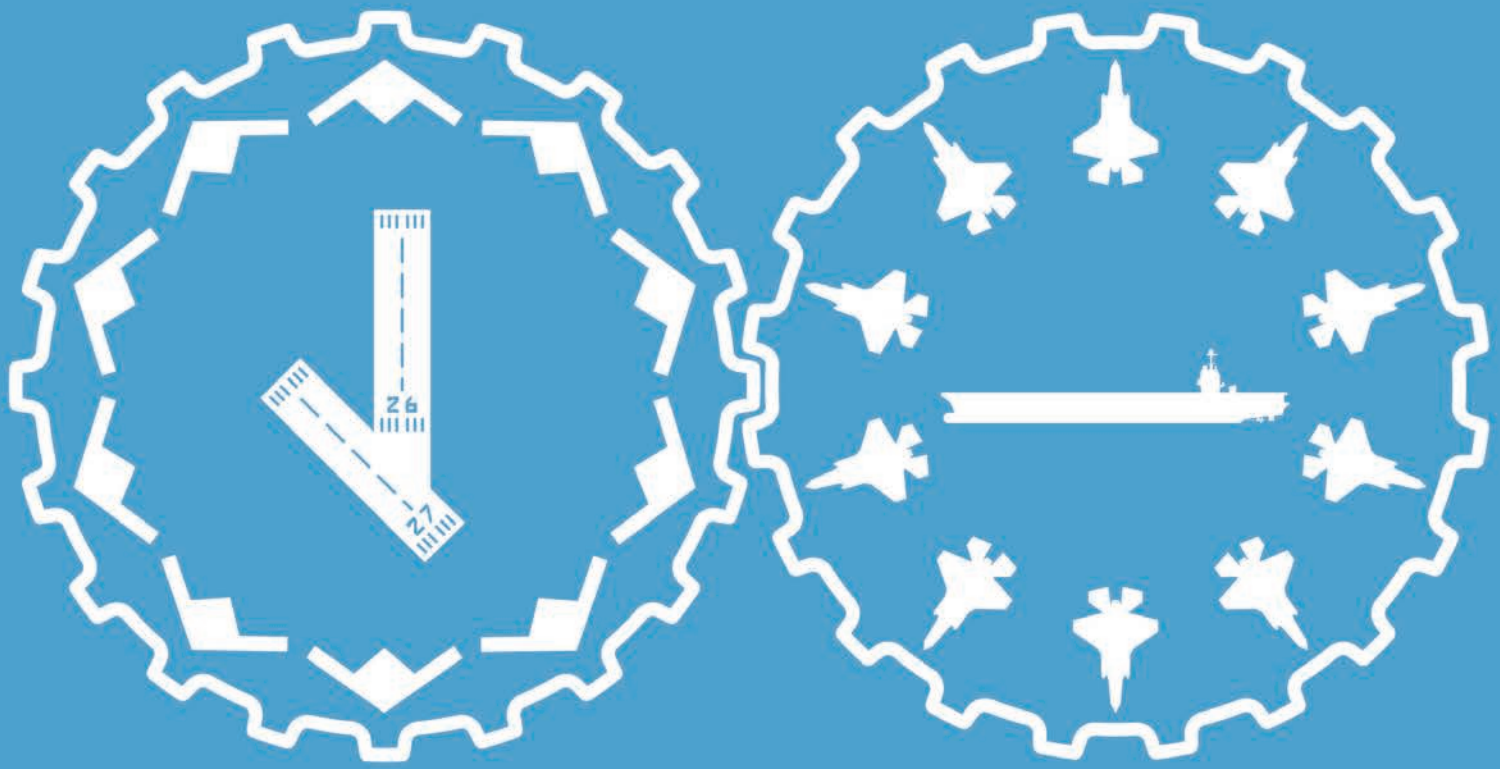
FILLING THE SEAMS IN U.S. LONG-RANGE PENETRATING STRIKE



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About the Defense Program

The Defense Program focuses on the strategic choices and opportunities available to preserve and extend U.S. military advantage in the face of evolving security challenges. From assessing the past, present, and future security environments to exploring alternative operating concepts, force structures, and basing options to testing alternatives through innovative scenarios and war games, the program aims to be a hub of innovation and action.

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Executive Summary

The end of the Cold War signaled the end of the U.S. Navy and the U.S. Air Force working closely together in support of the long-range penetrating strike mission; for the better part of the nearly 30 years that have followed, they each have gone their own way, with disastrous results. The Air Force has shifted the balance of its force from long-range strategic bombing aircraft to short-range tactical fighters. The Navy, after the failure and cancellation of its A-12 Avenger II aircraft program, the planned replacement for the A-6 Intruder, effectively pulled out of the long-range strike mission all together. These decisions could be understood against the context of the 1990s and U.S. campaigns in Kuwait and Kosovo, which were waged by land- and sea-based aircraft flying short distances from their airfields and carriers, but they did not take into account the old dictum that, "The enemy gets a vote," and vote they did.

Both Russia and China noted with alarm U.S. actions in the Middle East and in the former Yugoslavia and made significant investments in what have come to be known as anti-access/area denial, or A2AD, weapons. These systems, made up of combinations of long- range sensors, advanced surface-to-air missiles, and long-rang aircraft, as well as cruise and ballistic missiles, were designed to push American power projection forces outside their combat effective ranges, with the intent of prohibiting the United States from executing regime change within either China or Russia. Both nations, which are now recognized as rising great powers, chose to zig while the United States zagged, with great effect.

This study, building upon previous studies of the carrier air wing and long-range bombers, seeks to identify a path forward for the United States military with regard to long-range penetrating strike. It does so by suggesting areas for increased investment in strike capabilities within the U.S. arsenal and then seeking opportunities to more fully integrate those capabilities into one coherent joint concept of operations that fully leverages the potential of land-based and carrier-based strike. Such an approach would allow the nation to revitalize existing capital investments such as its aircraft carriers and long-range heavy bomber and sustain its position as the superpower even in an environment characterized by rapidly rising powers who seek to offset American dominance.

Challenges of Conducting Penetrating Strike in A2/AD Environments

The U.S. military faces a crisis in the way it approaches the "American Way of War."[1] For more than a generation, since the end of the Cold War, the U.S. military has been able to go where it wants to; establish local air, sea, and land dominance; and execute its assigned strategic mission.[2] Over that time frame, the U.S. Department of Defense (DoD) operated under the assumption that proximity to targets would be the natural condition of battle and hence pursued weapon systems that emphasized short range, high sortie rates, and precision strike. However, the enemy gets a vote, and for the past 20 years nations such as China, Russia, Iran, and North Korea have been making investments in new anti-access/area denial (A2/AD) capabilities that seek to push the United States back from their borders and limit its ability to coerce or bring about regime change.[3] The net result of the enemy "zigging" while the United States "zagged" has left the United States at a disadvantage when it comes to the challenge of hitting key enemy positions, be they military, economic, or political targets. If the United States is to remain effective as a superpower, it will need to recapitalize its ability to execute penetrating, long-range strike missions in the face of advanced defenses.

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U.S. strategies to address this shortfall are already in development. The department has begun to critically examine its alliances in Europe and in the Pacific with a view toward strengthening relationships and encouraging allies and partners to not only increase their defense budgets but also to procure wisely in the face of emerging threats.[4] After a generation marked by downsizing and withdrawal from forward bases around the world, the U.S. military has begun to expand its ranks again as well as take a serious look at its force posture, which is to say, the locations it bases and deploys its

The B-21 Raider represents the next evolution in penetrating strike aircraft needed to punch through the anti-access/area denial bubble. (U.S. Air Force)

forces. Additionally, the Department of Defense has begun to make a number of strategic investments in new weapons systems, including a new generation of long-range missiles such as hypersonic missiles as well as electromagnetic railguns intended to increase the lethal range of the force.[6] The Navy has made a significant investment in modifying the design of its new Block V nuclear-powered Virginia-class fast-attack submarine to enable it to carry up to 28 Tomahawk cruise missiles (or their replacements).[7] Submarines, due to the "stealth" that comes with being submerged, can operate close to shore with the capacity to launch salvos of long-range strikes. This is a game-change capability.[8] Perhaps most importantly, the department has begun in earnest the process to acquire a new long-range stealth bomber, the B-21 Raider. Intending to purchase 100 of the aircraft, the Air Force plans to introduce this new platform during the 2020s.[9]

