

MITCHELL INSTITUTE
for Aerospace Studies



**Collaborative Combat Aircraft
for Disruptive Operations**

**Mitchell Institute CCA Wargame
Executive Summary**



Problem statement

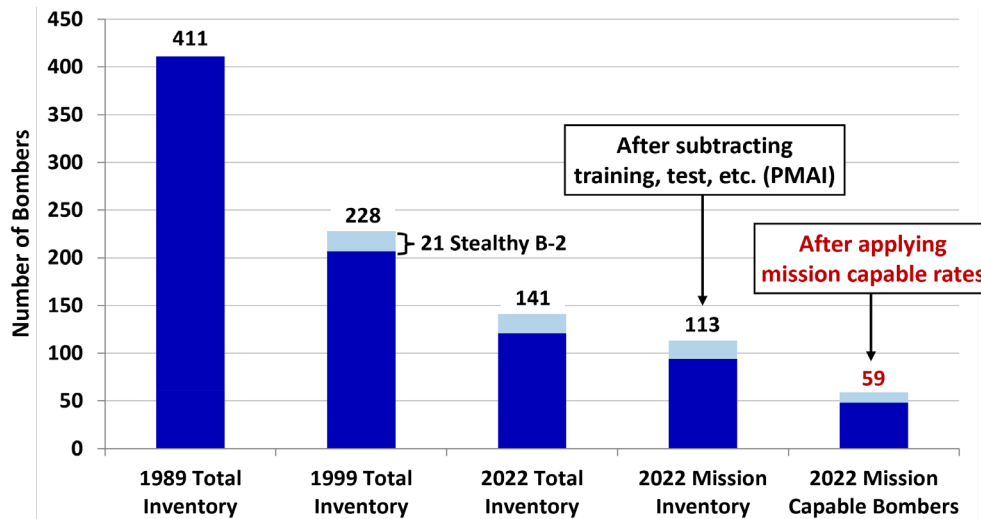
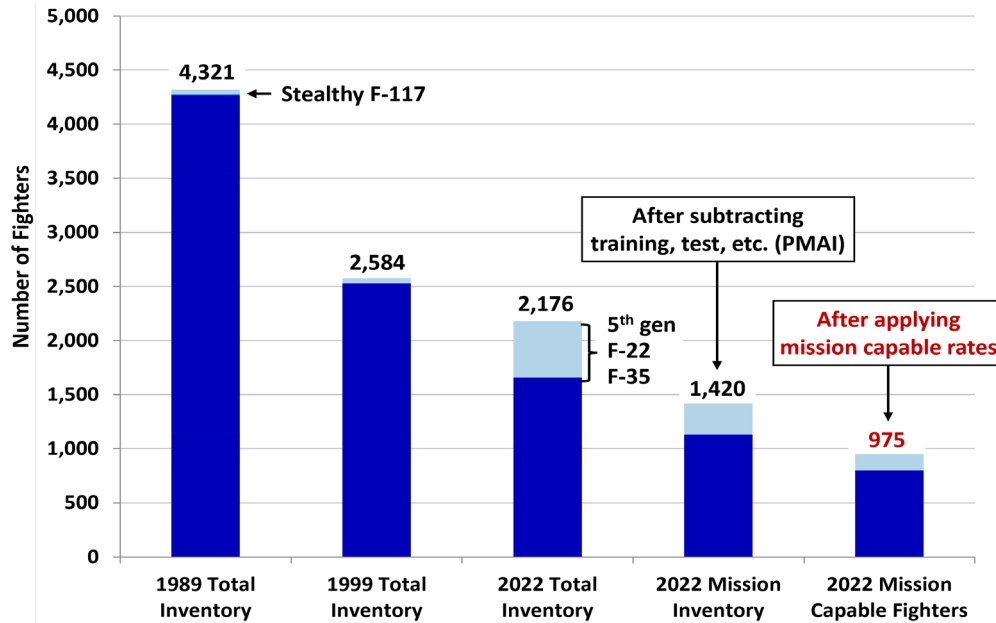
The Air Force currently lacks:

- **Sufficient force capacity to achieve the degree of air superiority needed to defeat the pacing threat**
- **Air-to-air and air-to-ground munitions inventories that are sized and shaped for peer conflict**
- **Resources to acquire enough “exquisite” capabilities to meet the Air Force’s global operational requirements**

Part of the solution: An “affordable mass” force design that prioritizes the acquisition of disruptive, cost-effective crewed and uncrewed combat systems including CCA



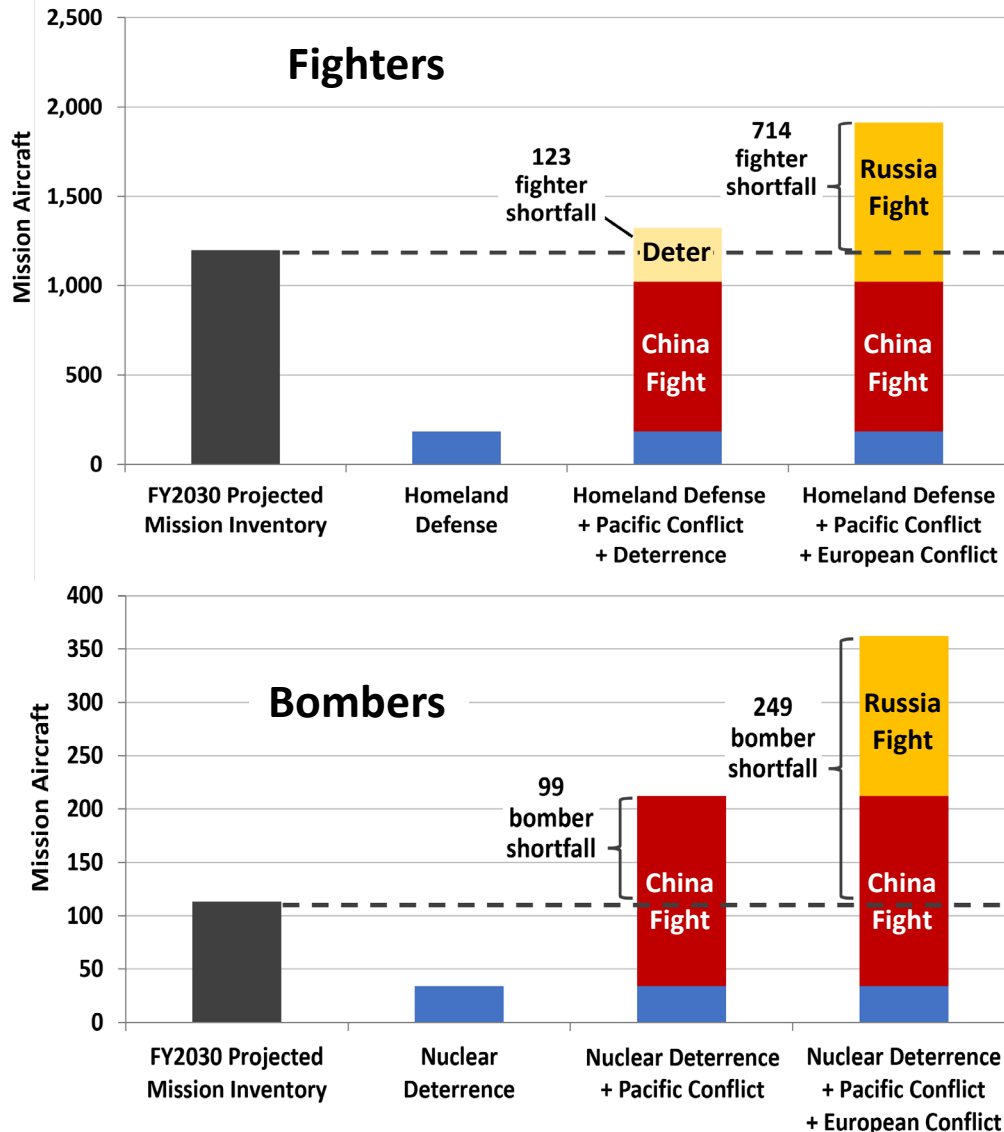
Background: The Air Force's current force design is the result of 30 years of cuts & deferred modernization



