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RESEARCH BRIEF

Breaking the Firepower versus Protection Paradox

OFFSETTING DISADVANTAGES AND SPURRING NEW COMPETITION USING CCA FOR HVAA PROTECTION

September 2026 | Greg Malandrino and Dao Tran

Unlike Russia's war with Ukraine or U.S. operations against Iran, any future fight between the United States and the People's Republic of China (PRC) is likely to feature widespread aerial combat between opposing air forces.[1] In this potential conflict, establishing temporary U.S. air superiority would depend on more than fighter-based firepower.[2] Contemporary air-to-air combat relies heavily on specialized airborne early warning (AEW) and aerial refueling aircraft, particularly for the United States Air Force.[3] These high-value airborne assets (HVAA) provide the critical information and fuel required to conduct air combat, particularly across the Western Pacific Ocean. Without them, Washington's ability to project power would begin to falter. Concerningly, U.S. HVAA are relatively easy to track and have few organic defenses, relying solely on fighter aircraft for protection. It is no wonder, then, that the People's Liberation Army Air Force (PLAAF) has devoted considerable effort to targeting and destroying U.S. HVAA using extended-range air-to-air missiles such as the PL-17.[4]

This creates a dilemma: too little emphasis on HVAA protection would leave U.S. fighters and strike aircraft without the support they need to generate aerial firepower, while too much emphasis on protection could degrade firepower by diverting an excessive number of fighters into purely defensive roles. To safeguard its HVAA, the Air Force can acquire more fighters to reduce the net protection tax, develop an entirely new generation of HVAA capable of surviving the latest Chinese threat, or, for AEW, transition to space-based

[1] The single day of combat between the Indian and Pakistani Air Forces on May 7, 2025, may offer a glimpse of what modern, long-range, networked aerial combat looks like. However, separating fact from fiction and acquiring accurate engagement details remains elusive. Saeed Shah and Shivam Patel, "How Pakistan Shot down India's Cutting-Edge Fighter Using Chinese Gear," *Reuters*, August 2, 2025, https://www.reuters.com/business/aerospace-defense/how-pakistan-shot-down-indias-cutting-edge-fighter-using-chinese-gear-2025-08-02/.

[2] For a fuller appreciation of the trends shaping contemporary aerial warfare, see John Stillion, *Trends in Air-to-Air Combat: Implications for Future Air Superiority* (Washington, DC: Center for Strategic and Budgetary Assessments, 2015).

[3] Ian Shaw and Sérgio Santana, *Beyond the Horizon: The History of AEW&C Aircraft* (Vienna, Austria: Harpia Publishing, 2014).

[4] The PL-17's maximum HVAA-engagement range could exceed 250 NM. Tyler Rogoway, "Shadowy New Missile Appears Under The Wings Of Chinese J-16 Fighter," *The War Zone*, November 21, 2016, https://www.twz.com/6108/shadowy-new-missile-appears-under-the-wing-of-chinese-j-16-fighter; Thomas Newdick, "China's Massive PL-17 Air-To-Air Missile Seen Up Close," *The War Zone*, January 27, 2026, https://www.twz.com/air/chinas-massive-pl-17-air-to-air-missile-seen-up-close.

sensing.[5] Yet a fourth option offers promise: Increment Two of the Air Force's Collaborative Combat Aircraft (CCA), which aims to fly uncrewed systems alongside crewed aircraft. A central aim of CCA Increment One is to increase firepower by generating more combat mass with systems that are affordable enough to lose.[6] To solve the protection paradox, Increment Two should prioritize the HVAA protection mission.[7] CCAs capable of defending HVAA aircraft would break the current protection-versus-firepower paradox, enhance the Air Force's capability to inflict aerial attrition on the PLAAF and establish air superiority.

Traditional Approaches to Aerial Firepower and Protection

Since its inception, the Air Force has pursued air superiority through fighter firepower, emphasizing qualitative advantages across its fighters, missiles, and pilots. In the 1960s, the Air Force developed HVAA to command, control, and refuel its fighter aircraft, providing American fighter pilots with an additional qualitative advantage.[8]

The Air Force's contemporary investments align with its traditional preferences and methods. Several efforts are working to increase the Air Force's relative firepower by enhancing the lethality of its existing fighter force. These include alternative concepts such as Increment One CCAs operating alongside F-22 *Raptors* and F-35 *Lightning IIs*.[9] Additionally, the Air Force is developing the F-47, a sixth-generation fighter aircraft, and arming it with ever-longer-range missiles.[10]

