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The Unmanned Combat Air System Carrier Demonstration Program:

A New Dawn for Naval Aviation?

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Our Aim Today

- **The 2006 Quadrennial Defense Review (QDR) directed the Department of the Navy to:**

  "…develop an unmanned longer-range carrier-based aircraft capable of being air-refueled to provide greater stand-off capability, to expand payload and launch options, and to increase naval reach and persistence."

- **The key first step toward achieving this transformational capability is the Navy's new Unmanned Combat Air System Carrier Demonstration Program (UCAS-D) and its associated technology maturation efforts**

- **The purpose of this morning's meeting is to:**
  - **Outline the rationale for inserting a carrier-based, air-refuelable, unmanned combat air system (N-UCAS) in future carrier air wings (CVWs)**
  - **Explain the importance of both the UCAS-D and technology maturation efforts toward developing operational N-UCASs**
  - **Urge Congress, OSD and the DoN to protect the UCAS-D/technology maturation program from institutional neglect or "death from a thousand cuts"**

Outline

- **Part I**
  - **Background and definitions**
  - **The importance of carrier aviation to American military power**
- **Part II**
  - **The US Navy and unmanned aircraft**
  - **The rationale for N-UCAS**
- **Part III**
  - **Preventing a missed opportunity**

CSBA's interest in the UCAS-D program derives from our work on future warfare

- **Since the mid-1990s, CSBA has explored radical changes in warfare**
  - **In particular, the US-initiated Guided Weapon/Battle Network Revolution**

- **The ramifications of this revolution have already been profound and will continue to influence future warfare**
  - **American dominance in guided weapons and battle networks has diminished the likelihood that future conflicts will be "traditional" force-on-force campaigns**

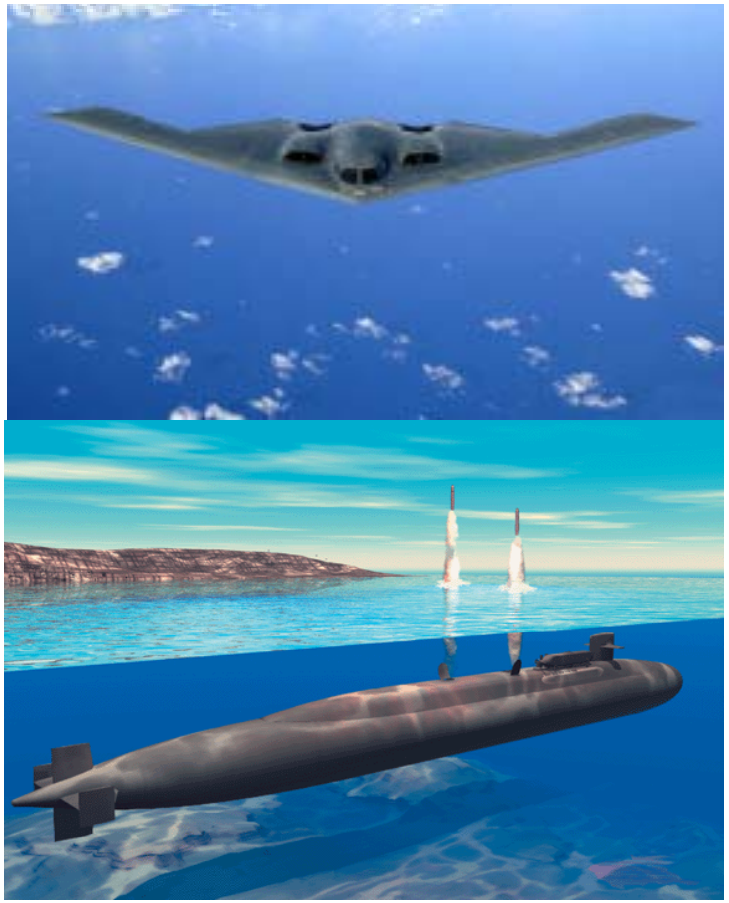
  - **At the same time, it has increased the likelihood that:**
    - **Many adversaries will turn to irregular warfare, and more ominously, "irregular warfare under high technology conditions" (e.g., Hezbollah's operations against Israel in southern Lebanon)**

    - **Some adversaries will seek nuclear weapons to deter the assembly of a US Joint Multi-dimensional Battle Network**

