Capstone Paper

Integrated, Multinational, Multi-Domain, and Multi-Layer— How the US Achieves Victory in the Defense of Guam

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Introduction

The United States' island territory of Guam is under threat from an increasingly belligerent and expansionist China. Guam must be defended. The criticality of Guam's strategic position within the broader Pacific region is clear: the island provides an ability to launch and recover joint capabilities from its shores against both Chinese and North Korean threats. This strategic power projection node is, therefore, a prime target for adversaries during a crisis. To adequately protect the local population of 153,000 U.S. citizens, maintain critical force projection and sustainment capabilities, the current Integrated Air and Missile Defense (IAMD) system and architecture in Guam must be enhanced.

The requirement for an IAMD system for Guam is being increasingly discussed within the DOD and Congress. This paper highlights that the Guam defense strategy must be informed by and must be tailored to Chinese capability developments. Undoubtedly, China is the pacing region threat with proven ballistic missiles and testing of hypersonic glide vehicles. Therefore, an IAMD capability for Guam is necessary due to the rapidly evolving, multi-domain threat imposed by increasing Chinese capabilities. The threat posed by China requires an integrated, multilayered, and multinational solution set, necessitating proactive investments in science and space-based technology as well as changes in corresponding national policies to provide not only a sufficient defensive capability for Guam but to improve U.S. integrated deterrence.

Recently, the Department of Defense (DOD) drafted plans for a new air- and missile-defense capability to give "a mobile land system that protects Guam against advanced Chinese threats as soon as 2026 that could also have utility in other regions of world, including protecting U.S. cities and critical domestic infrastructure" (Sherman). For this year's fiscal year 2023 budget, the Biden administration requested $892 million for a new Guam defense system that

produces persistent air and missile defense of Guam (*Ibid.*). The IAMD architecture will consist of the current missile defense systems to include the Army's Terminal High Altitude Area Defense (THAAD) on land, Aegis-equipped ships sailing around the island, and eventually new capabilities such as the Patriot radar, new mobile Tomahawk missile launchers, and Standard Missile-6 (*Ibid.*). These significant investments in Guam's defense underline how crucial the island is to the national interests and the ability to influence a crucial region of the globe. This paper asks whether there are gaps in the current defense design of Guam that requires change or rethinking.

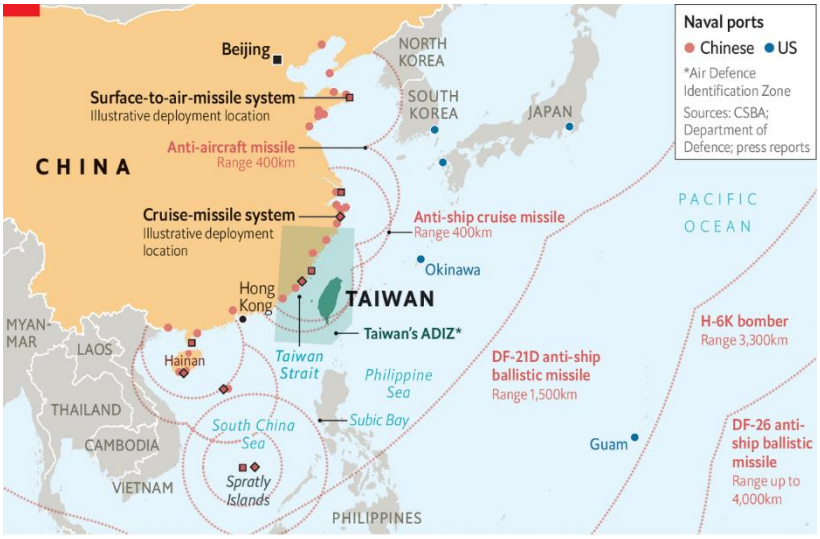
Background

Guam is an island territory of the United States comprising 225 square miles, about 30 miles long and 1 mile to 8.5 miles wide (U.S. Department of the Interior). Guam is the western most point of U.S. territory— roughly 5,000 miles west of San Francisco and 1500 miles east of Manila. The defense of Guam falls under the requirement to defend the U.S. homeland from attack, which is the number one priority in the National Defense Strategy (NDS). Home to two major military bases (Naval Base Guam in Santa Rita and Andersen Air Force Base in Yigo) and over 20,000 military personnel (Aquilino), Guam has military capabilities to include command and control (C2), a deep-water port for maritime operations, and force projection. It also hosts F-22 squadrons, Bomber Task Force, and submarines; as well as holding some of the region's most significant ammunition and fuel storage capabilities, and intelligence, surveillance and reconnaissance (ISR) platforms and protection (Underwood). Guam is critical to maintaining deterrence and stability within the Indo-Pacific region and, in any conflict, would be relied upon for logistics and sustainment support to enable power projection operations against any regional threat (Olson).