The growing size and capabilities of the PLAAF, however, make Air Force efforts to match Chinese firepower by purchasing more and improved fighter aircraft and missiles problematic. Although the F-47 will outclass the latest J-20C *Mighty Dragon*, it is unlikely to similarly outclass the coming J-36 and J-50/XDS.[11] The Air Force's current plan is to purchase 187 F-47s, whereas the PLAAF has 300 J-20s today, and an unknown

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[5] Space-based airborne moving target indicator (AMTI) capabilities offers promise for detecting, tracking, and providing engagement information for long-range air-to-air kill chains. However, these engagements still require command and control to direct and manage aircraft in a complex battlespace covering thousands of square miles. Mikayla Measley, "SpaceX Wins $4B Deal to Accelerate Deployment of Aircraft-Tracking Satellites," *DefenseScoop*, May 29, 2026, https://defensescoop.com/2026/05/29/spacex-amti-contract-space-force/.

[6] For further details about the Air Force's efforts to develop CCAs, see Travis Sharp, *Ready Player None? An End-to-End Assessment of the Air Force Collaborative Combat Aircraft Program* (Washington, DC: Center for Strategic and Budgetary Assessments, 2025).

[7] Currently, fighter escorts protect HVAA, a defensive counterair role. "Joint Publication 3-01 Countering Air and Missile Threats," April 21, 2017, I–6.

[8] Shaw and Santana, *Beyond the Horizon*.

[9] Efforts also include exploring options for increasing the number of AIM-120s the F-35 can carry from four to six. "U.S. Air Force Collaborative Combat Aircraft (CCA)," *Congressional Research Service*, November 28, 2025, https://www.congress.gov/crs_external_products/IF/PDF/IF12740/IF12740.6.pdf; Emma Helfrich, "F-35 Closer To Carrying Six AIM-120 Missiles Internally," *The War Zone*, March 24, 2023, https://www.twz.com/adapter-for-f-35-internal-carriage-of-six-aim-120-missiles-is-progressing.

[10] The JATM, or AIM-260, may be capable of hitting targets over 120 miles (190 km) away. Tyler Rogoway, "F-47 Now Has An Officially Stated Combat Radius Of 1,000+ Nautical Miles," *The War Zone*, May 13, 2025, https://www.twz.com/air/f-47-now-has-an-officially-stated-combat-radius-of-1000-nautical-miles; Parth Satam, "New AIM-120D AMRAAM Variant Will Be 'Complementary' to the Secretive AIM-260 JATM - Raytheon Exec," *The Aviationist*, September 12, 2024, https://theaviationist.com/2024/09/12/aim-120d-amraam-complementary-to-aim-260-jatm/.

[11] Tyler Rogoway, "China's Massive J-36 Stealth 'Fighter' Gets Major Design Tweaks With Second Prototype," *The War Zone*, October 28, 2025, https://www.twz.com/air/chinas-massive-j-36-tailless-fighter-gets-major-design-tweaks-with-second-prototype.

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number of future fighters.[12] The resulting quantitative disadvantage may leave even the most cutting-edge mixed-U.S. fighter fleet effectively outnumbered. Worryingly, a fighter-firepower preference may come at the expense of HVAA protection, potentially leaving HVAA critically exposed to Chinese attacks. This creates a paradox: if the Air Force increases its firepower without also addressing protection, its net offensive counterair capabilities could suffer.

When it comes to the survivability of its fighter fleet, the Air Force has placed a heavy bet on signature management. Yet its total aerial combat effectiveness also requires HVAA—early warning and refueling aircraft that have significant signatures due to their size and shape, and that ultimately rely on outmoded self-defense systems as their only organic source of protection. Keeping these aircraft alive may require operating them outside the range of PLAAF threats or escorting them with fighter aircraft that can engage airborne threats.[13] In the latter case, for example, a U.S. HVAA protection mission could include multiple fighter aircraft tasked with engaging a counter-HVAA formation before it launches a long-range attack. This defensive mission puts fighters in a reactive posture, curtailing their freedom of action. In contrast, fighters executing independent offensive counterair missions can more freely engage opposing formations, likely inflicting greater attrition.

