategy must integrate these capabilities with each other and enact a division of labor that avoids redundancy and most efficiently utilizes the possibility for larger volumes of ground-based fires.

At the same time, there has been very little focus on developing and reconstituting a medium- or intermediate-range missile force based in the middle and outer rings. As long as Moscow and Beijing continue to outrange U.S. systems in this specific category, advances made for strike assets employed within the 1,000 km range will be insufficient unless they are further reinforced by missiles with even greater targeting depth. In the Indo-Pacific, however, the middle ring is mostly devoid of land to deploy medium-range missiles. For this

132 See Steven T. Dunham and Robert S. Wilson, "The Missile Threat: A Taxonomy for Moving Beyond Ballistic," *Aerospace Corporation*, August 2020, available at https://aerospace.org/sites/default/files/2020-08/Wilson-Dunham_MissileThreat_20200826_0.pdf.

reason, the United States cannot simply resurrect the Pershing MRBM for the contemporary Indo-Pacific. Medium-range missiles should be left to European allies, if they choose to pursue them, with the United States assisting through co-development, advising, technology and component sharing, or even foreign military sales.

Because of the strategic geography of the Indo-Pacific, the outer ring holds more promise than the middle ring. Procuring new intermediate-range strike systems offers flexibility for the United States in both the military and diplomatic spheres. The United States and its allies may be able to close some of the existing long-range strike gap, or at least have a greater array of options and capacity to threaten targets in the Chinese and Russian interior and counter adversary missiles that threaten U.S. and allied bases and assets. Closing the existing gap would greatly increase the capability of the United States and allies to counter Chinese and Russian military aggression. These new weapons would help mitigate the A2/AD dilemma by better rectifying the strike balance in contested theaters and complementing strike platforms in the air and maritime domains.

Another possible advantage of reconstituting the U.S. intermediate-range missile force could be to compel Russia and China to reengage with the United States on arms control agreements to limit these types of weapons systems on all sides. The continued buildup of these weapons by all three countries (as well as U.S. allies) could increase the potential for strategic instability, creating an opportunity for Washington, Beijing, and Moscow to use diplomacy to defuse tension and uncertainty. Furthermore, a future arms control agreement could limit the long-term economic costs Washington and its allies would incur if they chose to build missiles to close the strike gap with Russia and China. This scenario would not be unprecedented by any means, as the U.S. deployment of Pershing IIs and BGM-109G Gryphon cruise missiles in Europe in the 1980s eventually ushered in talks that led to the ratification of the INF Treaty. Similarly, fielding these systems today could lead to limits being achieved later.

Most importantly, these intermediate-range systems would require a coherent strategy to guide their procurement, deployment, and employment concepts. This study has presented a framework to devise such a strategy, along with the foundational building blocks of a U.S. missile strategy simultaneously centered on the Indo-Pacific and European theaters. More broadly, it has shown that the United States cannot unthinkingly rerun the Cold War playbook. Today's ground-based missile strategy must be tailored to the unique geographic, political, strategic, technological, and coalitional circumstances of the current Indo-Pacific and European theaters. Defense planners and policymakers can further utilize this framework to build on these initial insights and complete the puzzle of a robust portfolio of short, medium, and intermediate-range strike assets. The three rings are intended to help set the stage for more detailed discussions and planning about exact deployment locations, force size, force posture, allied negotiations, and so forth. This framework is a necessary and important analytical stepping stone to determining these details.

The preliminary strategy outlined in this monograph would be a significant departure from the current overwhelming weight of U.S. investments in short-range capabilities. Like any

significant change, particularly those relating to expensive strike platforms, shifting investment toward long-range missiles will encounter political and bureaucratic resistance in Washington and potentially in allied capitals as well. Nevertheless, fielding intermediate-range weapons is necessary to compete with China and Russia. Moreover, these weapons are not novel. The United States has previously fielded such missiles with even more escalatory and controversial nuclear payloads.