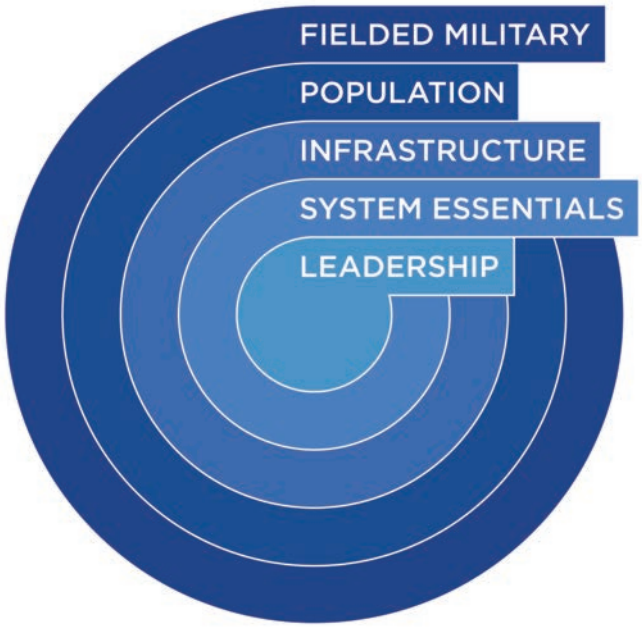
Unfortunately, these investments do not go far enough to fill the seams created by deficiencies in previous acquisition decisions. While the department has made a significant investment in fifth-generation stealth strike fighter aircraft, none of them have sufficient range to reach their targets without the assistance of large "big wing" tankers, which are susceptible to attack from enemy A2/AD systems, a critical vulnerability.[10] Attempts to pair these aircraft with long-range missiles with sufficient range to reach deep into A2/AD "bubbles" to reach critical strategic targets are hampered both by slow development of modern weapons to replace Tomahawk cruise missiles based on 1970s-era designs and by a lack of capacity within the defense industrial base and the logistics supply chain to keep forward shooters well supplied during high-tempo combat operations.[11] Additionally, there are command and control difficulties associated with missile control after launch in competitive spectrum and cyber environments.[12]

Perhaps most concerning to planners is that the U.S. Navy's carrier aviation arm, composed of 11 supercarriers and 10 accompanying air wings of approximately 60 aircraft, is not optimized to execute long-range penetrating strike missions. The carriers, given their size and electronic emissions, are vulnerable to attack by anti-ship ballistic and cruise missiles and hence are restricted to operating in excess of 1,000 nautical miles (nm) from enemy shore.[13] Air wing aircraft, largely consisting of F/A-18 C/D/E/F Hornets and F-35C Lightning II aircraft, which have unrefueled ranges of 500nm and 630nm

Large Air Force "big wing" tankers are too vulnerable to penetrate A2/AD bubbles, and the Navy currently lacks sufficient organic mission tanking to effectively extend the range of the air wing.

Air wing aircraft, largely consisting of F/A-18 C/D/E/F Hornets (like the F/A-18F pictured) and F-35C Lightning II aircraft, which have unrefueled ranges of 500 nautical miles and 625 nautical miles respectively, are unable to reach enemy targets without tanking. (U.S. Navy)

Warden's Center of Gravity



For the past 70 years, since the end of the last great conflagration, the United States has specialized in attacking the enemy's key centers of gravity, as demonstrated by retired Air Force Col. John Warden's five-rings concept. Doing so has shortened U.S. Wars to durations as little as 100 hours.

respectively, are unable to reach enemy targets without tanking.[14] As mentioned previously, large Air Force "big wing" tankers are too vulnerable to penetrate A2/AD bubbles, and the Navy currently lacks sufficient organic mission tanking to effectively extend the range of the air wing.[15] Oddly, naval aviation has consistently either fumbled or bypassed opportunities to develop new long-range strike aircraft that could maintain the relevance of the carrier itself in future security environments dominated by A2/AD technologies.[16]

This study seeks to explore the strategic implications of investments made by China, Russia, and others and the emerging great-power competition now underway in order to identify any weak points within their force architecture.[17] Similarly, U.S. strategic constructs and procurement investments shall be examined in an effort to identify shortfalls and critical vulnerabilities. An effort shall then be made to mesh current land-based and sea-based long-range penetrating strike systems together in an effort to create a new coherent concept of operations for this critical mission. Lastly, this paper shall seek to advance a series of recommendations with regard to U.S. strategy and procurement decisions going forward in order to mitigate or supplant adversary investments.

World War II, the last intensive, theaterwide war fought by the United States, was executed with the aim of rolling back enemy defenses in order to visit destruction upon their capitals and thus compel surrender. That it took so long, 42 months in Europe and 45 months in the Pacific, was due to the inability of U.S. systems to reach strategic targets in a sustained manner early in the war. For the past 70 years, since the end of the last great conflagration, the United States has specialized in attacking the enemy's key centers of gravity, where it was important, shortening U.S. wars to durations as little as 100 hours, the length of the Desert Storm campaign.[18] Because of this short-war capability, the United States believed that it could afford to shrink its defense budget, industrial base, and forces, relying on high-end capabilities to deliver short, killing blows.[19] But today those who would make themselves the enemy of the United States and the values it espouses have sought to thwart this strategy by pushing U.S. military forces back and forcing them to once again wage long, expensive, and debilitating campaigns. This study seeks to suggest how to reverse this trend.

A2/AD Development in China and Russia

The appearance and shocking effectiveness of precision strike during Operations Desert Shield and Desert Storm during the winter of 1990–1991 had a significant impact on China's leadership, which took two separate and distinct lessons from the United States' decisive victory in Kuwait. The first lesson regarded the effectiveness of the United States' initial blinding strikes against Iraq's surveillance and command and control (C2) networks. Cruise missile- and precision-guided weapons dropped from F-117 stealth aircraft effectively blinded Saddam Hussein's forces in the opening moments of the aerial campaign of Desert Shield, allowing for other, less stealthy aircraft to follow with less precise weapons to clean up the remainder of the exposed Iraqi forces.[20] By the time the ground campaign began a month later, Air Force F-111F bombers – not small or stealthy by any means – could interdict Iraqi armored units in the open on "tank-plinking" missions while facing no effective threat.[21]

The second lesson focused on China's and Russia's conclusion that Iraq had made a huge strategic mistake allowing the United States to build up its forces in neighboring Saudi Arabia without resisting. Both came away believing that Iraq should have attacked the United States while it was establishing its forces in the region or attempted to prevent the United States from building up its forces at all.[22] This led China to develop new weapons systems, some to deny the United States access to its home territory or areas adjacent to it, while others were intended to directly threaten traditional U.S. military assets. A stream of articles in Chinese military professional journals followed, each exploring niches in which China could pursue advances that did not mirror the United States so much as challenge the other nation in different areas of competition.[23]

China has its own areas of emphasis and expertise. Established in 1966, the People's Liberation Army (PLA) Rocket Force, known until very recently as the Second Artillery Corps (2AC), was developed as a strategic deterrent and a weapon of mass destruction. After the Soviet Union's withdrawal of its scientific advisors from China in the early 1960s over ideological differences regarding the future of communism, China found itself without advanced weapons systems, including the atomic bomb. In response, the nation's revolutionary leader, Chairman Mao Zedong, directed the PLA to pursue the development of nuclear weapons as well as the means to deliver them to prevent the two major superpowers from having a monopoly over the destructive capability.[24] Simultaneous with its nuclear weapons design and research, China moved quickly with the development of medium-range (1963) and intermediate-range (1966) missiles capable of delivering its new nuclear weapons to targets in the Soviet Union and United States. In 1966 China conducted its first (and only) mated test of a missile with a nuclear weapon, demonstrating for all the world to see that it had entered the family of nuclear-armed nations.[25]

For most of the Cold War, China maintained a very small nuclear arsenal and accompanying missile force. After the first successful test of a uranium 235 atomic bomb at Lop Nor in October 1964 that was very similar to the American "Little Boy" bomb dropped on Hiroshima, analysts believe that China's arsenal during that era never climbed above 300 bombs, and some believe that the number hovered around 120 weapons. Similarly, during this time frame, the 2AC possessed less than 100 medium-range Dong Feng-3 (DF-3) and intermediate-range Dong Feng-4 (DF-4) missiles.[26] These ballistic missiles, developed in China after the departure of Soviet advisors, formed the backbone of China's technological "cutting edge" during its formative modernization efforts. For nearly 25 years, Chinese technologists,

Chairman Mao Zedong directed the People's Liberation Army to pursue the development of nuclear weapons, as well as the means to deliver them, to prevent the two major superpowers from having a monopoly over the destructive capability. (Zhang Zhenshi)

The Dong Feng-21 (pictured) represents a critical anti-access/area denial capability for China and a major challenge for U.S. penetrating strike aircraft (Sino Defence)

engineers, strategists, and politicians viewed the threats from the outer world through a prism that contained a bias toward a ballistic missile-based response.