The tension between offense and defense, between tethering escort fighters to the protected asset, or to unshackling them for offensive missions, is not new. In 1944 during Operation *Argument*, the Eighth Air Force faced a similar question. After the development and deployment of effective long-range fighters—drop-tank equipped P-47 *Thunderbolts* and P-51 *Mustang*s—fighter groups split their forces. During a typical mission supporting a bomb group attack against a target inside Germany, a fighter group of three squadrons would task one squadron with the purely defensive role of close-bomber escort and the other two squadrons with the offensive tactic of forward, free-ranging offensive missions that sought combat with German fighters "on our terms, not theirs." Within months, this tactic evolved into dedicated low-altitude fighter sweeps into Germany.[14]

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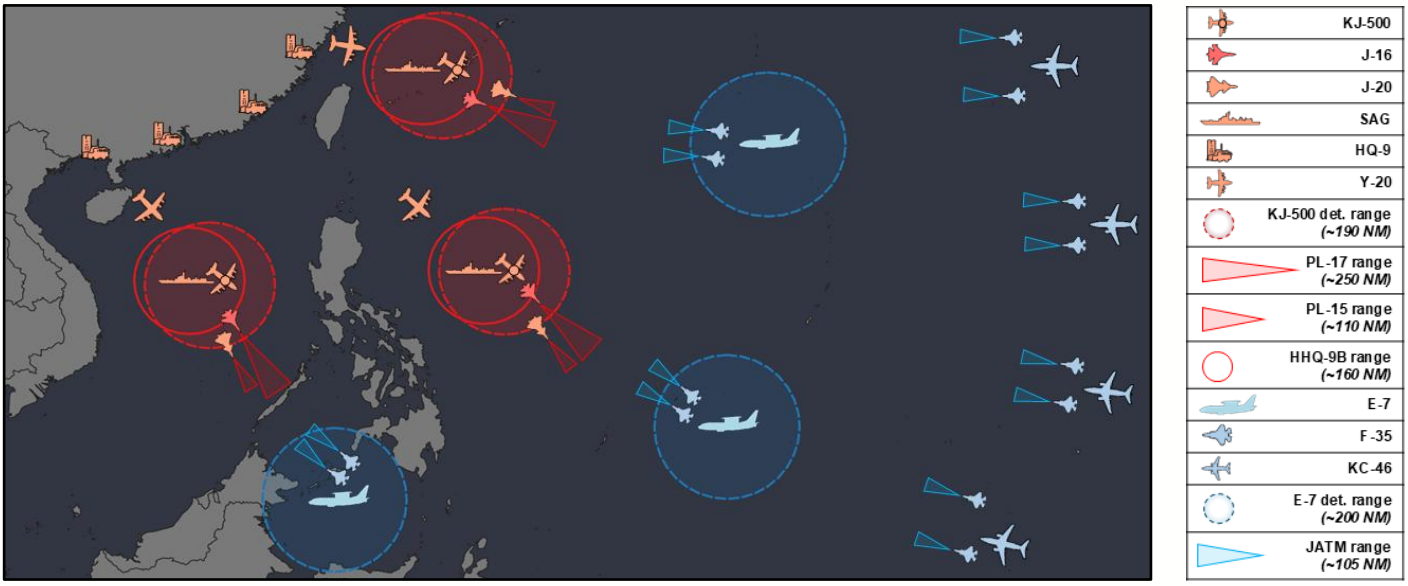
[12] Parth Satam, "China's 300th J-20 Spotted at Changchun Air Show," *The Aviationist*, September 17, 2025, https://theaviationist.com/2025/09/17/china-300th-j-20/.

[13] This is a relatively new instantiation of the classical firepower-versus-protection paradox. In contemporary aerial combat, fighter protection of HVAA enhances the overall fighter mission, rather than being distinct from it. This makes today's aerial firepower-protection dynamic somewhat similar to determining the type and number of forces required to defend an operating location or supporting element, such as a forward operating base or a carrier strike group, while retaining sufficient firepower for offensive operations. "Joint Publication 3-01 Countering Air and Missile Threats," GL-11.

[14] William R. Emerson, *Operation POINTBLANK: A Tale of Bombers and Fighters*, USAFA Harmon Memorial Lecture #4 (United States Air Force Academy, 1962).

FIGURE 1: FIGHTER-BASED HVAA PROTECTION IN THE WESTERN PACIFIC



Notes: Long-range kill chains also use terrestrial and space-based sensors to detect, track, and engage aircraft. Map created by CSBA staff.