Arguments against long-range ground-based fires center around two arguments. First, critics contend that MIRVs, MARVs, and other long-range conventional strike capabilities increase strategic instability, escalate arms competitions, and enhance adversary misperceptions due to the potential dual-use ambiguity inherent in some of these systems.[133] However, adversaries are more likely to ride out any initial attacks to verify whether they are indeed conventional. The fact that U.S. adversaries, most notably China and Russia, already possess MIRV and MARV-capable missiles with both nuclear and conventional strike packages also demonstrates that they are uninterested in the potential impact their deployments might have on the prospect for arms reduction agreements. This calculus might change if they are confronted by U.S. and allied countervailing capabilities. The United States' reduction of its MIRV capabilities within its ICBM arsenal was not reciprocated by either the Russians or Chinese, leaving Washington in a continued state of vulnerability even as it adhered to arms restraints.[134] It is also illogical to assume that continued adherence to restraint will convince Moscow and Beijing to reverse course and broadly accept the same limitations when both states are already ahead of Washington in these capabilities. Instead, the imbalance in this category of strike assets will tempt Russia and China to leverage these capabilities to intimidate the United States and its allies and gain bargaining advantages in crises. U.S. acquisition of intermediate-range missiles will counter this disadvantage, inject uncertainty in Chinese and Russian risk calculi, and shore up a multiple-range precision-strike complex that signals U.S. resolve.

Second, many doubt the feasibility and willingness of U.S. allies to host intermediate-range weapons. As previously discussed in this monograph, this line of argument falls short for several reasons. One of the U.S.'s closest allies, Japan, has already expressed a willingness to host U.S. missile systems.[135] Other nations, such as the United Kingdom, have previously hosted U.S. ballistic and cruise missiles. The Russia-Ukraine war has shown that allied

133 See James M. Acton, "Debating Conventional Prompt Global Strike," *Carnegie Endowment for International Peace*, October 3, 2013, available at https://carnegieendowment.org/2013/10/03/debating-conventional-prompt-global-strike-pub-53165; and "The Lure & Pitfalls of MIRVs From the First to the Second Nuclear Age," *Stimson Center*, ed. by Michael Krepon, Travis Wheeler, and Shane Mason, May 2016, https://www.stimson.org/wp-content/files/file-attachments/Lure_and_Pitfalls_of_MIRVs.pdf.

134 In fact, reports show the opposite, with China increasing the MIRV capacity of its missiles. Mark B. Schneider, "The Number of Chinese Nuclear Warheads," *Real Clear Defense*, April 27, 2021, https://www.realcleardefense.com/articles/2021/04/27/the_number_of_chinese_nuclear_warheads_774594.html.

135 Alexander Ward and Quint Forgey, "Japan not closing door on hosting American INF missiles," *Politico*, January 31, 2022, https://www.politico.com/newsletters/national-security-daily/2022/01/31/japan-not-closing-door-on-hosting-american-inf-missiles-00003840.

attitudes and threat perceptions can rapidly change. AUKUS, a significant step for U.S.-U.K.-Australia defense cooperation, came as a surprise to many experts and observers. The increasingly aggressive actions of China and Russia could change allied willingness to host or field their own intermediate-range missiles quickly—much more quickly than intermediate-range missile forces can be developed, tested, and fielded. Like Kevin Costner's "if you build it, they will come" mantra in the motion picture *Field of Dreams*, there is strong potential for U.S. development of modern intermediate-range missiles to draw interest from allies, particularly if Chinese and Russian aggression intensifies. Even if allies do not immediately embrace long-range ground-based fires, this study has shown the utility of unilaterally stationing these missiles on U.S. territory such as Alaska and Guam and complementing the shorter-range capabilities of allies. By making such systems mobile and more easily transportable by air and sea, the United States can ensure that missile forces can be rapidly deployed should circumstances change in a theater of interest.[136]

To further assist policymakers and planners address the challenges of introducing these capabilities in allied nations, this monograph is accompanied by a companion study that examines several historical cases in which the United States deployed controversial military capabilities to allied territory.[137] These cases explore how the United States has deployed ground-based missiles abroad on several occasions, and highlight the valuable lessons each case yields for today's decision-makers as they negotiate with nations across the three rings. Together, these studies make the case for developing a coherent conventional ground-based missile strategy that closes the strike gap between the United States and its adversaries. This study demonstrates that the missile balance will likely continue to deteriorate if the United States fails to fully maximize new opportunities to deploy theater-range missiles following its withdrawal from the INF Treaty. Moreover, this report shows that Washington, along with its allies and partners, must organize well-coordinated responses tailored to the unique demands of the Indo-Pacific and European theaters. Given the expected long lead times and painstaking efforts required to develop and implement a sustainable, long-term missile strategy, it behooves policymakers, defense planners, and diplomats to think through their options sooner rather than later.