- The U.S. Air Force has lost half its fighters and two-thirds of its bombers since 1990
 - Attrition reserves are not sized for a peer conflict
- The Air Force's combat aircraft inventories have reached an unprecedented high average age
 - 80% of its fighters are past their original design lives
- Only about 20% of the Air Force's fighter and bomber mission aircraft are now stealthy



Background: Today's Air Force could run out of combat forces before it meets its operational requirements



- Fighter and bomber capacity fall short of requirements for a single peer conflict plus homeland defense and deterrence in other regions
- Shortfalls in Air Force mission capacity increase risk for all U.S. joint force operations
- No other U.S. service or Allied military can bring enough combat air capacity to fill existing gaps

Notes: Data on charts from studies directed by the NDAA to assess the USAF's aircraft requirements; fighter and bomber requirements adjusted for their mission capable rates



What are Collaborative Combat Aircraft (CCA)?



Uncrewed aircraft capable of operating with other crewed and uncrewed aircraft to perform missions in contested environments. CCA will employ “a distributed, mission-tailorable mix of sensors, weapons, and other mission equipment” and are intended to be “significantly less expensive” so they can be used as expendable or recoverable/atritable assets

(quotes from DAF Scientific Advisory Board)

- The Air Force is developing CCA for counterair operations, electromagnetic warfare, ISR, and other missions in highly contested environments
- **Premise for Mitchell Institute’s wargame series:** There is an ongoing need to refine CCA requirements, develop and assess new CCA operating concepts for disruptive air warfare, and understand logistics, forward postures, and other capabilities to support a CCA force design



MI is leading wargames and conducting analyses to better understand how CCA could contribute to the AF's force design

Sample questions addressed by teams of warfighters, technologists, and defense industry experts during a 2023 Mitchell counterair wargame (defense of Taiwan scenario, 2030)

- **Assess force design shortfalls:** What are some of your force's most significant counterair capability gaps and other disadvantages a peer adversary could exploit?
- **Develop operating concepts:** How could CCA operate with crewed 5th and 6th gen combat aircraft to mitigate these gaps and improve counterair mission effectiveness in highly contested environments?
- **Determine force mix and scale:** What mixes of CCA and crewed combat aircraft would improve the potential for counterair mission success and reduce mission attrition?
 - How will you employ your CCA (missions, tasks, other) and why?
 - What are some of the most significant advantages of using CCA for your mission?
- **Other CCA design features, technologies, capabilities** needed for your CONOPs?
- **CCA forward operating locations:** What are your proposed CCA operating locations, threats to sortie generation, and sustainment requirements?



Top-level insights

Future Force Design

- DOD cannot afford a warfighting strategy and force design that seek to match the PLA aircraft-for-aircraft, missile-for-missile, ship-for-ship
 - Must develop asymmetric capabilities and operating concepts that prevent the PLA from achieving its campaign objectives
- CCA can help **disrupt** the PLA's counterair operations, **degrade** its battlespace awareness, and **achieve the degree of air superiority** needed for mission success
 - Employing CCA at scale could help offset the PLA's ability to mass superior combat capacity

MI has conducted multiple analyses to inform the AF's force design





Top-level insights (continued)

Force Capacity

- CCA can increase the density of sensors, weapons, and other mission systems the AF can project at range into contested areas
- CCA can enable non-stealthy fighters and bombers to contribute to the highly contested environment air superiority fight

Lethality

- CCA can help close sensor–weapon range gaps to achieve first-look/first-shot advantage
- Weaponized CCA must be designed with at least enough survivability to reach their weapon release points

Survivability

- CCA can help reduce U.S. force attrition in highly contested environments
- Dispersing and periodically relocating CCA operations would complicate PLA airbase targeting and improve resiliency of U.S. sortie generation operations

Maximizing CCA advantages requires a shift in thinking

- CCA can be more than adjuncts to crewed aircraft
- CCA could operate as lead forces to disrupt enemy air defenses – may require design attributes and additional mission systems that increase CCA costs

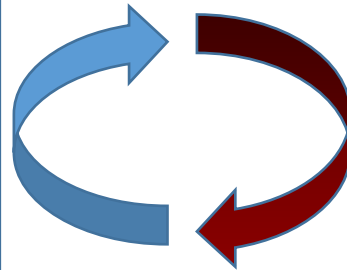


2023 CCA wargame methodology

Air Force/industry “Blue” mission planning teams and a “Red” team playing the PLA responded to each other’s moves

Blue Team Tasks

- **Develop and operating concept for your assigned mission**
- **Develop force packages using provided force lists (includes CCA variants team can select from)**
- **Determine basing posture, key logistics support (including aerial refueling), C2, and autonomy needed**



Red Team Tasks

- **Observe and assess Blue Team mission planning**
- **Identify key Blue Team operational vulnerabilities including basing and logistics**
- **Develop Red countermeasures to:**
 1. **Deny Blue mission success**
 2. **Impose attrition**



Wargame methodology: 3 “blue teams” independently planned counterair missions in a defense of Taiwan scenario

TEAM OLDS

First 2 day of campaign:

Plan to suppress surface-to-air threats on three SAGs screening NE of the Taiwan Strait; priority targets include Dragon Eye radars on Type 052C destroyers