In the end, tasking U.S. fighter aircraft with the HVAA protection mission reduces the Air Force's offensive counterair capacity and therefore represents a tax it must pay to retain its long-range air-to-air kill chains.

Estimating the HVAA Protection Fighter Tax

A host of factors could create conditions in which the Air Force pays a significant tax on aerial firepower. Consider the following rudimentary calculations.[15] The specific number of U.S. fighters assigned to HVAA protection depends on complex, highly classified mission-planning details. However, a few baseline force-planning assumptions for an air war against the PLAAF may help gauge the potential HVAA protection tax.[16] Assuming the Air Force commits two-thirds of its 1,780 total fighter force, approximately 1,187 fighters, and assuming it sustains 100 HVAA protection orbits with four fighters per orbit at any given time, it may incur a

[15] The trends in this briefing were generated from International Institute for Strategic Studies (IISS) military balance data. In FY25, the Air Force had approximately 1,780 fighters and 670 HVAA dedicated for conducting air-to-air combat. The HVAA number includes aerial refueling, AEW&C, C2, ELINT, and EA aircraft. Approximately 70 percent of this class of aircraft are aerial refueling aircraft. Based on previous unclassified wargames and reports, it seems reasonable that the Air Force may dedicate approximately two-thirds of its total air supremacy force, its fighters and HVAA, to an air war against the PRC above the Western Pacific Ocean.

[16] Air-to-air combat is an extraordinarily dynamic mission area, and the exact details of mission planning vary widely. However, for general illustrative purposes of the size of a potential protection tax on firepower, here are a few assumptions for a single day of aerial combat in the Western Pacific. The U.S. may establish 100 HVAA orbits for AEW, ISR, and aerial refueling aircraft supporting its fighter aircraft. Each HVAA orbit location is assumed to have two HVAA aircraft, regardless of mission. Lastly, this sketch assumes that four fighter aircraft are assigned to protect each of the 100 HVAA orbit locations. This creates a total U.S. protection tax of 400 fighter aircraft. If two-thirds of the Air Force approximate 1,780-strong fighter force is committed to combat operations in the Second Island Chain, this leaves 1,187 total U.S. fighters for aerial combat against the Chinese. Subtracting the estimated HVAA protection tax of 400 from the 1,187 available fighters leaves 787 U.S. fighters for dedicated offensive counterair missions against the PLAAF per 24 hours of flight operations.

total HVAA protection tax of 400 fighters. That would leave approximately 787 fighters available for other counter-PLAAF missions.

Estimating the PLAAF's protection tax using similar force-planning assumptions could leave only 1,303 of its 1,650 fighters available for other missions.[17] Comparing these two rough estimates for the Air Force (787) and PLAAF (1,303) fighter forces yields a nearly 2:1 numerical advantage for the PLAAF; achieving parity in this scenario would require the Air Force to dedicate all of its fighters to a campaign against the PLAAF. Estimating the potential rate of attrition between the world's two most advanced air forces is a highly complex undertaking. However, overcoming a 2:1 quantitative disadvantage could be challenging, even for the most qualitatively superior U.S. fighter force.[18]

FIGURE 2: NUMBER OF FIGHTERS AND HVAA SUPPORTING AIR-TO-AIR FOR USAF AND PLAAF (FY2025)

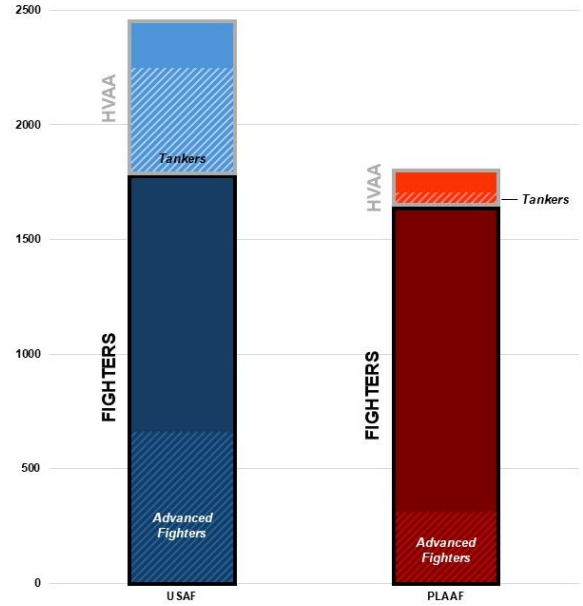
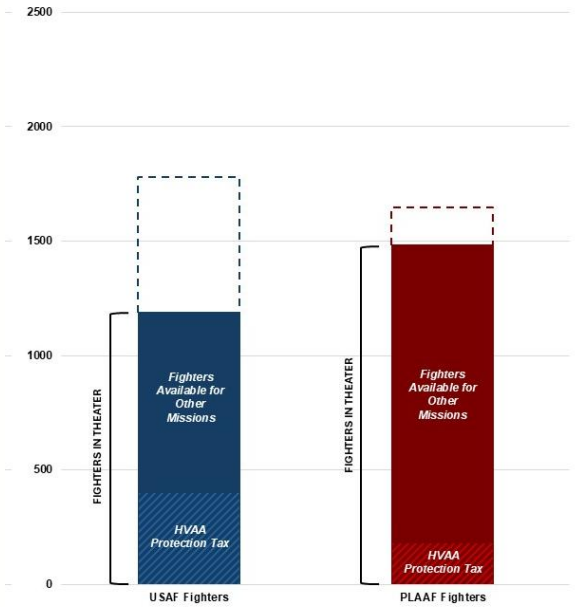