The U.S. views Guam as an anchor for U.S. forces within the second island chain, and as a strategic enabler to project forces into a future regional fight with China (USCC report). Unfortunately, and unsurprisingly, the People's Republic of China (PRC) views Guam in a similar manner. Multiple Chinese publications refer to Guam as a "chess piece of utmost importance in the US control of the Asia Pacific" (USCC Report). This understanding of the importance of Guam, as a geo-strategic location for any U.S. military action in the Pacific, led China to conclude that they needed an ability to attack Guam to maintain a strategic balance (*Ibid.*).

China has invested significant effort into building up its strike ability on Guam with conventional capabilities. Rear Admiral Benjamin Nicholson, Commander of Joint Region Marianas highlights the Chinese threat, "You always want to pace against whoever is the fastest runner, whoever can go the longest, the farthest, that's where you set your pace. In today's environment, that really becomes China. They are doing the most buildup, they are doing it the quickest with the most advanced weapons" (Wall Street Journal). These capability developments include, but are not limited to, air launch cruise missiles (ALCM) from H-6K bombers and DF-26 intermediate range ballistic missiles— conveniently named the Guam killer— as well as associated ISR to support targeting requirements (DoD 2021 report). China is also increasing its capabilities to strike Guam from the maritime domain and is fielding advanced sub- and surfaced-launched cruise missiles that could strike the U.S. Island. This capacity would give China an enhanced ability to strike Guam from a 360-degree threat axis, significantly complicating defense efforts and requirements for the U.S. (GAO, 2022). To complicate the

threat picture and defense calculus, China seeks to develop hypersonic weapons systems to challenge fielded U.S. IAMD systems (*Ibid*.).



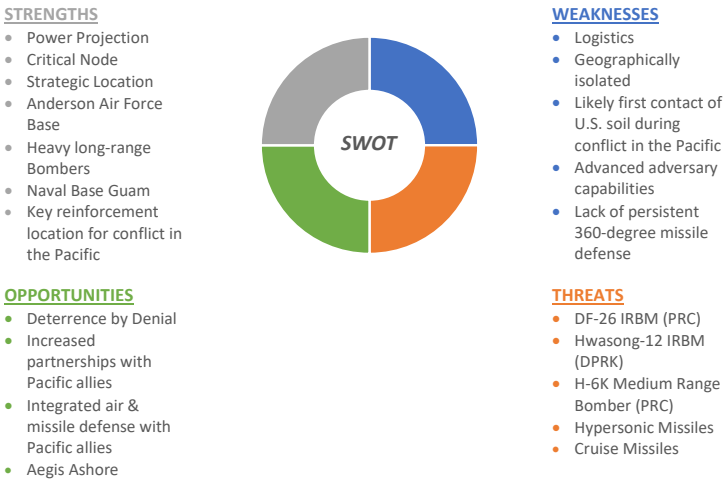
(Figure 1. Economist Newspaper, 2021)

The Guam IAMD strategy must be informed by the **threat** and specifically tailored to provide a defensive pacing strategy to counter demonstrated regional and strategic capabilities. China is the pacing regional threat with demonstrated advancements in ballistic missiles and testing of hypersonic glide vehicles. Recent Chinese testing involved a Chinese Long March 2C orbital launch vehicle flying a south polar trajectory into low-earth orbit. This was a possible test of a fractional orbital bombardment system (FOBS) that circled the globe before de-orbiting and landing near its target (Davis, 2021). These new capabilities demonstrate China's ability to project lethality against Guam and signal their intent to replicate former Soviet Union exploration to deliver ballistic missiles to the United States on a south polar trajectory (*Ibid.*).

In addition to kinetic weapons development and fielding, China is also increasing its fielding of non-kinetic capabilities in both the space and cyber domains. They have focused their cyber capabilities to degrade and disrupt an adversary's military operations and collect sensitive information (GAO, 2022). China has made great strides in the space domain, utilizing it to

further their own strategic end state, while using large scale anti-satellite strikes through physical, cyber, and electronic means to deny the space domain to their enemies (*Ibid.*).