Next 2 weeks:

Update plan and requested forces to sustain ops to suppress air and missile defenses on designated PLA SAGs and suppress mobile SAMs deployed to the PLA’s amphibious landing beachhead

Mission:

Suppression/Destruction of Enemy Air Defenses

TEAM CHENNAULT

First 2 days of campaign:

Plan to suppress PLA fighters and their airborne BMC2 in advance of U.S. penetrating strike pulses



Next 2 weeks:

Update plan and requested forces to sustain operations to suppress PLA fighters and their airborne BMC2 in advance of U.S. penetrating strike pulses

Mission:

Offensive Counterair “Sweep”

TEAM BOYD

First 2 days of campaign:

Plan to suppress the PLA’s long-range counterair kill chains (includes KJ-500s) and other threats to U.S. high value airborne aircraft (HVAA) supporting Allied operations



Next 2 weeks:

Update plan and requested forces to sustain counterair operations to suppress the PLA’s long-range counterair kill chains and other threats to U.S. HVAA aircraft

Mission:

Offensive and Defensive Counterair

Non-attributable

Greater \$40 million

CCA-1: Counterair

- Survivability: VLO (Supersonic)
- Range: 2,000 nm (capable)
- Sensors: AESA, IRST
- Weapons: 2 x SiAW, 4 x AMRAAM
- Takeoff: Runway independent
- Landing: 5,000 ft

CCA-2: Counterair

- Survivability: VLO (Supersonic)
- Range: 3,000 nm (capable)
- Sensors: AESA, IRST
- Weapons: 2 x SiAW; 2 x JATM
- Takeoff: Runway independent
- Landing: 5,000 ft

- Notional CCA missions, capabilities, and categorization provided by warfighters and technological and defense industry experts during Mitchell Institute's 2022 wargame
- 2023 wargame players chose from these notional CCA designs

Recoverable/Attributable

\$15-40 million

CCA-3: Counterair

- Survivability: VLO
- Range: 3,000 nm
- Sensors: AESA, IRST
- Weapons: 6 x AMRAAM
- Takeoff and landing: 5,000 ft

CCA-4: Counterair / SEAD

- Survivability: VLO
- Range: 3,000 nm
- Sensors: SAR, ATR
- Weapons: 6 x SiAW
- Takeoff and landing: 5,000 ft

CCA-6: Strike

- Survivability: No LO
- Range: 1,000 nm
- Sensor: None
- Weapons: 2 x LRASM
- Takeoff and landing: 5,000 ft

Mission needs

\$2-15 million estimated flyaway unit cost

CCA-9: ISR, Communications

- Survivability: LO
- Range: 1,000 nm
- Sensor: SAR
- Weapons: None
- Takeoff & landing: Road, runway

CCA-10: Electronic Attack

- Survivability: VLO
- Range: 3,000 nm
- Sensor: EW pod
- Weapons: None
- Takeoff and landing: 5,000 ft

LO/VLO = Low/very low observable
 SiAW = Stand-in Attack Weapon
 JATM = Joint Advanced Tactical Missile
 LRASM = Long Range Anti-Ship Missile
 ATR = Automatic target recognition

CCA-5: Counterair

- Survivability: LO
- Range: Greater than 650 nm
- Sensors: Low-cost passive
- Weapons: 2 air-to-air weapons
- Air-launched, ground by rocket

CCA-7: Strike/ISR (loitering)

- Range: 1,000 nm rocket launched
- Sensor: Low-cost EO/IR
- Each CCA-7 deploys 20 small loitering PGMs with warheads

CCA-8: Strike/ISR (loitering)

- Range: 600 nm
- Survivability: VLO
- Sensor: Low-cost synthetic-aperture radar
- Air-launched, 500 lb. warhead