In 1993, the 2AC was given a mission to carry conventional arms atop existing missiles. A short-range ballistic missile brigade was added to the force with an eye toward intimidating nations that might challenge Chinese interests in the Western Pacific. Along the way it evolved, moving from its first-generation DF-3 and DF-4 missiles to a series of increasingly sophisticated ballistic missiles as well as the introduction of a new generation of cruise missiles with both land- and sea-attack capabilities.[27] In the early 1990s, China began to collect the technologies necessary to assemble the new cruise and ballistic missiles it desired. In 1992 it approached Israel to purchase guidance systems and companies in the United States for support on constructing advanced turbofans for a cruise missile.[28] The next year China unveiled the C-802 advanced, sea-skimming missile at an arms show.[29] Simultaneously China began to upgrade its DF ballistic missiles, promising to field three new variants within a decade.[30] In January 1994, Jane's Defence Weekly reported that China had replaced the nuclear warheads on some missiles with conventional loads. As part of this process, the Dong Feng-21 (DF-21) was redesigned to allow China more options "in the event of a local war."[31] As part of its modernization efforts and as a signal to Taiwan and the international community, China in 1995 conducted a series of short-range missile tests over and around the island of Taiwan, triggering a U.S. response in the form of sending two nuclear aircraft carrier strike groups to visit the strait that separated the island nation from the mainland.[32] The U.S. response and China's inability to respond proportionally humiliated the Chinese Communist Party, causing the government to redouble its efforts to develop technologies to push American assets farther away. Resources for a pre-existing anti-ship ballistic missile project within the PLA, the 863 Program, increased dramatically.[33]

To effectively target naval forces at sea, China had to mature its intelligence-surveillance-reconnaissance (ISR) capabilities in order to generate accurate location data. In the 1990s, in cooperation with Brazil, China launched a series of satellites with multisensor payloads and a digital transmission capability to download their information to Earth. The early 2000s saw the introduction of electro-optical sensors and improved downlink capabilities.[34] These satellites were followed rapidly by a series of optical-reconnaissance satellites referred to as the Yaogan group. These provided .8-meter optical resolution and a synthetic aperture radar capability. Launched into sun-synchronous orbits, the Yaogan constellation provides China with a significant ability to locate and target a wide array of targets around the world.[35]

Geosynchronous satellites have very large search areas and depend upon local area sensors for cueing to allow them to locate the proverbial needle in the haystacks they cover. Sometime in the early 2000s, China built a complex of over-the-horizon radars (OTHRs) to constantly monitor activities in the Pacific Ocean. Using constantly transmitted low-frequency pulses, OTHR systems can search for ships and aircraft thousands of miles from China's coast. The radars' low transmission frequency also provides them with the ability to detect (although not necessarily track) stealth aircraft.[36] These radars can provide initial detection and cueing for other sensors within China's growing ISR constellation. Thus, China's surveillance-reconnaissance infrastructure has grown dramatically in a short time, with a clear focus on

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developing an ability to uphold Chinese national interests in a rapidly changing geostrategic environment.

By 2004 U.S. intelligence agencies began to correlate reports that suggested China had developed a new type of anti-ship capability, but they were unsure where the capability would reside within China's military. Initial thoughts were that it was being developed within the PLA-Navy, given its suggested maritime focus. Others thought perhaps it would be found within the PLA-Air Force, particularly the long-range bomber force. Thus, it came as a surprise that the weapon lay within 2AC. During the early 2000s, 2AC began testing a new warhead, the maneuverable re-entry vehicle, mated to the DF-21 missile. In this configuration, it could target American aircraft carriers 900 nautical miles from China's shores.[37] When combined with the strong investments in overhead reconnaissance and a reliable indigenous regional positioning system, the potential of the new weapon system hit American strategic planners hard. U.S. Navy cruisers and destroyers equipped with the Aegis weapon system and Standard Missile 2 missiles would have little to no ability to defend against a hypersonic weapon coming in at the near-vertical angles associated with ballistic missiles. Such a weapon could push Navy carriers and their F/A-18 Hornet-based air wings back beyond their operational reach, upsetting the balance of power in the Pacific.[38]

In the mid-1990s, about the same time as China was making major investments in A2/AD technologies, Russia made a similar choice. Recently Russian President Vladimir Putin revealed plans to develop a nuclear-powered cruise missile, which would have virtually unlimited range.[39] He also described a new hypersonic ballistic missile that is under development that appears to be a modification of Russia's existing Iskander missile.[40] It is clear that both nations proceed from a similar strategic outlook and pursue a common intent, that being to push the United States further from its critical economic, military, and political centers of gravity. However, cruise and ballistic missiles are only effective against ground- and sea-based targets; it takes another type of weapon to stop aircraft attacking from the vertical plane, and Russia has made strong investments with great success in this space as well.

Russian President Vladimir Putin (pictured) continues to aggressively pursue advanced capabilities that enable Russian anti-access/area denial capacities. (Russian Kremlin)

The combination of S-400 (pictured), and even S-500 systems, has made it difficult for all legacy aircraft that do not possess all-aspect stealth characteristics to operate effectively within their proximity. (Russian Kremlin)

In the depths of the instability that followed the fall of the Soviet Union and operating with a defense budget that was a fraction of its former size under the USSR, Russia's defense leaders made the decision to invest in a small number of highly capable, exquisite weapons systems. One of these was the SA-20 surface-to-air missile, otherwise known as the S-300, due to its ability to be effective out to 300 kilometers or approximately 185 miles from the launcher. A road mobile system consisted of up to nine vehicles: one carrying a long-range surveillance radar, one serving as the command team vehicle,

one carrying the final engagement radar, and the last six carrying four missiles each for a total of 24 missiles per battalion. The search, tracking, and designation radars range from I-Band to X-Band frequencies and are capable of illuminating nonstealth aircraft or missiles, even at low altitude against high background clutter.[41] This combination, updated now in S-400 and even S-500 systems, has made it difficult for all legacy aircraft that do not possess all-aspect stealth characteristics to operate effectively within their proximity. China operates a system that is equally effective in the form of its HQ-9 missile system.[42] Both nations have purchased these missiles and their accompanying sensor radars in sufficient quantities to make penetration of their airspace, or the airspace of their allies, difficult at best. It is against these weapons, and those that will evolve from them going forward, as well as the strategy that lies behind them, that the U.S. force structure of the future must position itself to fight.

Land-Based, Long-Range, Precision Strike

Land-based, long-range, precision strike has been around as a mission since shortly after the aircraft was invented. Just over a decade after the Wright brothers first flew at Kitty Hawk, North Carolina, a group of intrepid young flyers was taking to the skies over war-torn Europe to hand-drop small bombs on enemy targets below them.[43] What has changed since the first bomb fell is the size of the aircraft, the distance they can fly, the number of bombs they can drop, and how easy or hard it is for the enemy to shoot them down.[44] The U.S. Air Force, and its previous incarnations within the U.S. Army, has gone through a series of evolutions that once emphasized the heavy bomber for both conventional and strategic missions but more recently has come to invest more in shorter-range, stealthy fighters.[45] This emphasis can be seen in the raw numbers of the aircraft of interest. While the Air Force bought only 22 B-2 Spirit stealth bombers, it acquired 187 F-22 Raptors and plans to purchase 1,763 F-35A Lighting II fighter-attack aircraft.[46] Clearly the post-Cold War-era assumption of permanent permissive

A2/AD Bubble

Without advancements in penetrating strike capabilities, China's anti-access/area denial bubble will continue to hold ships and aircraft at bay.