136 Already, the U.S. Congress has shown interest in exploring basing and access agreements for ground-based intermediate-range missiles. The House version of the fiscal year 2023 National Defense Authorization Act includes a requirement for the Secretary of Defense, U.S. Indo-Pacific Command, U.S. European Command, and the Secretary of State to provide briefings to the House Armed Services Committee on the status of access agreements for ground-based missiles. U.S. Congress, House, Committee on Armed Services, *National Defense Authorization Act for Fiscal Year 2023: Report*, 117th Cong., 2nd sess., 2022, H. Rep. 117-397, p. 301, available at https://www.congress.gov/117/crpt/hrpt397/CRPT-117hrpt397.pdf.

137 See Eric Edelman, Josh Chang, and Tyler Hacker, *Arming America's Allies: Historical Lessons for Implementing a Post-INF Treaty Missile Strategy* (Washington, DC: Center for Strategic and Budgetary Assessments, 2022), https://csbaonline.org/research/publications/arming-americas-allies-historical-lessons-for-implementing-a-post-inf-treaty-missile-strategy.

LIST OF ACRONYMS

A2/AD	anti-access and area denial
AAGS	Army Air-Ground System
ARRW	Air-Launched Rapid Response Weapon
ASCM	anti-ship cruise missile
ATACMS	Army Tactical Missile System
AUKUS	Australia-United Kingdom-United States Partnership
BMD	ballistic missile defense
C2	command and control
CAV	common aero vehicle
CHAMP	Counter-electronics High-powered Microwave Advanced Missile Project
CNMI	Commonwealth of the Northern Mariana Islands
CSBA	Center for Strategic and Budgetary Assessments
DoD	U.S. Department of Defense
EABO	Expeditionary Advanced Base Operations
ESSM	Evolved Sea Sparrow Missile
FMS	foreign military sales
GLBM	ground-launched ballistic missile
GLCM	ground-launched cruise missile
GMLRS	Guided Multiple Launch Rocket System
HGV	hypersonic glide vehicle
HIMARS	High Mobility Artillery Rocket System
HTV	hypersonic technology vehicle
IADS	integrated air defense system
ICBM	intercontinental ballistic missile
INF	intermediate-range nuclear forces
IRBM	intermediate-range ballistic missile
ISR	intelligence, surveillance and reconnaissance
JLTV	joint light tactical vehicle
km	kilometer
LOCAAS	Low Cost Autonomous Attack System
LRASM	Long-Range Anti-Ship Missile
LRHW	Long-Range Hypersonic Weapon
MARV	maneuverable reentry vehicle
MDTF	Multi-Domain Task Force
MEF	Marine Expeditionary Force

MIRV	multiple independent reentry vehicle
MLR	Marine Littoral Regiment
MLRS	Multiple Launch Rocket System
MRBM	medium-range ballistic missile
MRC	Mid-Range Capability
MST	Maritime Strike Tomahawk
MTCR	Missile Technology Control Regime
NATO	North Atlantic Treaty Organization
NFP	networked force package
NMESIS	Navy/Marine Expeditionary Ship Interdiction System
NSM	Naval Strike Missile
NTIB	National Technology and Industrial Base
PLA	People's Liberation Army
PLAAF	People's Liberation Army Air Force
PLAF	People's Liberation Army Rocket Force
PLAN	People's Liberation Army Navy
PRC	People's Republic of China
PrSM	Precision Strike Missile
ROGUE-Fires	Remotely Operated Ground Unit Expeditionary Fires
ROK	Republic of Korea
SAM	surface-to-air missile
SLBM	submarine-launched ballistic missile
SRBM	short-range ballistic missile
STRIKEFORNATO	Naval Striking and Support Forces NATO
TACS	Theater Air Control System
TAGS	Theater Air-Ground System
TEL	transporter erector launcher
USAREUR	U.S. Army Europe
USARPAC	U.S. Army Pacific
USMC	U.S. Marine Corps

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