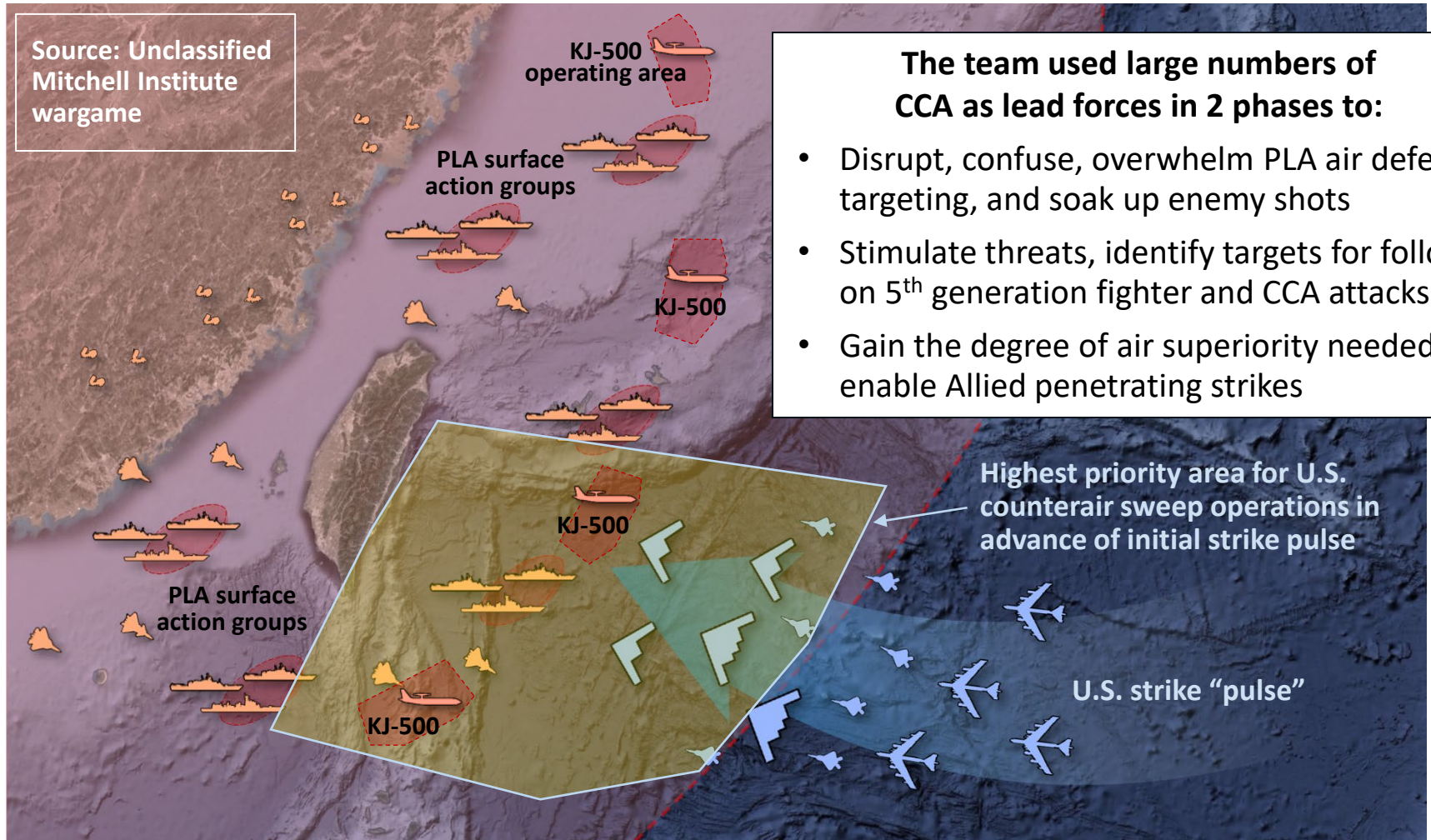
Expendable



“Sweep” Blue Team disruptive counterair operating concept

Team was tasked to plan a sweep operation to gain air superiority needed to enable a follow-on Allied strike pulse

Source: Unclassified Mitchell Institute wargame



The team used large numbers of CCA as lead forces in 2 phases to:

- Disrupt, confuse, overwhelm PLA air defense targeting, and soak up enemy shots
- Stimulate threats, identify targets for follow-on 5th generation fighter and CCA attacks
- Gain the degree of air superiority needed to enable Allied penetrating strikes

Highest priority area for U.S. counterair sweep operations in advance of initial strike pulse

U.S. strike "pulse"



Sweep team phase #1 operations ("Brawler" force pulse)

Counterair Sweep Phase #1 (called a "Brawler pulse" by team): Used multiple waves of lower-cost CCA to identify and target KJ-500 and other PLA high-value combat aircraft while complicating enemy countermeasures

A wave of long-range CCA (including CCA-5s carrying 3 JATMs each) launched from dispersed ground locations and B-52s penetrated from multiple directions to confuse enemy targeting, act as decoys, identify enemy high-value airborne assets (KJ-500s), and strike airborne threats

Overall objective was to degrade the enemy's air defense kill chains and enable strikes during a follow-on phase of operations

Forces requested to support the counterair sweep Phase #1 CONOPs:

- **130 uncrewed:** 110 CCA-5 (50% ground-launched, 50% air-launched from 3 B-52s carrying 10 CCA-5 each); 10 F-15EX with 2 CCA-5 each; 30 CCA-10; and MQ-9 Reapers to act as comms relays
- **24 5th gen fighters:** 8 F-22 (two 4-ships) and 16 F-35 (two 8-ships) for operations and rapid transition to Counterair Sweep Phase #2 operations
- **HVAA:** 2 E-7s on station; every U.S. HVAA provided with a kit to command and control crewed and uncrewed aircraft



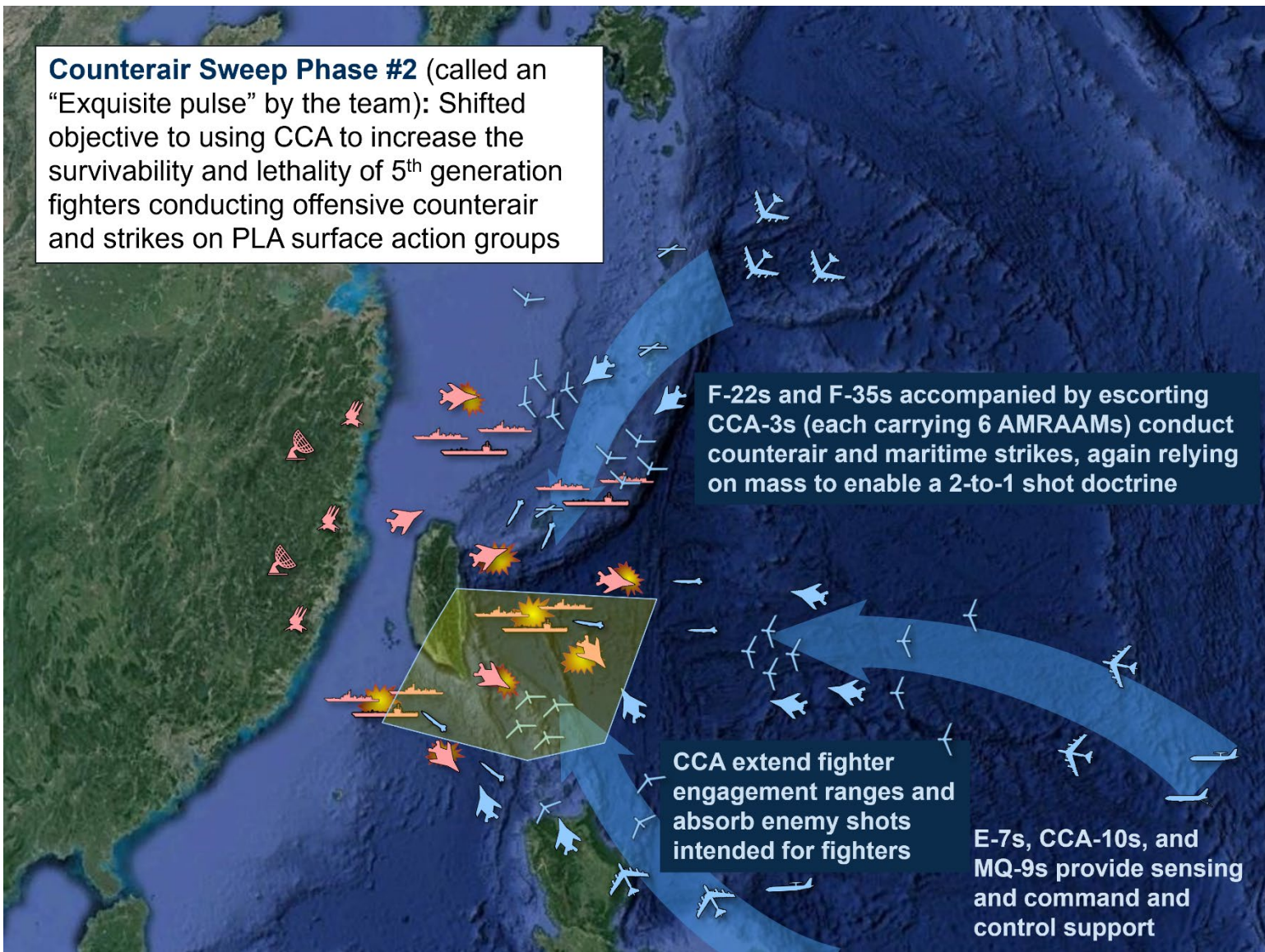
Sweep team phase #2 operations ("Exquisite" force pulse)