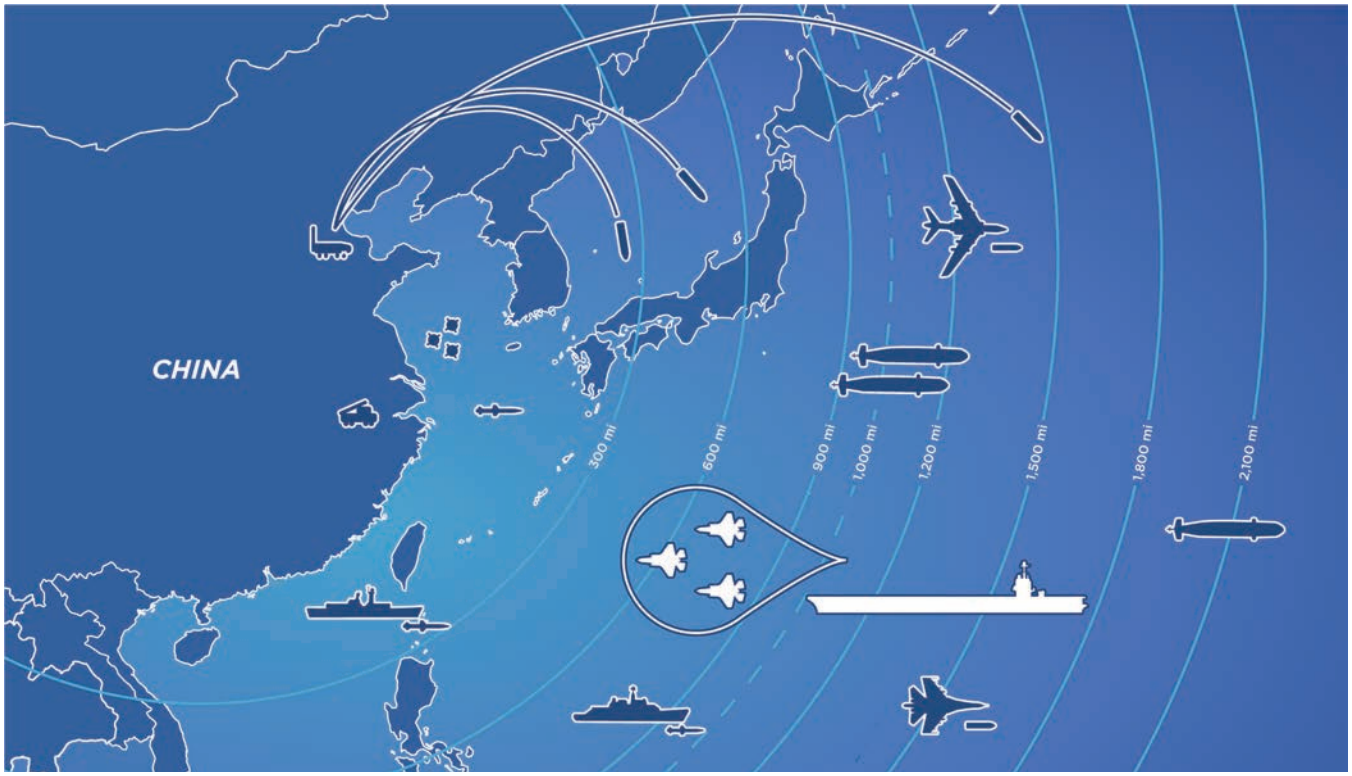
With this in mind, the Air Force's complement of stealthy fighters is not positioned, from an overall system architecture perspective, to execute a long-range mission, penetrate a robust A2/AD surface-to-air missile envelope, and hit a target with precise weapons.

environments, the idea that the U.S. military will always be able to get where it wants to go without significant resistance, has permeated Department of Defense and Air Force thinking when it comes to force structure strategy; it is a strategy that would severely constrain the Air Force and the United States during a time of war against an A2/AD power.

This constraint would emanate from the F-22 and F-35A aircraft's innate design as short-range fighters.[47] While the sheer numbers of the smaller fighters could create the mass necessary to make up for their small ordnance-carrying capacity (F-22s can carry 2,000 pounds and the F-35A can haul 5,700 pounds within their internal bomb bays without compromising their low radar detection profiles), the aircraft themselves are limited to an unrefueled range of 460nm and 670nm respectively. While it is true that both aircraft can refuel from Air Force "big wing" tankers, such as the new KC-46 Pegasus, the range that would be most effective to perform refueling for the fighter-attack aircraft in order to make them most mission effective would also render the larger tanker aircraft vulnerable to enemy fighters and missiles.[48] With this in mind, the Air Force's complement of stealthy fighters is not positioned, from an overall system architecture perspective, to execute a long-range mission, penetrate a robust A2/AD surface-to-air missile envelope, and hit a target with precise weapons.

There is a school of thought that urges caution before accepting this conclusion, however. This line of thought advances the argument that such aircraft need not penetrate all the way to the target, but rather could carry and launch long-range missiles that are able to bridge the gap between shorter-range launch aircraft

The United States Pressing into the A2/AD Bubble



It has been proposed that aircraft need not penetrate all the way to the target, but rather could carry and launch long-range missiles that are able to bridge the gap between shorter-range launch aircraft and enemy targets. Certain missiles, however, such as the Tomahawk Cruise missile or the JASSM-ER, are too large to be carried in the bomb bays by fifth generation stealth fighters.

and enemy targets. The argument against this approach can be found in the design parameters of the attacking weapons. Certain missiles, such as the Tomahawk cruise missile, which measures 18 feet long, weighs approximately 2,600 pounds, and flies over 1,000 miles,[49] or the Joint Air-to-Surface Standoff Missile – Extended Range (JASSM-ER), which measures 14 feet in length, weighs 2,500 pounds, and flies 620 miles,[50] could bridge the gap, but neither weapon is small enough to be carried in the bomb bays of the two stealth fighters. So, if F-22s or F-35s were selected to carry such weapons, the "stealthiness" of their designs would be compromised, suggesting that perhaps other aircraft, such as cheaper fourth-generation F-15s or F/A-18s, would be a better option or even larger bombers, such as the legacy B-52 Stratofortress, which can carry up to 20 cruise missiles, would be a better solution.[51] These options, it could be argued, bring increased mass or efficiency to the long-range strike mission.

However, this approach comes with clear drawbacks that center upon the projectile. The Tomahawk missile is subsonic in speed and unstealthy by modern standards. As such, it has a low probability of penetrating a modern A2/AD surface-to-air perimeter. With regard to the JASSM-ER, it is stealthy, but it is also subsonic and its 620-mile range is far too short to keep the older and most unstealthy B-52 bombers out of harm's way. New missiles now under development, such as boost-glide hypersonic systems, could be part of the solution, but they remain experimental and years away from initial operational capability.[52] In addition, a hypersonic missile would almost certainly be too large and heavy to be carried on smaller fighter-attack aircraft. Lastly, hypersonic weapons will be expensive, a characteristic that will render them a cost-prohibitive solution for a drawn-out campaign against a major A2/AD power.

An artist rendering of an Office of Naval Research-funded electromagnetic railgun. Electromagnetic railguns will be a critical technology for penetrating into anti-access/area denial environments. (U.S. Navy)

Time separation within the find-fix-finish kill chain will be the major challenge in a future security environment populated with mobile launchers. Even hypersonic weapons, going Mach 5, will take 15 minutes to traverse 1,000 miles.

Then there is the problem with latency. Time separation within the find-fix-finish kill chain will be the major challenge in a future security environment populated with mobile launchers. Even hypersonic weapons, going Mach 5, will take 15 minutes to traverse 1,000 miles, allowing an important mobile target to reposition during the interim. In a future security environment dominated by A2/AD defenses, advantage will accrue to the side that possesses the ability to penetrate the defensive perimeter and bring mass quickly to bear. As such, logic suggests that the Air Force's current ratio between short-range fighter-attack aircraft and long-range bombers represents a strategic mistake.

Of course, there is another way forward, another approach to getting to the target, as one cavalry general said, "firstest with the mostest." Long-range, all-aspect stealth platforms, such as the B-2 Spirit and B-21 Raider bombers, have the potential to penetrate advanced surface-to-air defensive networks and then "dwell" behind enemy lines, serving as both sensor and shooter. Some newer, low-observable unmanned designs such as the Avenger variant of the MQ-9, the RQ-170 Sentinel, and the X-47B test prototype also have these characteristics. The larger airframes, necessary for increased lift as well as expansive fuel storage, also allows for arrays of sensors embedded along the aircraft's wings and fuselage that can include passive electronic electro-optical sensors that can allow the airborne platforms to develop a baseline understanding of the enemy's local order of battle and force disposition.[53] Human operators as well as artificial intelligence systems can quickly spot changes or anomalies within the local picture, such as a mobile launcher moving from one location to another, and can help develop targeting coordinates. Lastly, deep magazines within the aircraft can then destroy the target through a variety of means.[54]

Deep magazines should be a critical characteristic of any modern aircraft designed to penetrate and operate

within an A2/AD environment. It would be a waste of potential to create a platform that could stay on-station for long periods and yet would have so few weapons that it would have to return home after just a few attacks. While heavy bombers such as the B-2 Spirit and the new B-21 Raider define their magazine depth by the number of bombs or missiles they can carry, that would be an incomplete definition in the current and future operating environment. In addition to rockets, cruise missiles, glide bombs, and gravity bombs, the most traditional forms of ordnance, future airborne platforms may well generate magazine depth by carrying electro-magnetic railguns. Railguns use relatively small "bullets" but they generate their destructive power by firing these rounds at hypersonic speeds, thus deriving their destructive power from Isaac Newton's classic equation Force = Mass x Velocity Squared.[55] Smaller munitions allow for many more rounds to be stored in the same sized space. Another opportunity for generating deeper magazines lies with the development of directed energy weapons, which move at the speed of light and are limited only by the platform's ability to generate power and the laser aperture's ability to hold up under repeated use. Given these latter two developments, even relatively small platforms, such as the unmanned Avenger, Sentinel, and X-47B, could provide long dwell lethality with precision strike from land bases in the future.