FIGURE 3: FIGHTER AVAILABILITY AFTER HVAA PROTECTION TAX FOR USAF AND PLAAF (FY2025)



Source: USAF and PLAAF fighter and HVAA inventory from *The Military Balance 2026* (IISS).

[17] In comparison to the Air Force, here are the PLAAF assumptions. The PLAAF fields approximately 148 HVAA for conducting air-to-air missions. In this straightforward scenario, the PLAAF dedicates nine-tenths of its fighter and HVAA forces to aerial combat within the Second Island Chain, and sustains 45 HVAA orbits, with two HVAA per orbit, protected by four fighters per 24-hour period. Based on these basic assumptions, the PLAAF may pay a total protection tax of 180 fighters, leaving it with 1,303 fighters for offensive counterair tasking. Additionally, it could be possible that the PLAAF may also leverage its interior lines, ground-based long-range SAMs, and the PLAN's ship-based long-range SAMs for further protecting its relatively limited number of vital HVAA. The use of non-fighters for HVAA protection by the PLAAF could increase the number of PLAAF fighters available for offensive counterair, further tipping the relative balance in Beijing's favor.

[18] During World War One, F.W. Lanchester wrote *Aircraft in Warfare: The Dawn of the Fourth Arm*. His book included an equation designed to calculate how many aircraft might be required to offset a numerical disadvantage. This equation became known as Lanchester's equation. His equation proposes that if an air force is outnumbered 2:1, balancing the scales requires each of its aircraft to be four times as capable as the adversary's. F. W. Lanchester, *Aircraft in Warfare: The Dawn of the Fourth Arm* (London: Constable and Company Limited, 1916); Glenn A. Kent, "Thinking About America's Defense: An Analytical Memoir," *RAND Project Air Force*, 2008, 178.

To restore the fighter-firepower balance, the United States could prioritize using fighters for offensive missions rather than HVAA protection. Biasing toward firepower, however, would leave U.S. AEW and refueling aircraft dangerously exposed to Chinese long-range attacks. Losing these critical aircraft would, in turn, cede dramatic first-look, first-shot, and range advantages to the PLAAF. Failing to resolve this attrition-protection paradox could collapse U.S. long-range air-to-air kill chains, ceding air superiority to the Chinese.

CCAs for Protection and Firepower

Rethinking the Air Force's traditional HVAA protection tactics could help resolve the firepower-versus-protection dilemma against the PLAAF. Seizing the opportunity to shape CCA Increment Two offers promise. A CCA favoring endurance over fighter-like speed, equipped with resilient datalinks and capable of semi-autonomous engagements, armed with a significant missile payload tailored to engage PLAAF HVAA, fighter aircraft, and perhaps even PL-17 missiles, could tip the balance.

Contemporary aerial combat is missile-centric, making the number of missiles per aircraft a key measure of firepower. Historical trends in beyond-visual-range combat suggest that destroying a single aircraft requires employing multiple missiles, meaning an aircraft with a larger missile payload likely has a combat advantage.[19] The first tranche of CCA appears likely to carry two AIM-120 Advanced Medium-Range Air-to-Air Missiles (AMRAAM). For the HVAA protection mission, developing smaller missiles and carrying larger weapons externally could increase total CCA missile capacity.[20] Maximizing missile payload is likely to increase the size and cost of each CCA. It may, however, yield an outsized return by increasing the aircraft's total payload and maximum range. This concept prioritizes aircraft size (endurance and payload) and places less emphasis on signature reduction and speed, a trade that may help constrain rising aircraft unit costs.