Counterair Sweep Phase #2 (called an "Exquisite pulse" by the team): Shifted objective to using CCA to increase the survivability and lethality of 5th generation fighters conducting offensive counterair and strikes on PLA surface action groups

F-22s and F-35s accompanied by escorting CCA-3s (each carrying 6 AMRAAMs) conduct counterair and maritime strikes, again relying on mass to enable a 2-to-1 shot doctrine

CCA extend fighter engagement ranges and absorb enemy shots intended for fighters

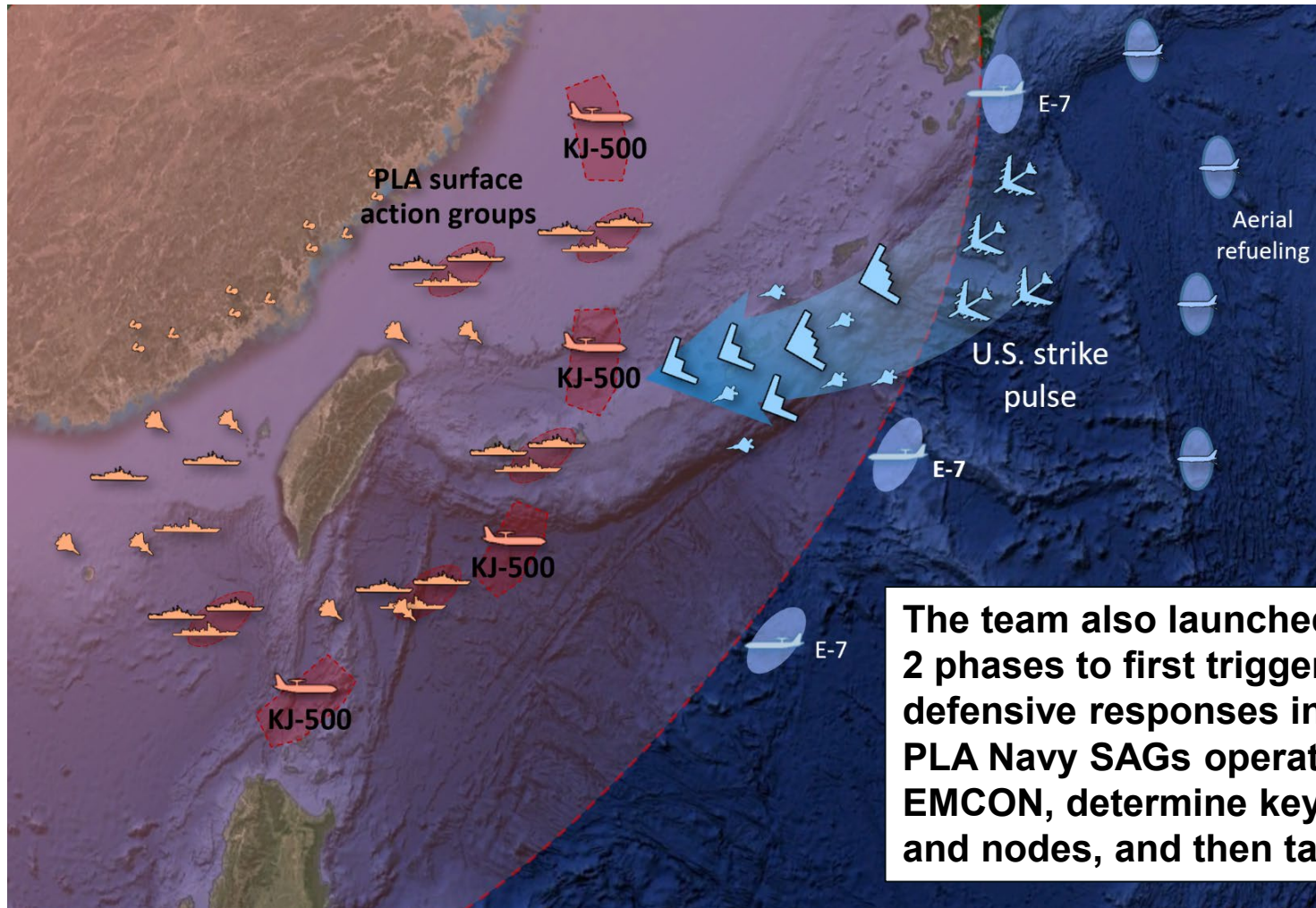
E-7s, CCA-10s, and MQ-9s provide sensing and command and control support





“HVAA protect” Blue Team disruptive counterair operating concept

Team was tasked to suppress PLA long-range air-to-air kill chains and defend Allied high-value aircraft (E-7s, tankers) supporting a strike pulse