In the modern era the Air Force has dramatically cut back on its long-range strike component as a percentage of its overall force. This is surprising in that there has been a significant amount of analysis done, especially by the Air Force Association think tank, the Mitchell Institute for Aerospace Studies, which reported in 2015 that a campaign against Russia would require 258 bombers to hit 250,000 targets over a 180-day campaign to destroy strategic military, economic, and political centers within the country.[56] It is not difficult to surmise that a similar campaign against China, with its larger population, more expansive economy, a modern military, and more extensive defenses, would of necessity generate more targets and more attrition against its enemy and hence require a longer campaign. Hence it is not a difficult leap to believe that an extended campaign against China would require a bomber force in excess of 300 aircraft constantly cycling to and from heavily defended targets.

Against this demand the Air Force now fields a force of 158 bombers of three varieties: 76 B-52Hs, 62 B-1Bs, and 20 B-2s, with only the latter aircraft being capable of penetrating modern A2/AD perimeters.[57] While the Air Force is planning to acquire 100 new B-21 Raiders beginning in the 2020s, it is also planning to retire its current force of B-1Bs and B-2s simultaneously to reduce maintenance costs and complexity. That will leave the force with 176 bombers, only 100 of which can perform penetrating strike missions themselves, although the B-52 will be able to salvo launch long-range missiles from outside the A2/AD bubble.[58] Clearly, any campaign against a great A2/AD power will require additional aircraft, possibly a minimum of 164 B-21 bombers, plus additional legacy bombers, to accomplish its mission. In the past, the United States could look to the Navy to provide such services, but due to a series of strategic decisions, the maritime service's long-range penetrating strike capacity has largely atrophied.[59]

A remote-controlled target aircraft (center) is hit by a Laser Weapon System fired from a U.S. Navy vessel (upper left). While currently nascent technology, opportunities for generating deeper magazine exist with the development of directed energy weapons. Currently, the systems are limited by the platform's ability to generate power and the laser aperture's ability to hold up under repeated use. (U.S. Navy)

At present the F-35C (pictured) is reported to have an unrefueled combat radius of approximately 625 nautical miles, far short of the F-14 and A-6 aircraft that preceded it on the flight deck. (U.S. Navy)

The Absence of Sea-Based, Long-Range, Penetrating, Precision Strike

The Navy finds itself dramatically out of step with the world it lives in and appears intent to remain so. After the Cold War the Navy created the A-12 Avenger II program to be the replacement for the service's A-6 Intruder medium attack bomber. The Intruder had a combat range of just under 900 miles and could carry 18,000 pounds of ordnance of all types, but it had been in service since the 1960s and its design was no longer viable in the new age of advanced radars and surface-to-air missiles.[60] The Navy had been involved in the long-range strike mission since the early 1950s, when the supercarrier was designed and built for the express purpose of carrying the larger and heavier aircraft that would be capable of striking targets deep inside of the Soviet Union. With the demise of the A-6 Intruder, the Avenger II was to take up the mantle of deep strike. It represented a stealthy flying wing design capable of carrying over 5,000 pounds of ordnance internally and hitting targets 800 miles from the carrier without refueling.[61] Originally the Department of the Navy was to purchase 850 of these aircraft throughout the 1990s, which would have kept both the Navy and the Marine Corps in the long-range penetrating strike mission for a generation, but the end of the Cold War, along with mismanagement and cost overruns, resulted in the cancellation of the program before initial production began. A subsequent decision by Department of Defense leadership as part of the 1993 Bottom Up Review formally aligned the long-range strike mission under the Air Force and directed the Navy to focus on shorter-range air and strike missions.[62]

The Navy, whose 11 supercarriers, mandated by statute, were created to launch and recover aircraft large enough to perform the long-range, penetrating strike mission, made a valiant attempt to remain engaged. It added a Low Altitude Navigation and Targeting

The Navy finds itself dramatically out of step with the world it lives in and appears intent to remain so.

Infrared for Night (LANTIRN) pod to its venerable F-14 Tomcat, allowing it to drop laser-guided munitions on targets in Afghanistan and Iraq and to be redubbed a "Bombcat."[63] The Navy also modified the design of the F/A-18 Hornet to increase its size and fuel capacity to create the "Super Hornet," adding 100 miles of tactical range in the process.[64] The Navy also leaned in hard on the design of the new multiservice "Joint Strike Fighter." According to the baseline memorandum signed in October 2001, the naval variant of the new aircraft was to have a minimum range of 730nm with 6,000 pounds of ordnance in its internal bomb bay.[65] But at present, the F-35C is reported to have an unrefueled combat radius of approximately 625nm, far short of the F-14 and A-6 aircraft that preceded it on the flight deck.[66]

Naval aviation spent the 1990s transitioning to an all F/A-18 Hornet/Super Hornet flight deck. Deck cycle times, the period between launch and recovery, shortened as the light attack Hornet dominated the flight deck and the carriers themselves moved in closer to their targets. In the post-Cold War world, carriers found themselves routinely operating in the shallow and congested waters of the Arabian Gulf and the Adriatic Sea off the former Yugoslavia. Shorter cycle times and transit distances changed the design of the supercarrier itself as the 1990s CVN-X design and requirements office chose to focus on a 33 percent increase in sortie generation rate as a driving requirement in its new USS Gerald R. Ford-class supercarrier.[67] In other words, the Navy zigged with its strategic assumptions while the world zagged in its investment in new A2/AD technologies.

In the early 2000s, after the 9/11 attacks, the Navy made an effort to develop a carrier-based Unmanned Combat Air System Demonstrator (UCAS-D).[68] The program had begun as part of a Defense Advanced Research Projects Agency (DARPA) project to develop "high performance, weaponized, unmanned air vehicles to effectively and affordably prosecute 21st century combat missions."[69] Within a short time the program was transitioned into a Joint Unmanned Combat Air System, which focused on "first day of war" missions including suppression of enemy air defenses and strike. This combination of missions generated DoD requirements that the new prototype's design incorporate stealth, range, and significant internal ordnance capacity. The resulting Navy variant, the X-47B Unmanned Combat Air System Demonstrator, emerged as a 42,000-pound all-aspect stealth design that could fly 1,750nm while carrying 4,000 pounds of ordnance internally.[70] Two prototypes were built and successfully tested, both taking off and

The X-47B (pictured) represents the Department of Defense's effort to produce a prototype that incorporates stealth, range, and significant internal ordnance capacity. (U.S. Navy)

landing on supercarrier decks in 2014,[71] and then went on to complete midair refueling tests with a commercial "big wing" tanker in 2015.[72] The X-47B aircraft was viewed by many analysts as a 2/3 scaled-down version of a potential MA-47C ("M" for unmanned, "A" for attack) penetrating unmanned strike aircraft that would weigh in at 65,000 pounds (smaller than the massive, 75,000-pound A-3 Skywarrior, which had flown from carrier decks for 40 years), have a range of 2,500nms, and carry 6,000 to 10,000 pounds of ordnance.[73] A squadron of 12 of these theoretical MA-47Cs, with four additional "MK-47C" tankers, each capable of some 20,000 pounds of "give" fuel, could place nearly 75 percent of all targets in any future campaign against great powers within range of the United States' 11 (and planned-for 12) supercarriers.

But then the Navy decided that it did not need an unmanned long-range strike aircraft. Instead, naval commanders defined a new requirement for a carrier-based unmanned intelligence-surveillance-reconnaissance aircraft that could also provide some limited strike capabilities in lightly contested environments.