These PRC capabilities highlight the significant weaknesses within the U.S. current infrastructure, force posture and composition, and the joint defensive plan for Guam. United States Indo-Pacific Command (USINDO-PACOM) has been enhancing Guam's IAMD over time, but the assessment is that these improvements are too few in number and unable to adequately protect against a potential 360-degree threat access (Lopez, 2021). The solution is to create both an active and passive defense plan (Dorner et al., 2015). Active defense includes systems like the combination of Patriot, fighters with air-to-air missiles, THAAD, Aegis, cyber, and space capabilities. These capabilities would be integrated into a single command and control network, to include allies and partners, to provide defense-in-depth and multiple engagement opportunities against inbound threats. Passive defense includes capabilities like rapid runway repair, hardening of facilities against both kinetic and non-kinetic attacks, redundant systems, camouflage, etc. Both these active and passive defense measures and countermeasures offer a comprehensive defense design to thwart a potential, if not inevitable, PRC attack.



(Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis)

The above strengths, weaknesses, opportunities, and threats (SWOT) assessment highlights the necessity for a joint and combined defense design to develop the most effective IAMD architecture in Guam. The following technical and operational recommendations will then be complemented with policy changes to address the PRC threat. The U.S. cannot accept that a PRC attack against Guam is simply a *fait accompli*; the first battle has not happened, and the future of the island has not been decided. The U.S. has options, and these recommendations offer ways for the U.S. and its allies and partners to achieve victory.

Technical and Operational Recommendations

Integrated Defense. Guam's geography and topography supports a 360-degree area defense design of dedicated air defense system(s) that is further enhanced by a regional IAMD defense strategy of coalition sensors and shooters. Guam has a total defended area of 225 square miles and a population of 153,836 citizens (U.S. Census Bureau, 2021). In comparison, Israel has a defended area of 8,635 square miles and a population of 9.217 million (*Ibid.*). The Israeli Iron Dome missile defense system reports a 90% success rate with 2,400 successful intercepts over the last 10 years of operations (Lee, 2020). However, the cost of the Israeli IMD systems seems to lack economic feasibility compared to the threat: the typical exchange rate between a Hamas rocket of $300-$800 is not sustainable in an Israeli defensive system that expends at least $40,000 per intercept (Roblin, 2021). This unsustainable cost difference is driving Israeli to rapidly develop directed energy systems to close the gap.

Undeniably, Guam's small size and distance from China and DPRK create the threats' technological requirements and costs. Hence, the U.S. must deny benefits of the adversaries' modernization efforts of cruise, ballistic, and hypersonic missiles; it must sharpen defenses with

enhanced layered defense using peer-to-peer engagement coordination, early warning track data, and battle management situational awareness (Karako & Dahlgren, 2022).

Sensors, Shooters, and C2 Integration. The integration of sensors, shooters, and C2 interoperability is imperative to the defense of Guam. The U.S. modernization efforts must provide a system-of-systems approach to deliver the right missile, against the right threat, at the right time. A perfect example of U.S. integrated modernization efforts is reflected in Flight Test THAAD Weapon Sytem-21 (FTT-21). This flight test demonstrated remarkable advancements in the THAAD weapon system integrated with the Patriot Advanced Capability-2 (PAC-3) Missile Segment Enhanced (MSE) interceptors (Cutshaw, 2022). During FTT-21 the THAAD weapon system computed a firing solution for the PAC-3 MSE to intercept a target. This new integration or layered approach increased interceptor fly-out time, improving battle space and increasing the defended area (*Ibid*.).

Furthermore, the U.S. Army continues to pursue the integration of Iron Dome with live fire testing, as conducted at White Sands Missile Range in August 2021. During the live fire, Iron Dome successfully negated eight cruise missile targets (Robson, 2021). This demonstration was followed later in the year by a three-week test of Iron Dome stationed at Andersen Air Force Base on Guam. The exercise included simulations and stressed command and control integration of Iron Dome, Patriot, and THAAD in defense of Guam (*Ibid*.). The area defense of Guam is nested in a systems approach to optimize sensors, shooters, and integrated C2. The U.S. end state remains as a sustained area defense architecture that is further enhanced by resilient joint and multi-national IAMD architecture weighted against the threat.