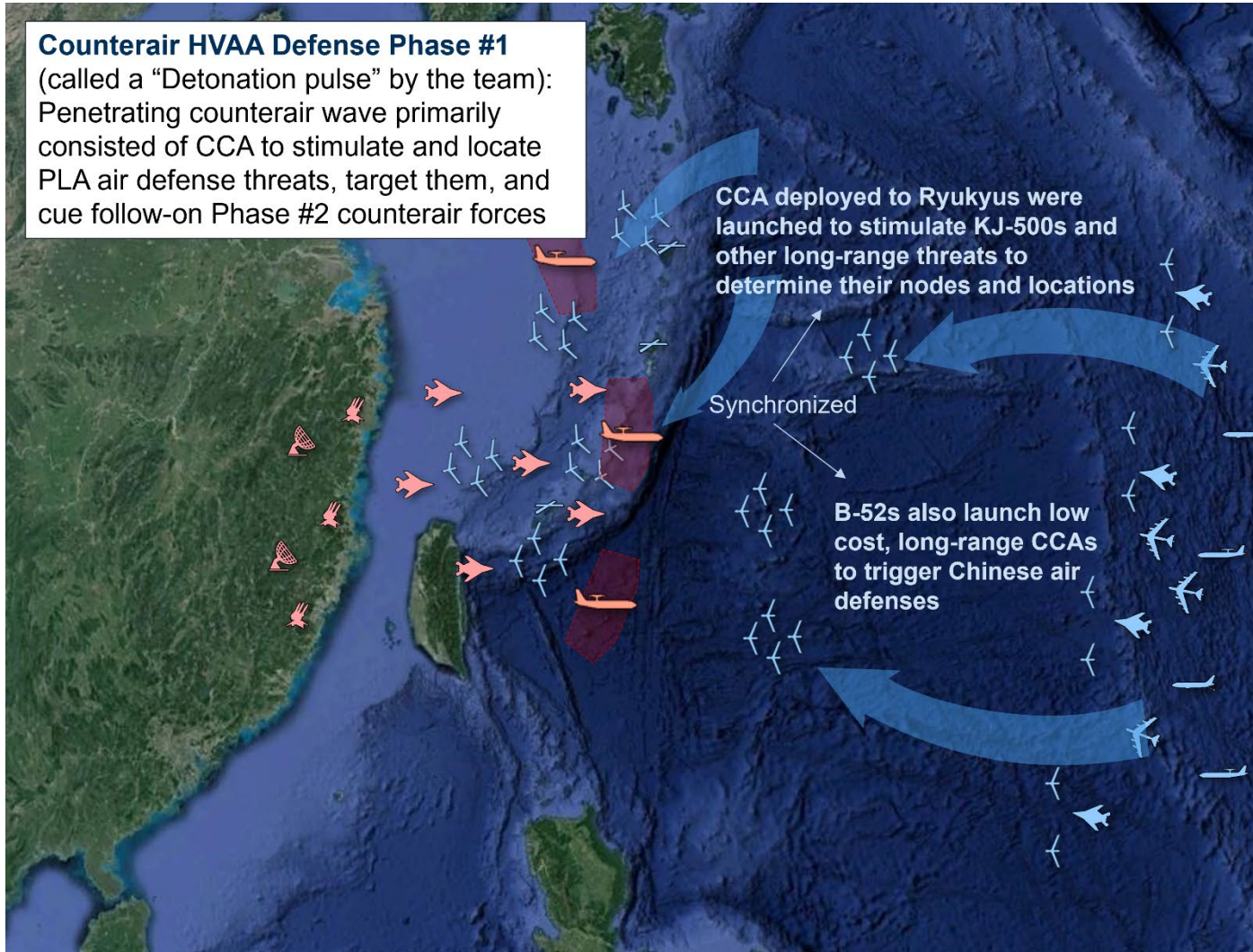


The team also launched aircraft in 2 phases to first trigger PLA defensive responses including by PLA Navy SAGs operating in EMCON, determine key threats and nodes, and then target them



HVAA protect team phase #1 operations (“Detonation” force pulse)

Counterair HVAA Defense Phase #1
(called a “Detonation pulse” by the team):
Penetrating counterair wave primarily consisted of CCA to stimulate and locate PLA air defense threats, target them, and cue follow-on Phase #2 counterair forces



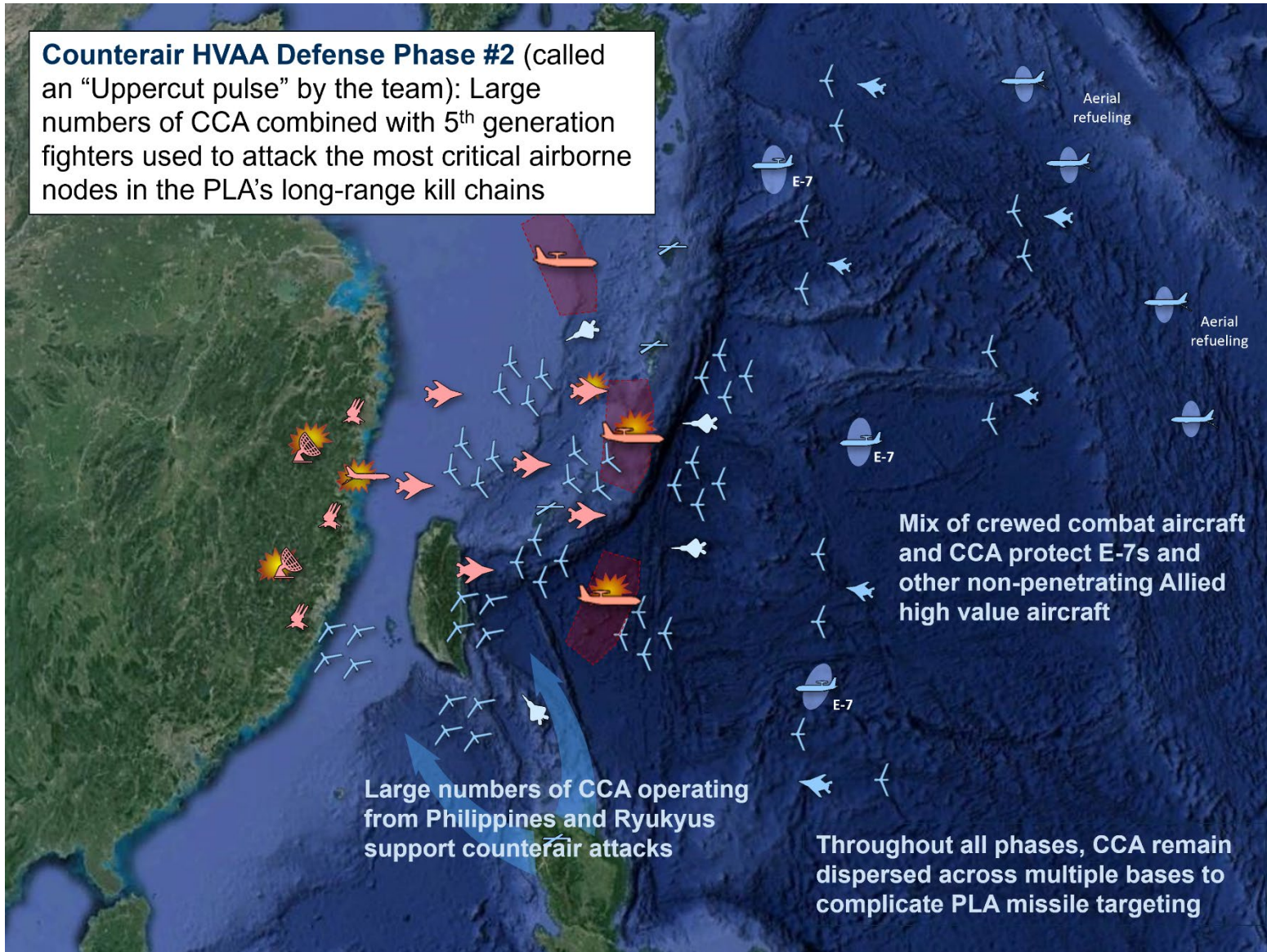
Forces requested to support the HVAA defense CONOPs (roughly 3:1 uncrewed / crewed ratio)

- **112 uncrewed:** 52 CCA-5s with non-cooperative ID capability, 30 CCA-9, 30 CCA-10 jammers, and 18 CCA-3 with runway independence
- **40 5th gen fighters:** 16 F-22 Raptors, 24 F-35s (with Sidekick modification for 6 internal AMRAAM)



HVAA protect team phase #2 operations (“Uppercut” force pulse)