[19] From December of 1992 until May of 1999, the Air Force fired 13 AIM-120 missiles to achieve six beyond visual range kills for a probability of kill (Pk) of .46. John Stillion and Scott Perdue, "Air Combat Past, Present and Future," *RAND Project Air Force*, August 2008.

[20] This could include missiles such as the Navy's compact air-to-air missile (CAAM). Joseph Trevithick Altman Howard, "Tiny Air-To-Air Missile In Development For Stealthy U.S. Navy Combat Aircraft," *The War Zone*, August 24, 2026, https://www.twz.com/air/tiny-air-to-air-missile-in-development-for-stealthy-u-s-navy-combat-aircraft.

FIGURE 4: NUMBER OF MISSILE RAILS TO FIGHTERS FOR USAF AND PLAAF (FY2025)

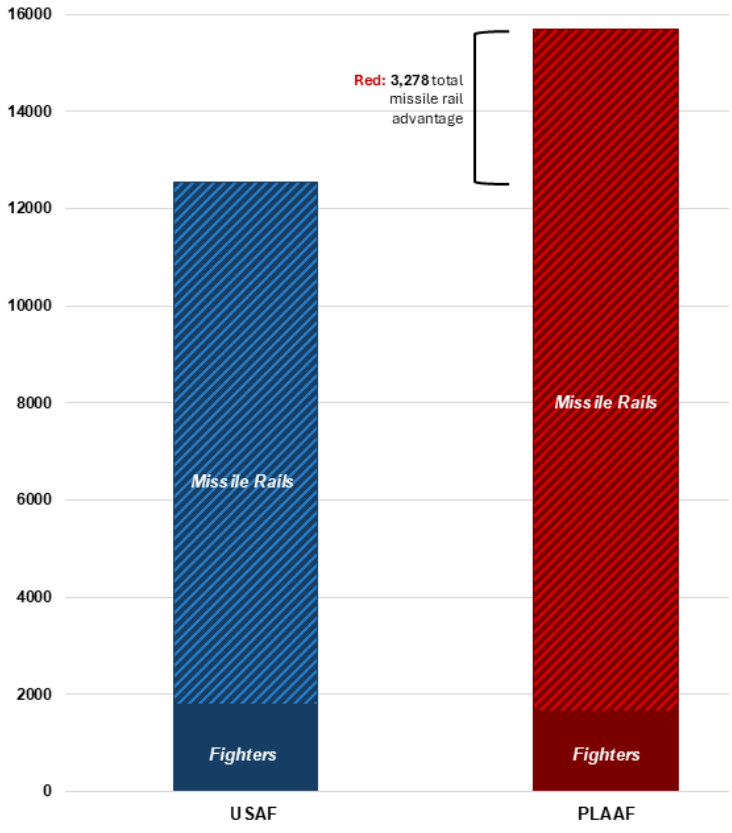


TABLE 1: NUMBER OF MISSILE RAILS TO FIGHTERS FOR USAF AND PLAAF (FY2025)

USAF TYPE	# OF AIRCRAFT	RAILS PER JET	# OF RAILS
F-16	813	6	4,878
F-35	474	4	1,896
F-15E	218	8	1,744
F-22	185	8	1,480
F-15C/D	82	8	656
F-15EX	9	12	108
TOTAL	1,781	-	10,762

PLAAF TYPE	# OF AIRCRAFT	RAILS PER JET	# OF RAILS
J-10	608	8	4,864
J-16	330	10	3,300
J-20	308	6	1,848
J-11	245	10	2,450
Su-30	97	10	970
Su-27	32	10	320
Su-35	24	12	288
TOTAL	1,648	-	14,040

Sources and Notes: For Figure 4, USAF and PLAAF fighter inventory is from *The Military Balance 2026* (IISS). For Table 1, several factors combine to determine how many air-to-air missiles a single aircraft can carry. The listed number of missile rails per aircraft is a general assumption based on review of available aircraft performance manuals and analysis of aircraft imagery. For fighter aircraft with weapons bays, such as the F-35, the number of rails assumes that the only missiles carried are within the weapons bay. The PLAAF's four J-35s are omitted from both Figure 4 and Table 1 as its number of rails per jet is unknown.