The reasons for this sudden shift were not well understood. Naval aviation leadership stated that it needed an Unmanned Carrier Launched Airborne Strike and Surveillance (UCLASS) system, effectively a carrier-based ISR asset,[74] but this assertion ran counter to the Navy's acquisition of the land-based MQ-4C Triton aircraft, which was purchased in sufficient numbers, beginning in 2015, to support both land- and sea-based commanders.[75] The Joint Requirements Oversight Council (JROC) stepped in in 2012 to provide

Davis-Monthan (pictured), known as the "boneyard," could provide needed S-3B Viking aircraft to alleviate service strain on current operational aircraft. (U.S. Navy)

some sense of direction to the Navy, and in early 2014, members of Congress provided their inputs and words of caution to the Navy with regard to the UCLASS program's direction.[76] Congress suggested that the aircraft have broadband stealth characteristics and be able to support surveillance and strike missions both over land and sea.[77] The Navy responded by minimizing stealth requirements, lessening ordnance-carrying capacity and emphasizing ISR systems.[78] At this point Pentagon leadership stepped in and directed the Navy to focus the newly designated MQ-25 Stingray's mission on tanking, in order to take strain off of the Navy's dwindling fleet of F/A-18E/F aircraft, rather than focus the new unmanned aircraft on ISR or penetrating strike.[79] Naval aviation attempted to retain some ISR capability but was repeatedly thwarted by the chief of naval operations and assistant secretary of the Navy for research, development and acquisitions, who signed a program decision memorandum clarifying the MQ-25's mission as a tanker. However, by this time the Navy no longer really needed a tanker, at least by its own reasoning.[80]

As previously stated, the F/A-18E/F inventory experienced excessive wear and tear brought on by the tanking mission, in which the Super Hornet aircraft were tasked with carrying three or five external fuel tanks in order to refuel and extend the range of other Super Hornets. These tanks, each holding hundreds of gallons of jet fuel, exerted strain on the jet's wing roots, shortening their lives, decreasing the population of aircraft, putting additional strain on the remaining aircraft, and accelerating their demise as well. It was a self-actuating death spiral that needed to be averted, and it has been. In June 2017 the Trump administration announced its intention to purchase up to 80 additional Super Hornets over a five-year period.[81] These additional aircraft should alleviate concerns regarding the mounting strains on a declining population of aircraft. However, if the Navy really required additional tanking capacity, it could recommission the 80-plus S-3B Viking aircraft preserved in the Davis-Monthan Air Force Base "boneyard" that have previously served as recovery tankers. These aircraft still have thousands of flying hours in their wings remaining. Logic therefore suggests that the driving fleet unmanned requirement is not for an unmanned tanker.[82] In the end, the big hole in the current carrier air wing's capabilities portfolio is long-range penetrating strike, and the Navy does not have, at present, a solution.

Stop Admiring the Problem. Solve It.

In the age of A2/AD technologies, the metric that will matter within the coming great-power competition will be the long-range penetrating strike mission. Within that mission, the nation that minimizes the latency between gaining intelligence on an enemy's disposition and acting upon it will have the advantage. Because of the distances involved, be it in European or Asian-Pacific regions, short-range fighters will have little utility beyond escorting bombers on the initial legs of their long journeys or protecting tankers as they refuel bombers prior to their press into enemy territory. Once detached from the tanker, the airborne platform that has the combination of the lowest observability, the deepest magazine, and the longest endurance will dominate the battlespace. Why? Because the modern battlespace changes on an hourly basis, and to find targets, an attacker has to be both looking at them and carrying something to hit them with.

This is because the future security environment is populated not only by static targets such as command and control centers or radars but also by long-range missiles mounted on mobile launchers that frequently relocate. If friendly commanders were to depend wholly upon space-based assets to identify their targets, they would miss many in the mass of trees and buildings that dominate rural and urban environments. If commanders place their faith in high-altitude, unmanned intelligence-surveillance-reconnaissance platforms to find and fix their targets, the target itself may well move before an attack platform can be summoned to hit it, inducing latency into the kill chain. What is needed is a platform that can penetrate an A2/AD environment, persist within it, perform its own ISR and targeting with internal and external sensors, kill its target once identified, and then have a deep enough magazine to move on to another target within the same mission. Such a platform represents the holy grail of counter-A2/AD warfare. Whereas up until Vietnam an entire squadron or air wing might be launched to destroy a single target, in the future the number of kills per platform per sortie will be the aspirational characteristic of war.

Deep, penetrating strike is neither an Air Force nor a Navy issue in an era of growing great-power competition. It was the office of the Secretary of Defense that eliminated "unnecessary redundancy and overlap" in the deep strike mission as part of the 1993 Bottom Up Review implemented by President Bill Clinton's first Pentagon chief, Secretary Les Aspin. It was the Clinton administration's strategic goal to make large cuts in defense spending and present the nation with a "peace dividend" that could be invested in targeted domestic programs.[83] The Air Force was given a monopoly over the long-range strike mission and the Navy was told to shift its focus to sea control and abandon power projection. However, the rise of A2/AD technologies and the emergence of Russia and China as great-power competitors have rendered many of the assumptions of the early 1990s moot. Today's critical strategic documents, the 2017 *National Security Strategy* and the 2018 *National Defense Strategy*, make clear the importance of re-examining concepts of operations as they pertain to overcoming the obstacles presented by A2/AD systems.[84]

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Strengthening the Air Force

The Air Force has taken the right first steps through its investments in a new long-range, stealth heavy bomber that is capable of penetrating and operating within heavily contested environments for prolonged periods. The only difficulty is that the Air Force has indicated it does not plan to purchase sufficient numbers of these new aircraft to conduct a successful campaign against either China or Russia. This is troubling because of the ranges associated with targets inside both those countries; the long-range threat of advanced Russian and Chinese interceptor aircraft will make it difficult for the Air Force's large inventory of short-range, land-based, stealth fighter aircraft to reach targets or protect large "big wing" refueling tanker aircraft. These tankers will be required to "top off" bombers prior to their penetration of enemy A2/AD airspace.

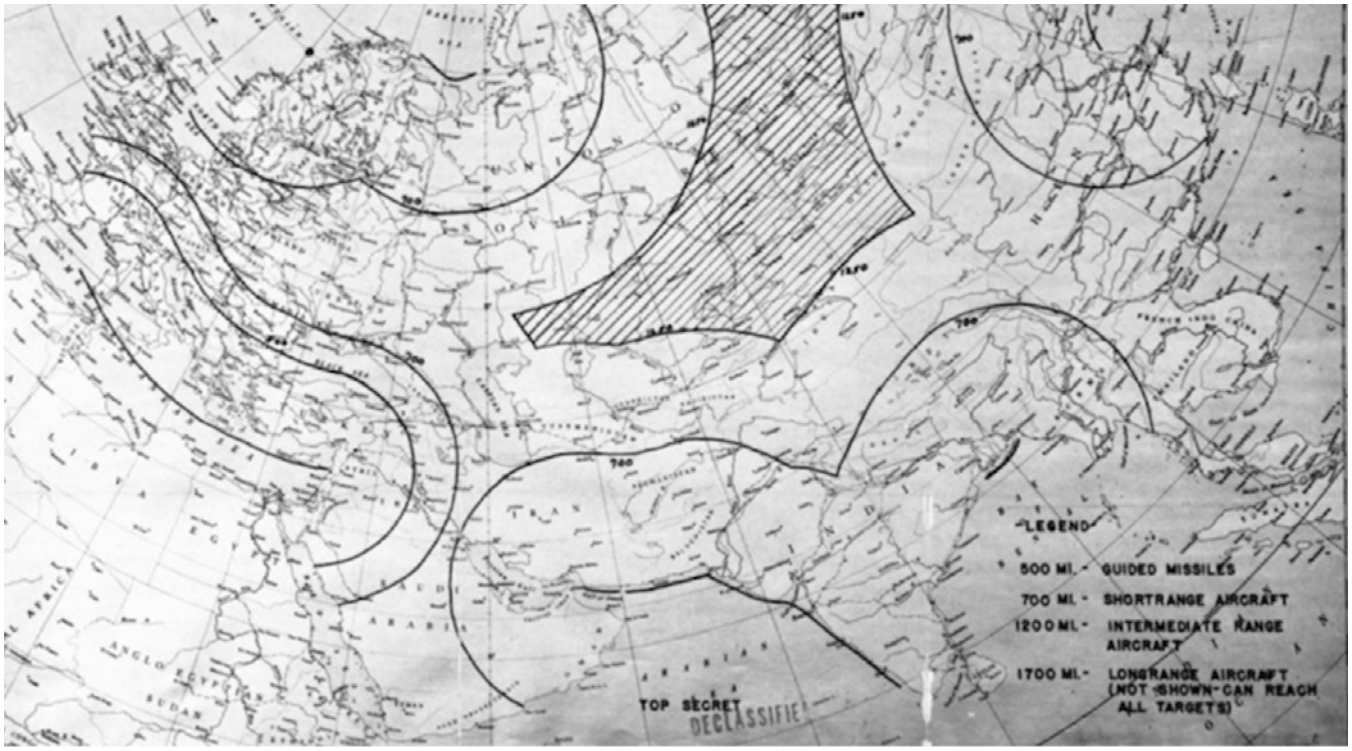
The United States can assure access to bastions within Chinese or Russian territory that were previously considered safe by forcing those geographically vast countries to spread out their defensive capabilities to the point of being porous or forcing them to concentrate limited resources around key infrastructure, thus creating large accessible holes in their outer defenses. Such assurance can be gained by growing the capacity for long-range strike within the Air Force and the Navy. This can be accomplished for the Air Force by retaining its current inventory of 20 B-2 Spirit bombers while adding another 50 to 75 aircraft to the planned buy of 100 B-21 Raiders. The Navy, for its part, can best serve the nation by ceasing its unwise and unneeded investment in a single-mission unmanned tanker and moving directly and expeditiously to a carrier-based, all-aspect broadband stealth, unmanned, long-range strike aircraft that could also be repurposed to serve as a mission tanker or surveillance platform for the Navy.