Counterair HVAA Defense Phase #2 (called an “Uppercut pulse” by the team): Large numbers of CCA combined with 5th generation fighters used to attack the most critical airborne nodes in the PLA’s long-range kill chains



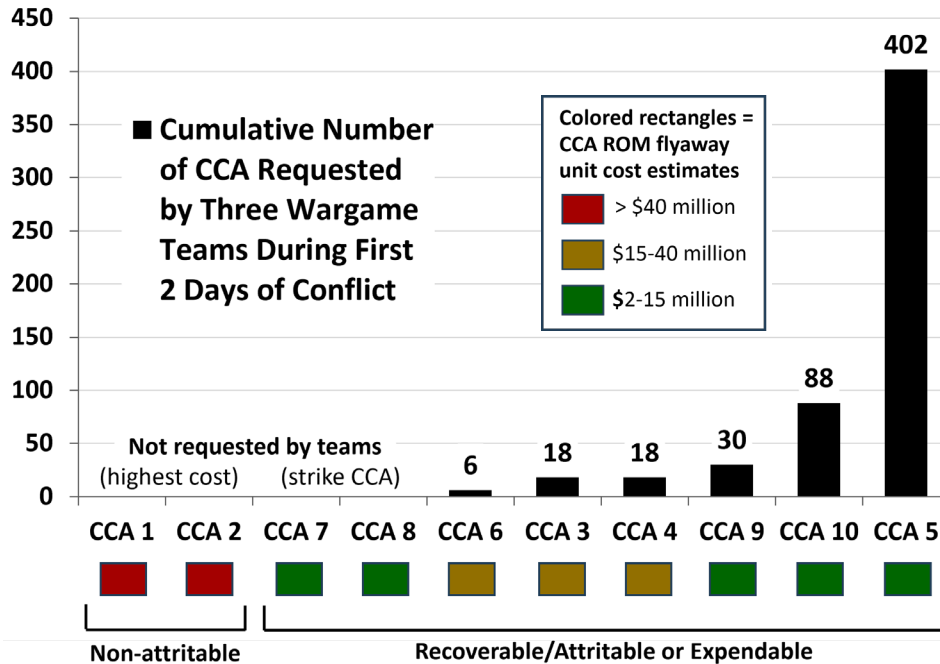
Mix of crewed combat aircraft and CCA protect E-7s and other non-penetrating Allied high value aircraft

Large numbers of CCA operating from Philippines and Ryukyus support counterair attacks

Throughout all phases, CCA remain dispersed across multiple bases to complicate PLA missile targeting

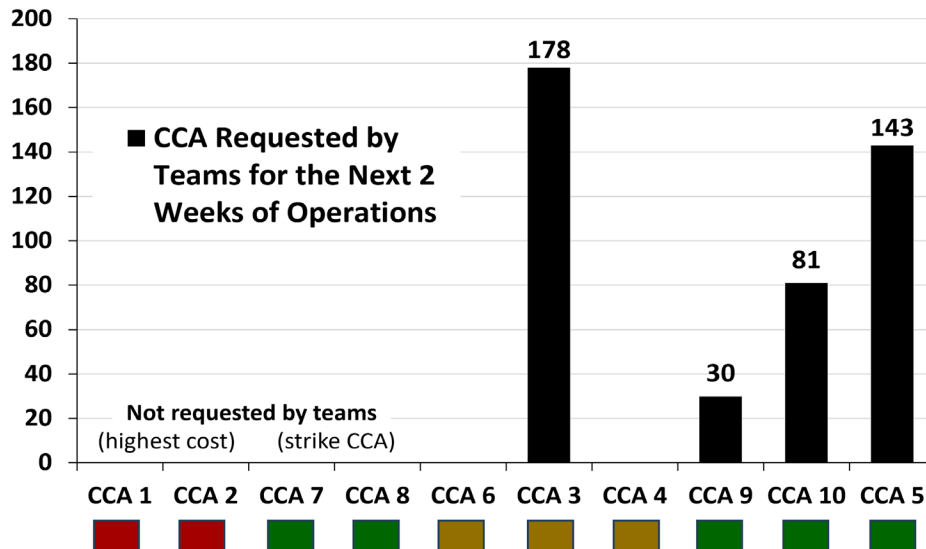


Teams overwhelmingly chose to use long-range CCA to conduct disruptive, cost-imposing operations



First 2 days of air campaign:

Used large numbers of more expendable, lower-cost CCA that could be launched by aircraft or from the ground off airbases (CCA-5, CCA-10, CCA-9) to disrupt the PLA's counterair ops and compel it to expend defenses on uncrewed systems



Next 2 weeks of air campaign:

Shifted toward more capable recoverable/attributable CCA-3s to increase air-to-air weapons density and create a distributed posture to counter PLA airbase attacks



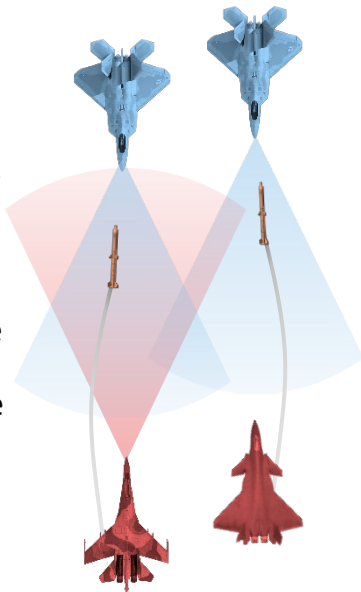


Engagement level insight: CCA can help maintain a first-look, first-shot advantage

- **Emerging threat:** PLA long-range kill chains (J-16, J-20, very long-range PL-17/PL-xx air-to-air weapons) increase risk to Allied air forces
- **Opportunity:** CCA can help close sensor and weapon range gaps to maintain first-look, first-shot advantage (must be designed with sensors & weapons that have sufficient range)

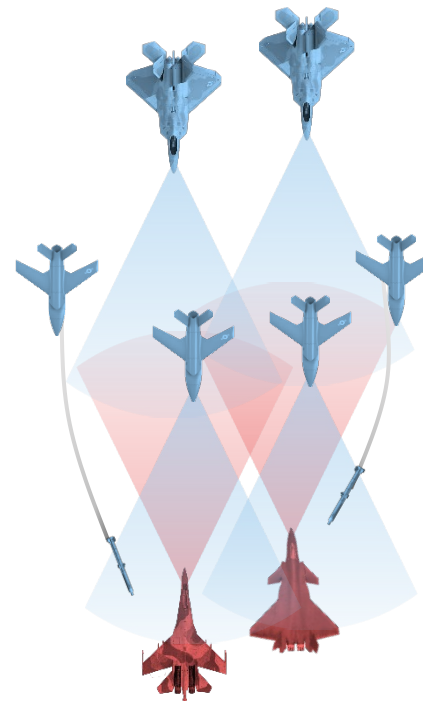
Fighters operating in contested environments without CCA