Rather than mimicking the attributes of a fifth- or sixth-generation fighter, a CCA with a larger airframe, longer range, greater endurance, larger payload, and an appropriate signature represents a superior HVAA protection option. The protection mission, unlike high-performance aerial combat, benefits from an aircraft that can remain airborne for extended periods while carrying a substantial missile payload. A formation of CCAs with these attributes could more efficiently protect HVAA than a formation of highly capable, multi-mission, manned fighters. Furthermore, incorporating an active counter-missile capability could fundamentally alter long-range aerial combat.

Degrading the PLAAF

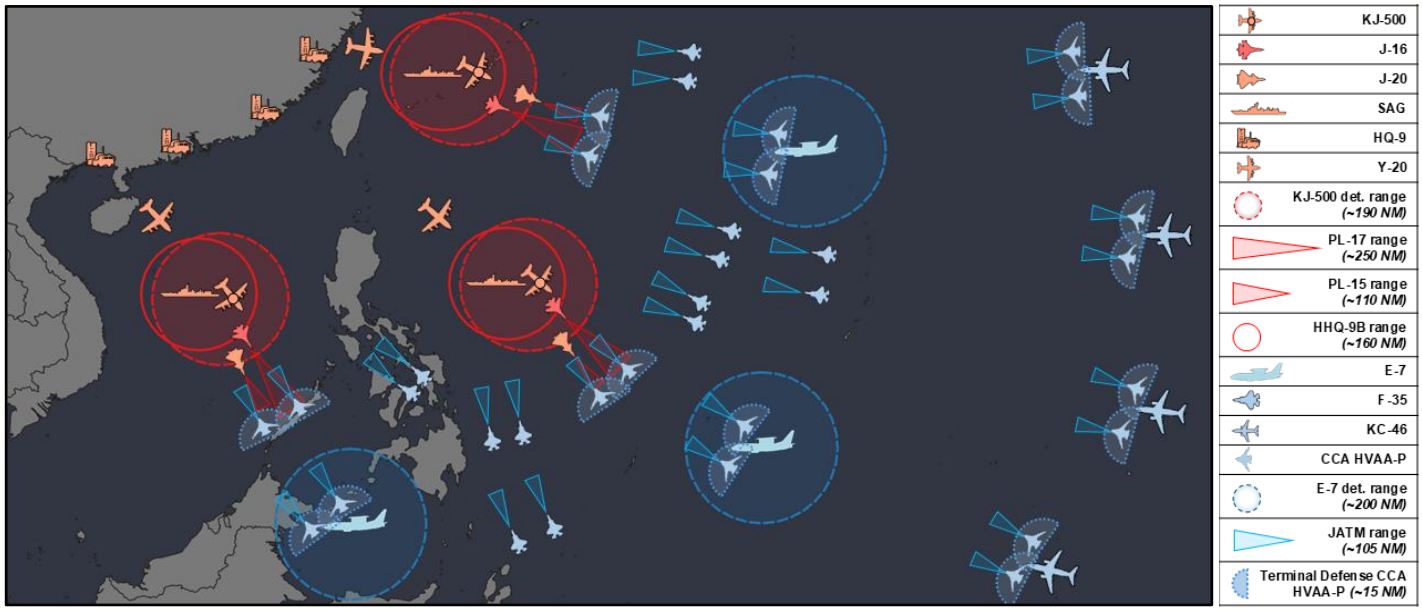
Emphasizing CCAs for HVAA protection could help the Air Force bridge the firepower gap and break the protection paradox. A CCA purposely built to carry a significant payload of air-to-air missiles could maximize

firepower and protection, freeing Air Force fighters for dedicated offensive counterair missions. CCAs capable of protecting vital HVAA could shore up the crucial long-range engagement information and fuel that U.S. fighters require. This may thwart a key objective of the PLAAF's systems destruction warfare (SDW) concept while simultaneously unleashing U.S. fighters to inflict direct attrition on the PLAAF.[21] Exploring the potential for terminal missile engagements may even tilt the balance of power in the defender's favor.

For example, a notional force of 150 CCAs armed with four missiles each would yield an additional 600 total missile rails for long-range air-to-air engagements. An ability to carry six missiles each would boost the Air Force's launch opportunities to 900.[22]

Earlier, the estimated U.S. HVAA protection tax was 400 fighters. Using the previous basic force-planning assumptions and a one-for-one swap, 400 HVAA protection CCAs could dramatically reduce the tax on firepower and restore near-quantitative fighter parity. Against other air forces, if HVAA are at significantly lower risk, the proposed CCA's range, endurance, and payload could be tailored to a range of alternative missions.