A key tenant of U.S. defense design includes the concept of “engage-on-remote,” where integrated sensors deliver a firing solution to a diverse layer of shooters. To keep pace with the

threat, U.S. modernization efforts must include enhanced autonomous integration of space-based sensors to close the gap of terrestrial sensors limited by the horizon (Karako & Dahlgren, 2022). To defeat hypersonic weapons, the U.S. must achieve "birth-to-death" tracking of threats from the initial detection of a launch through the various phases of glide/flight. The Missile Defense Agency (MDA) and Space Development Agency (SDA) are developing several space-based sensors to enhance ballistic missile and the hypersonic tracking missions (*Ibid.*). The SDA Tracking Layer will produce constellations for launch and warning. While MDA delivers the Hypersonic and Ballistic Tracking Space Sensor (HBTSS) capable of tracking hypersonic weapons and supporting "fire-control-quality data" providing shooters with "birth-to-death" engagement opportunities (*Ibid*.). The integration of space-based sensor capabilities mitigate potential gaps in terrestrial sensors that China hopes to expose with the development of HGLVs (*Ibid.*). This defense design must be considered and incorporated in the defense of Guam.

Space-based. Space must provide missile warning and missile tracking (MW/MT) for commanders to know when to 'duck and cover' and to find, fix, track, and ultimately defeat incoming traditional ballistic weapons and air-breathing, highly maneuverable hypersonic weapons. The U.S. must pivot from large-monolithic satellites in geosynchronous orbit to a resilient and proliferated architecture in the closer-medium and low-earth orbits. Such an architecture allows for an agile satellite production-line with faster replenishment rates and incremental improvements with the latest technology to keep pace with the PRC threat and the operational challenge of defending Guam. Dr. Kevin Paxton, Senior Technical Fellow at The Boeing Company, summarizes the challenge: "The hyperglide vehicle can actually change directions, so now we need to follow and contain its entire trajectory within our tracking system. That pushes us toward using a much more proliferated network of satellite constellations so we

can have more eyes in the sky to follow these threats through their entire trajectory, compared to just the beginning of that trajectory" (Paxton, 2022, para. 8). These improvements will require a large sustainment tail due to the accelerated tempo of assured access to space launches. In addition, a modern automated tactical ground system is just as important to minimize human-in-the-loop interactions and meet demand for ground-to-space contacts.

Continuity of Operations. Unity of effort well beyond missile warning and missile tracking is required to fully take advantage of space as a force multiplier and enabler for the defense of Guam. Commanders require position, navigation, and timing (PNT) to drop munitions and prosecute a war. Satellite communications are required for beyond-line-of-sight communications and provide an alternate path if fiber-optic communication lines are cut to Guam.

The space protect and defend mission is critical, so an adversary is unable to make the U.S. military blind or deaf. Space is no longer an uncontested environment where the U.S. can have large, undefended and sophisticated satellites, nor can the U.S. allow adversaries to operate freely in space. The U.S. must protect its high-value assets in space and project power through offensive and defensive space control capabilities to deter future and reckless Direct Accent Anti-satellite (DA-ASAT) tests and aggressive actions in space and all-domains.

All-Domain Awareness. Space Domain Awareness (SDA) is a key enabler for the "protect and defend" mission, so the U.S. can characterize, attribute, identify, and understand the space operational environment. In a defense of Guam scenario, China could possibly conduct a "space blitzkrieg" attack to deny U.S. vital space capabilities and leave Guam in the dark.

Therefore, the U.S. needs to pivot from a peacetime mentality and invest into tactical responsive space to rapidly reconstitute and augment space capabilities such as PNT, communications, SDA, and space control during a conflict in hours instead of years. Equal investments into the Space C2 ground system are required to outpace the adversary's Observe, Orient, Decide, and Act (OODA) loop. Space C2 synergizes space effects across capabilities and optimizes scheduling and collection of SDA resources to improve track quality and maintain custody of targets as well as enable dynamic sensor tasking for high-priority missions. The rapid deployment of high-altitude systems with diverse payloads provides additional resiliency for persistent sensor surveillance and communications (Defense Brief Editorial, 2021). These C2 capabilities can be tied into the IAMD architecture, the Multi-Domain Task Force, as well as the total joint defense package.