> **A few clear investments accompanied by a new joint concept of operations with regard to penetrating modern A2/AD environments could return the carrier to relevance.**

Returning the Carrier to Relevance

The Navy currently finds itself without the necessary tools to operate persistently within the A2/AD bubble, lacking both aircraft with sufficient range to penetrate, loiter on mission, and return as well as the necessary capabilities to defend increasingly expensive supercarriers while operating closer to enemy shores. The carrier air wing, composed as it is of 500-mile combat radius F/A-18E/F Super Hornets and 625-mile combat radius Joint Strike Fighters, is unable to overcome cruise and ballistic missiles that can target the carrier up to 1,000 miles from enemy shores. The carrier itself could risk moving closer if it had sufficient protection surrounding it. In the past, as late as the mid-1990s, carriers routinely deployed with two cruisers, four destroyers, two frigates, and two fast-attack nuclear-powered submarines, as well as an air wing of up to 85 aircraft, all of which could defend the large capital vessel against air, surface, and subsurface threats.[85] Today, supercarriers often operate with only a cruiser and/or a destroyer as an escort and embark a reduced air wing of approximately 65 aircraft.[86] Given this paucity of offensive and defensive power on and around the carrier, it is no mystery why the Navy is not more active in the long-range, deep penetrating strike arena. However, a few clear investments accompanied by a new joint concept of operations with regard to penetrating modern A2/AD environments could return the

From its AIM-9 Sidewinders to its Tomahawk Land Attack Missile (pictured), the U.S. Navy has been relying on weapons that have designs nearly 50 years old. (U.S. Navy)



The graphic, from a 1946 study by the Navy, looked at the need for long-range strike from the carrier deck. Note that "short range" in the 1950s was considered to be 700 nautical miles. To reach 700 nautical miles with today's carrier air wing would require refueling. (Naval History and Heritage Command)

carrier to relevance, strengthen land-based strike assets, and return the United States to a position as a shaping force (versus a shaped force) in the world.

First, the Navy could take the step of modernizing its weapons inventory. From its AIM-9 Sidewinders to its Tomahawk Land Attack Missile, the Navy has been relying on weapons whose basic designs are nearly 50 years old.[87] It needs to rapidly invest in a new generation of weapons that are stealthy, hypersonic, lethal, have extended ranges, and can be launched from aircraft, ships, and submarines.[88] In addition, the Navy (and the Air Force) should procure a new family of missiles that can mimic the radar and electronic signature of attack aircraft, be they a B-21 Raider or a new carrier-based Navy attack aircraft. The Navy should also seek to add a long-range missile that can serve as an active, multispectrum jammer to mask the approach of attack aircraft or sow confusion in the minds of the enemy as to the true axis of approach for actual attack craft. These missiles should be designed for potential launch from either carrier-based aircraft such as the F/A-18E/F and the F-35C or from land-based aircraft such as the venerable B-52 bomber. None of these missiles will be inexpensive to develop, but they have been long needed.

A New Generation of Missiles

The assistance these new missiles could bring would help create opportunities to attack an enemy from multiple axes of approach, a true strategic advantage that needs to be re-established. It would force China and Russia, which possess large land masses and very long and dispersed territorial and maritime boundaries, to distribute scarce defensive resources accordingly and prepare for attack from disparate points of origin.[89] Such a threat creates a cost-imposing burden for the defending nation. To the degree that the United States can induce China and Russia or, for that matter, Iran and North Korea to spend money on defending themselves rather than investing in offensive capabilities that complicate the lives of the United States, its allies, and partner nations, it is winning the great-power competition.[90]

The assistance these new missiles could bring would help create opportunities to attack an enemy from multiple axes of approach, a true strategic advantage that needs to be re-established.

Unmanned strike platforms, due to their high-risk missions, should be designed to incorporate the latest in stealth (like the flying wing design) and onboard electronic spectrum control technology. (U.S. Navy)

In this light, strengthening ties with NATO nations, Japan, the Philippines, Australia, and Taiwan, as well as continuing the development of partnerships with Asian nations such as India, Vietnam, and Afghanistan, creates opportunities for air bases and logistics hubs that are closer to both China and Russia, allowing rapid access to their interiors as well as logistical support for maintenance and rearming of aircraft.[91] However, without the capability to strike from the sea, this cost-imposing strategy is compromised.

Modern naval aviation, based as it is upon supercarriers as a base, was created around the deep strike mission. The designs for the larger carriers created after World War II, first the Forrestal class and then ever larger carriers after it, emerged out of a strategic requirement to be able to reach targets deep inside the Eurasian land mass.[92] Being able to fly bombers from bases in Europe eastward or even to launch long-range heavy bombers from the United States and fly over the North Pole to hit targets in Russia or China was not enough. The United States decided that it needed to be able to hit communist nations from the sea, but to launch and recover long-range attack aircraft such as the A-3 Skywarrior and later the A-6 Intruder, the Navy needed a longer and wider aircraft carrier than it had employed in World War II. This drove naval architects to build what are now known as supercarriers. These carriers, and their air wings, not only created the ability to launch strikes from any maritime location with enough deep water and space to accommodate a carrier conducting flight operations, but also drove the creation of an air wing that was diverse enough to clear the seas, both on and below the surface, and the airspace above it between the carrier and its target.[93]

Carriers also bring the advantage of electromagnetic and geographical maneuver. They have the ability to launch their aircraft under a specific electromagnetic configuration at one location but then can impose a restrictive electromagnetic emissions control regime, quickly reposition hundreds of miles, launch aircraft, relocate again, and only then bring up their sensor suite to recover their aircraft.[94] No land base in the world has these characteristics. Such mobility will force opponents to spend time, forces, and energy attempting to locate U.S. forces, making them "look where we ain't." But this will not be enough to win.

Carriers also bring the advantage of electromagnetic and geographical maneuver.

Going forward with a strategic eye toward China and Russia, a well-designed future carrier air wing should return to its historical strategic focus of being able to hold targets deep inside the Eurasian land mass at risk. To do this, it should immediately begin the acquisition of a new unmanned, aerial, all-aspect broadband stealth, long-range penetrating attack platform. It should be unmanned because human occupants physiologically are incapable of remaining combat effective across the long flight profiles of up to 50 hours duration that modern aircraft can execute. Nor can human pilots make the picosecond OODA loop (observe-orient-decide-act) airspeed-altitude-high G maneuver decisions that are necessary to penetrate advanced A2/AD perimeters and hit their targets. Only unmanned platforms will be able to successfully navigate and survive such missions in the future.