An adversary fighter (red) may have a first look, first shot advantage in engagements where its sensors and weapons exceed the opposing fighter's (blue) sensors and weapons



An adversary with "home field advantage" cued by off-board sensors and launches its long-range weapons before the friendly fighter can detect the threat

CCA can increase fighter sensor/weapon ranges and lethality



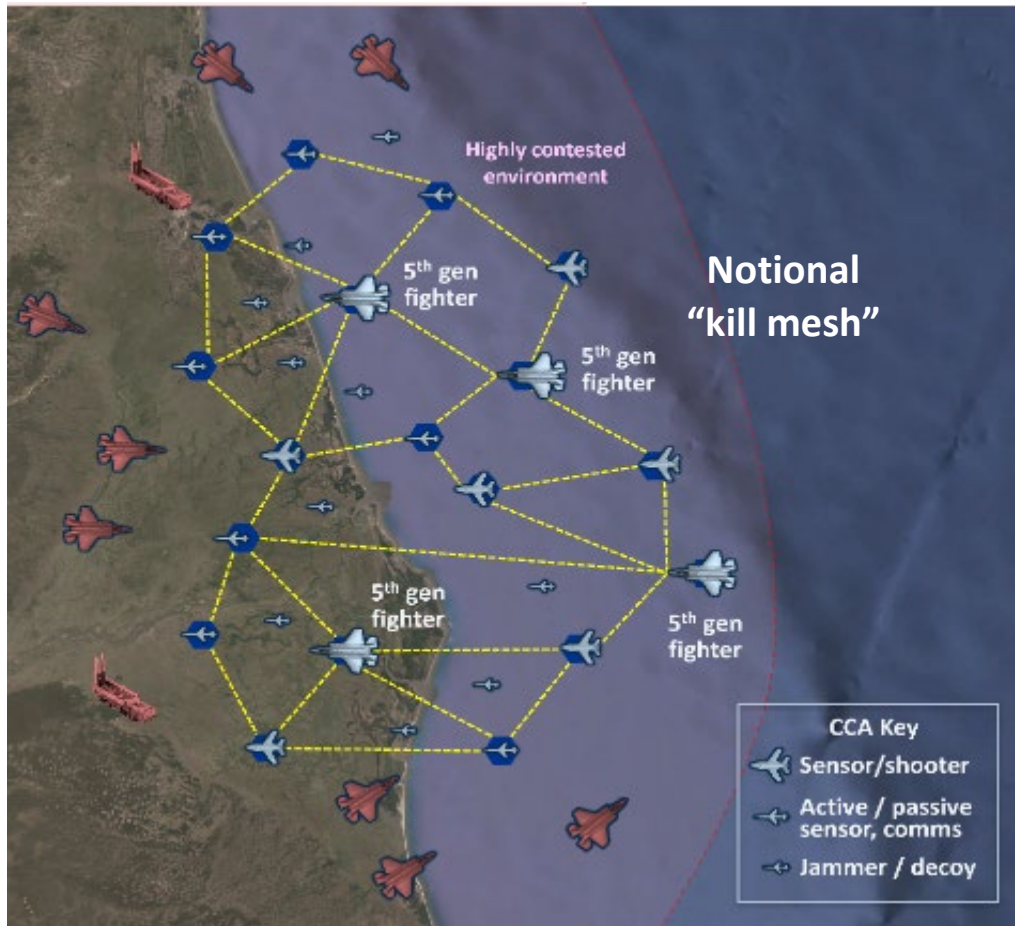
Manned aircraft sensor range

CCA extend sensor and weapon ranges and generate intercept quality tracks before enemy fighters are within launch range



CCA can also form part of kill meshes to increase survivability & lethality in highly contested environments

- Kill meshes would increase options for crewed fighters to detect, avoid, and counter enemy defenses in dense, 360-degree threat environments



- Creating a more heterogeneous force mix, spreading sensing, comms, and other functions across meshes would complicate an enemy's ability to identify nodes and other targets
- Employing large numbers of lower-cost CCA could help deplete PLA air defenses, impose costs, and open the path to follow-on crewed and uncrewed forces



Recommendations

- **Assess CCA design and cost tradeoffs to define requirements**
 - Seek the right balance of CCA attributes such as their sizes, ranges, payload capacity, low observability, and mission systems—all of which influence unit costs—with risk and missions they must perform
 - Determine a cost-effective mix of CCA for the AF's future force design
- **Develop operating concepts for using CCA as lead forces to disrupt China's air and missile defenses and other A2/AD operations**
 - Identify enemy battle management nodes and other high-value targets for attacks, complicate enemy targeting, compel defenses to expend their weapons
- **CCA are complementary and additive to 5th and 6th gen aircraft requirements – a counterair family of systems is needed in greater capacity to disrupt and defeat a PLA campaign**
 - CCA will be force multipliers, could enable the creation of kill meshes that increase lethality of current forces, and help offset emerging shortfalls in air-to-air engagement ranges



Recommendations (continued)

- **Weaponized counterair CCA must have enough survivability to reach their air-to-air missile launch points**
- **Acquire CCA at scale this decade to increase the USAF's capacity to project affordable counterair mass at range into contested areas**
 - CCA weapon “trucks” could increase the AF's sensor & weapons density at range and multiply effects created by 5th/6th gen fighters
- **Determine supporting capabilities to sustain a high tempo of CCA operations in the Indo-Pacific**
 - Operating locations, theater lift to replenish and sustain distributed CCA sortie generation, prepositioning requirements (like containerized CCA and logistics), personnel requirements, capabilities to merge CCA and crewed aircraft operating from multiple locations



Recommendations (continued)

- **Field CCA that can reduce the Air Force's dependence on main operating bases in the Indo-Pacific and other theaters**
 - CCA that can launch/recover from shorter runways or without runways would complicate the PLA's ability to find, fix, and attack USAF combat air forces where they are most vulnerable—on the ground and generating for sorties
- **As CCA designs are iterated, adapt current munitions and develop new munitions that increase CCA lethality**
- **DOD should work with Congress to increase Air Force funding to create a family of uncrewed CCA and 5th and 6th gen fighters for counterair operations**
 - The Air Force cannot continue to cannibalize its current forces to partially fund modernization – the force is now too small and the risk is too great



**The Next Frontier: UAVs
for Great Power Conflict**



**The Need for Collaborative
Combat Aircraft for
Disruptive Air Warfare**



By Col Mark A. Gunzinger, USAF (Ret.)
with Maj Gen Lawrence A. Stutzniem, USAF (Ret.)
and Bill Sweetman



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