Policy Changes

Acquisition. Missile defense is a no-fail mission; consequences are catastrophic and fatal. Current systems are designed to be a 'bullet hitting a bullet' with an accompanying requirement to have a very high probability of success per engagement and a complex solution to meet the difficult challenge. However, taking some risk in how to build and acquire missile defense systems can yield better risk-adjusted outcomes to defeat new threats. Pivoting from high-unit cost and high-performance systems to a proliferated architecture of less sophisticated individual systems can improve overall missile defense resilience and overwhelm potential aggressors. A more proliferated architecture would lead to more interceptors and non-kinetic weapons, such as directed energy or high-powered microwave technology. The effect would be the higher overall mission success, despite less capability at the individual system level.

The U.S. also needs to pivot to a "fail fast mentality," where it learns from its failures to rapidly prototype and rapidly field systems successfully. New technology needs to bridge the "valley of death" between prototypes and full capabilities. National research laboratories need a link to programs of record and budgets to deliver end-to-end capabilities. Furthermore, establishing an ecosystem of technology incubators will grow disruptive and innovative ideas from small nimble companies to the next offsetting capability.

Furthermore, the traditional acquisition lifecycle of formal milestone reviews with heavy documentation and process requirements unnecessarily locks weapon system programs into large block improvements and buys. Instead, milestone decisions need to be replaced with smaller annual reviews, which have highly tailored requirements and foster incremental improvements. These annual reviews should be chaired by the Program Executive Officer and include stakeholders from the test, finance, cost-estimation, contract, and operation communities.

Capabilities. Guam requires investment of the latest missile defense capabilities. The systems need to leverage an open and modular architecture to allow frequent and iterative improvements of hardware and software to evolve and outpace advanced threats. These capabilities need to be fully integrated both as part of the Guam Defense System and as part of a larger regional defense with partner nations.

***Allies and Partners*.** The U.S. requires more cooperation with allies, such as the joint U.S. and Japan development of the SM-3 Block IIA and deploying Aegis Ashore in Japan. Further integration of the Command and Control, Battle Management and Communications (C2BMC) operational center for the Missile Defense System with allies and partners in the Indo-Pacific region is a necessary force multiplier. Such integration will allow synchronized, synergized, dynamic, and distributed responses through the end-to-end sensor-to-shooter kill

chain. Effective collaboration will require an emphasis on an open policy for sharing classified data and information with partner nations (Savage, 2022).

One recent example that demonstrates the importance of including allies and partners in defense design and force posture is the North Atlantic Treaty Organization's Enhanced Forward Presence (eFP) battlegroups in the Baltics and tailored presence in the Black Sea region. At the 2016 NATO Summit in Warsaw, in response to stability and security along NATO's periphery (e.g., the annexation of Crimea in 2014), the Obama Administration and other NATO Heads of State and Government agreed to enhance forward in the east and southeast of Europe (NATO). Today, more than 20 NATO allies serve, exercise, and operate together, "representing a strong expression of Alliance unity and solidarity" (*Ibid.*).

For the defense of Guam, the NATO forward presence in Eastern Europe represents an ally and partner playbook that could deter PRC aggression and stop an attack from occurring. Although the alliance dynamic in the INDO-PACOM Area of Responsibility (AOR) is not the same as in Europe, a policy change to include allies and partners to forward station forces in Guam and be part of the defense design could serve multiple deterrent purposes: 1) a "trip wire" force to support follow-on force; 2) place multiple flags to change the strategic calculus; and 3) if necessary, blunt and defeat a PRC attack by putting additional allied and partner troops, fighter jets, and naval presence on the island through episodic multinational training and exercises.

Whole-of-government (WoG). Lastly, the U.S. must have a WoG approach to protect national interests on Guam enabling freedom of movement in the USINDO-PACOM AOR. Recognizing the criticality of Guam and the concerted national effort to protect it, the U.S., its allies, and partners must create an integrated defense design to achieve unity of effort.

Conclusion

The U.S. must deter, and if necessary, defeat air and missile threats to Guam to protect critical regional power projection and sustainment capability while demonstrating United States resolve to local civilians and its allies. An integrated defense, to protect Guam and the U.S. citizens living on it, demands a systems approach to optimize sensors, shooters, and integrated C2 that defeats Chinese capabilities in time and space. This future entails forward and layered positioned forces and multi-domain capabilities, integrated with multinational forces that can deter by denial and punishment and defeat through the employment of exquisite, overwhelming defensive and offensive weapons and systems. The U.S. must then relook its technological investments, acquisition strategies, defense design, and policies to actualize this future.

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