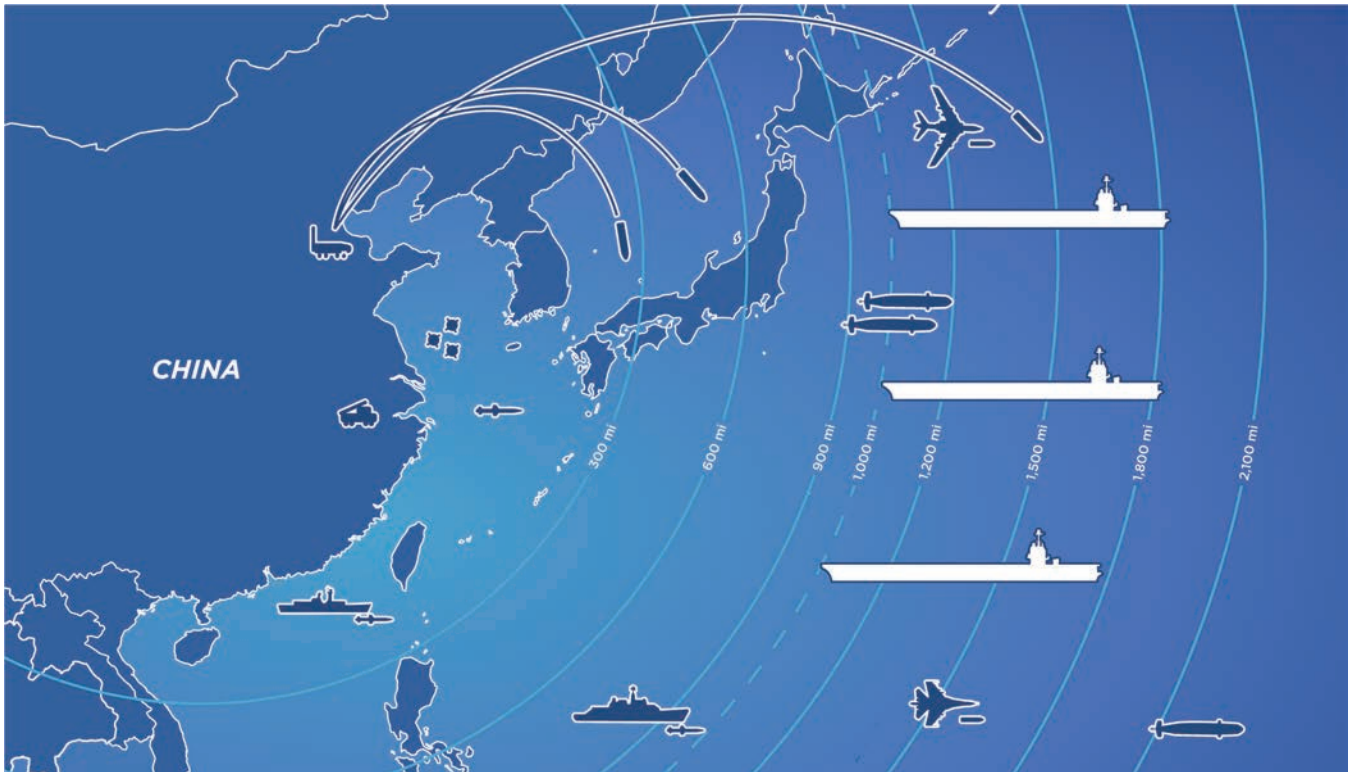
Summing Up

Unmanned strike platforms, due to their high-risk missions, should be designed to incorporate the latest in stealth and onboard electronic spectrum control technology. Airframe design, external coatings, internal fuel, and ordnance carriage should all be optimized to lower the aircraft's radar cross section as well as its thermal signature. Survivability should be maximized, and cost, due to the fact that unmanned aircraft need only be flown for direct support combat missions, should be weighted appropriately as a factor. The aircraft should be designed with a threshold minimum unrefueled combat radius of 1,500 nautical miles, while carrying approximately 5,000 pounds of ordnance and/or sensors internally.[95] While some might argue that such a small internal load might limit the aircraft, increased precision and lethality would allow the aircraft to carry up to 20 modern small diameter bombs or some lesser number of various combinations of forward-firing missiles or glide bombs.[96] Twelve aircraft of such design embarked on each of the nation's deployed carriers would allow the United States to attack its enemies simultaneously from multiple maritime- and land-based axes. This is the critical seam in current U.S. operational plans that needs to be filled, but it is not the only glaring gap in the nation's strategic profile.

The assignment of four additional unmanned aircraft of similar design but optimized for the tanking mission could bring the additional advantage of extending the range of the new attack platforms as well as existing legacy air wing elements consisting of F/A-18E/F Super Hornets, F-35C Lightning IIs, EA-18G Growlers, and E-2D Hawkeyes. These new unmanned tankers would not only allow the unmanned strike platforms to extend their reach farther into enemy territory but would also allow the air wing's manned aircraft to control the seas around the carrier farther out, enabling the U.S. Navy to attrite the enemy's deployed naval forces as well as interdict vital energy and raw resource supplies being carried on the high seas. However, and perhaps most importantly, extending the range of carrier-based aircraft would bring interesting tactical advantages for the joint force as well.

As stated previously, modern long-range bombers such as the B-2 Spirit and B-21 Raider can be most effective when their fuel tanks are full as they enter an enemy's A2/AD bubble. This is accomplished by having the bombers match speed and altitude with one of the Air

Separate Carrier Axes of Approach

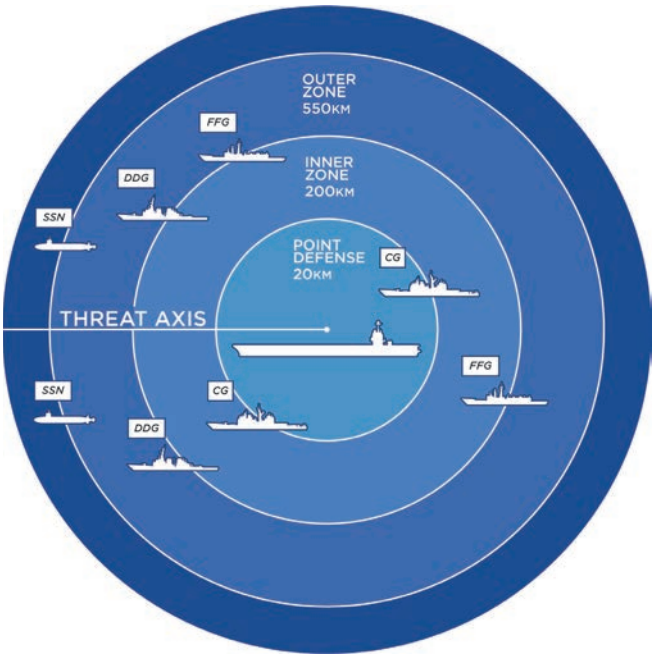


Multiple carriers could establish sanctuaries along separate axes of approach to enemy territory.

Force's large "big wing" tankers, such as the new KC-46 Pegasus, which can pass over 200,000 pounds of fuel in flight.[97] Refueling evolutions close to enemy territory maximize stealth bomber utility while on station, but also expose the highly vulnerable and nonstealthy tankers to enemy attack. The loss of even a few tankers, which are low-density (the United States does not have enough of them), high-demand (everyone wants to use the ones it has) assets, would have significant implications for operational planners.

However, carriers ringed by more defensive systems that would come with a larger, 355-ship Navy can operate closer to the enemy's A2/AD perimeter. From these locations, it would be possible to launch defensive counter air packages to provide escort of the large tankers into A2/AD airspace in order to allow both manned and unmanned penetrating strike bombers to refuel within protected sanctuaries. Carrier-based E-2D Hawkeyes will be able to assist by using their air search radar to constantly scan the skies for approaching enemy fighters or missiles. EA-18G Growlers could electronically jam enemy sensors, keeping them from either spotting or gaining a targeting "lock" on the tankers or the bombers. F-35Cs and F/A-18E/Fs could act in concert to attack and down approaching enemies. They will also be able to "plow the road" for large B-52 formations carrying multiple modern long-range strike, decoy, or jamming missiles to their launch points. A single carrier could thus establish multiple sanctuaries along separate axes of approach to enemy territory. Multiple carriers operating under wartime conditions in widely spaced locations could establish numerous ingress/egress tanking and/or missile launch sanctuaries for carrier-based and land-based bombers, thus filling the largest seam in the United States' current wartime concepts of operations by maximizing the offensive time and opportunities for bombers over enemy territory.

The decision to take the long-range penetrating strike mission away from the Navy was shortsighted, as were many strategic decisions in the years immediately after the end of the Cold War. Returning both the capability and the capacity for the Navy to participate in this mission will serve to complicate strategic calculations for those who would make themselves the enemy of the United States in the rising great-power competition, but not as much as if the newly re-emergent Navy and the Air Force learn to combine the capabilities of their various platforms into a new, modern, long-range precision strike complex. Such a combination would represent a constructive wave action that is not simply additive but in fact multiplies its effects. Concepts of operations that fully leverage Air Force and Navy capabilities could cause China and Russia not only to have to spend more on their own defenses, but perhaps choose, as they did in the latter stages of the Cold War, to withdraw from the competition altogether.



With additional ships, carriers can be ringed by defensive systems that would allow them to operate closer to the enemy's anti-access/area denial perimeter.

It would be possible to launch defensive counter air packages to provide escort of the large tankers into A2/AD airspace in order to allow both manned and unmanned penetrating strike bombers to refuel within protected sanctuaries.

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