FIGURE 5: CCA-BASED HVAA PROTECTION IN THE WESTERN PACIFIC



Notes: This figure updates the legacy HVAA protection tactics by relying on CCA for protection, freeing fighters for offensive missions, while leveraging CCA for the additional defensive mission of terminal defense against incoming PL-17 missiles. Map created by CSBA staff.

[21] The PLA intends to focus its efforts on crippling and destroying U.S. hubs of information fusion and direction. Air Force HVAA are airborne versions of the types of targets the PLA's SDW intends to destroy." PLA literature calls for strikes that degrade or disrupt the flow of information within the adversary's operational system." Jeffrey Engstrom, "Systems Confrontation and System Destruction Warfare: How the Chinese People's Liberation Army Seeks to Wage Modern Warfare," *RAND Corporation*, 2018, 16.

[22] Missile rails without missiles are ineffective. Thus, increasing the U.S. air-to-air missile production rate and the number of rails are symbiotic efforts.

Air-to-air combat relies on first-look and first-shot advantages, presently achieved via reduced aircraft signatures, increased missile launch ranges, and networked information. Yet, the increasing amount of sensor fusion makes remaining completely undetected problematic. Additionally, as missile ranges increase, air forces face a dilemma: either build ever-longer-range weapons to retain a first-shot advantage or explore novel options for survival within missile launch ranges. Developing an interceptor system for active missile defense could address the emerging situation in which avoiding a missile engagement is improbable, but remaining far enough away is ineffective, creating another defensive CCA mission. If viable, this concept could negate the billions Beijing spent on long-range counter-HVAA air-to-air kill chains. Tailoring future CCAs for HVAA protection via active missile defense could not only reduce the protection tax but also spark a new aerial competition.

This terminal defense concept may offer advantages in other scenarios. The PLAAF fields a diverse array of increasingly long-range surface-to-air missiles (SAMs), also designed to detect and engage U.S. HVAA, such as the HQ-9.[23] These missiles have a plunging, vertical final attack profile, the same as a long-range air-to-air missile.[24] These shared terminal parameters could enable a CCA to engage long-range air-to-air missiles and also defeat long-range SAMs. Active terminal engagement could upend the attack-versus-suppression dilemma against surface-to-air systems. An aircraft capable of establishing a limited protection bubble may also help protect and escort other non-HVAA aircraft, such as electronic attack, strike, and airlift aircraft, into previously denied areas.

Meeting Today's Challenge and Stealing the Next March

The PLAAF has invested billions of yuan over decades to reach its contemporary state. As such, there is no panacea for achieving air dominance, or even temporary air superiority against the PLAAF. Rather, combining a host of investments, adaptations, and new concepts offers promise for countering today's threat. Prioritizing the HVAA protection mission, enabled by missile payload and endurance for Increment Two CCAs, can increase the survivability of critical U.S. aerial assets and maximize aerial combat effectiveness.[25]

Contemporary aerial combat's long-range kill chains require protecting HVAA. This adds a dimension to the legacy challenge of balancing firepower and protection. The novel concept of specialized CCAs designed to maximize missile payload and provide adequate endurance for HVAA protection could break this paradox. By doing so, it offers promise for upscaling a tactical advantage over the PLAAF for strategic effect.

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[23] The HHQ-9B is a sea-based HQ-9. The missile may have a maximum engagement range greater than 160 NM (300 km). J. Michael Dahm, "Offensive and Defensive Strike," *Johns Hopkins Applied Physics Laboratory*, 2021, 6.

[24] For a maximum range engagement, a missile likely flies a highly parabolic flight path, with a terminal plunge down towards the intended target. This flight path is similar to how a football thrown to a deep wide receiver has a highly parabolic flight path.

[25] The Air Force may consider several other options to further grow its aerial firepower. This could include incorporating air-to-air combat options into non-fighter aircraft, such as bombers. Gregory Malandrino and Thomas G. Mahnken, "What's in a Name? Fighters, Bombers and Modern Aerial Combat," *Defense News*, July 3, 2025, https://www.defensenews.com/opinion/2025/07/03/whats-in-a-name-fighters-bombers-and-modern-aerial-combat/.

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