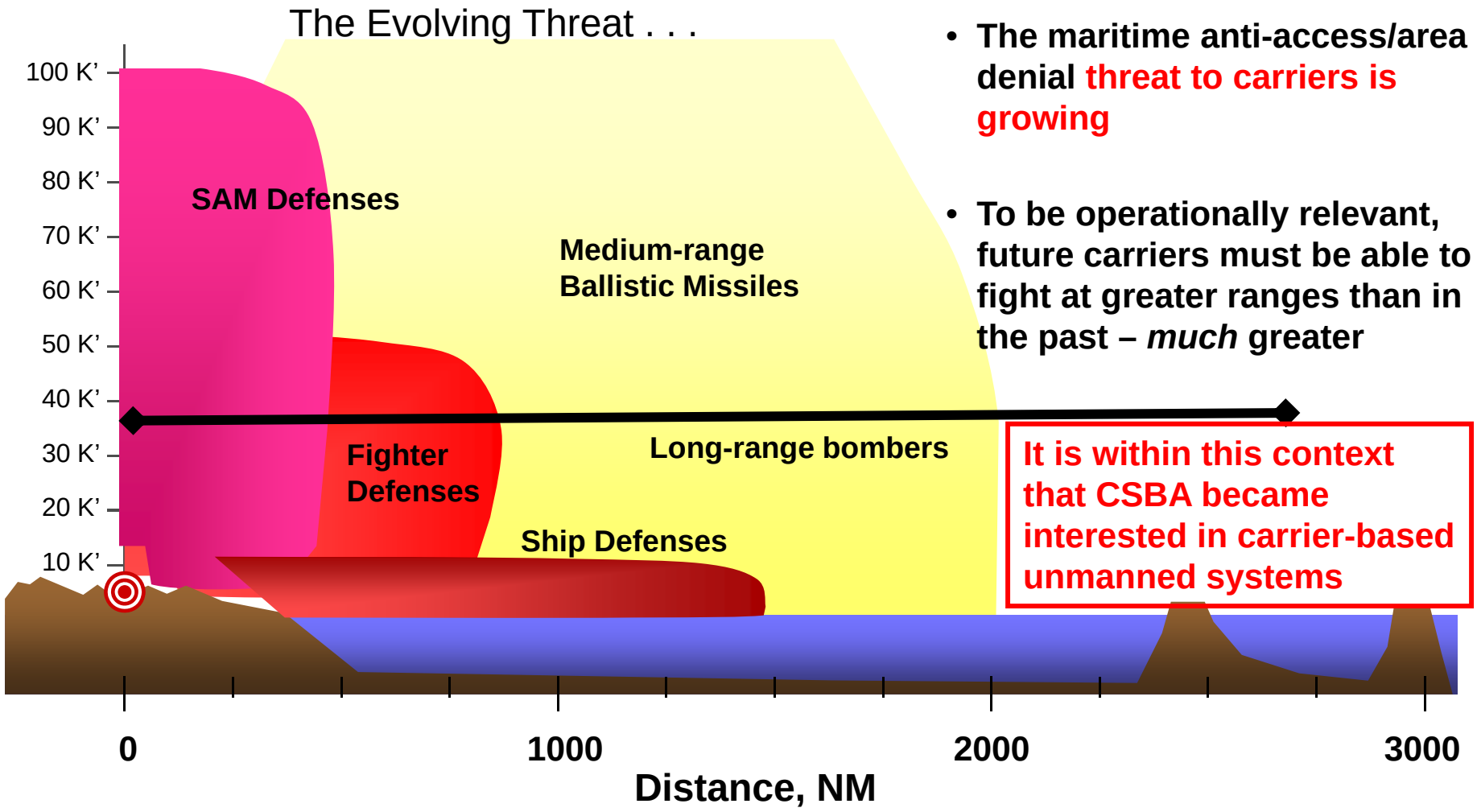
    - **A few adversaries will compete against the US in the Guided Weapons Warfare/Battle Network regime, but in an asymmetrical manner**

CSBA wargames suggest three required future platform attributes: *range, stealth, and persistence*

- **A consistent wargame finding—regardless of scenario—is that platforms with greater range (independent reach), improved stealth (an ability to operate clandestinely over geographic areas or in contested airspace), and greater persistence (a combination of long range, improved stealth, and great endurance) will be among the most fungible and useful platforms in America's future defense portfolio**
  - **Starts with a consistent need to establish *persistent surveillance-strike orbits or coverage***
- **As a result, CSBA has consistently supported a re-balancing of the American air fleet from an emphasis on shorter-range systems to an emphasis on longer-range, stealthy systems**
- **The need for greater range, improved stealth, and greater persistence is not limited to air platforms; CSBA was an early supporter of the SSGN program for the same reasons**



Wargames also suggest that improved carrier air wing range, stealth, and persistence should be a high-priority goal for the US Navy

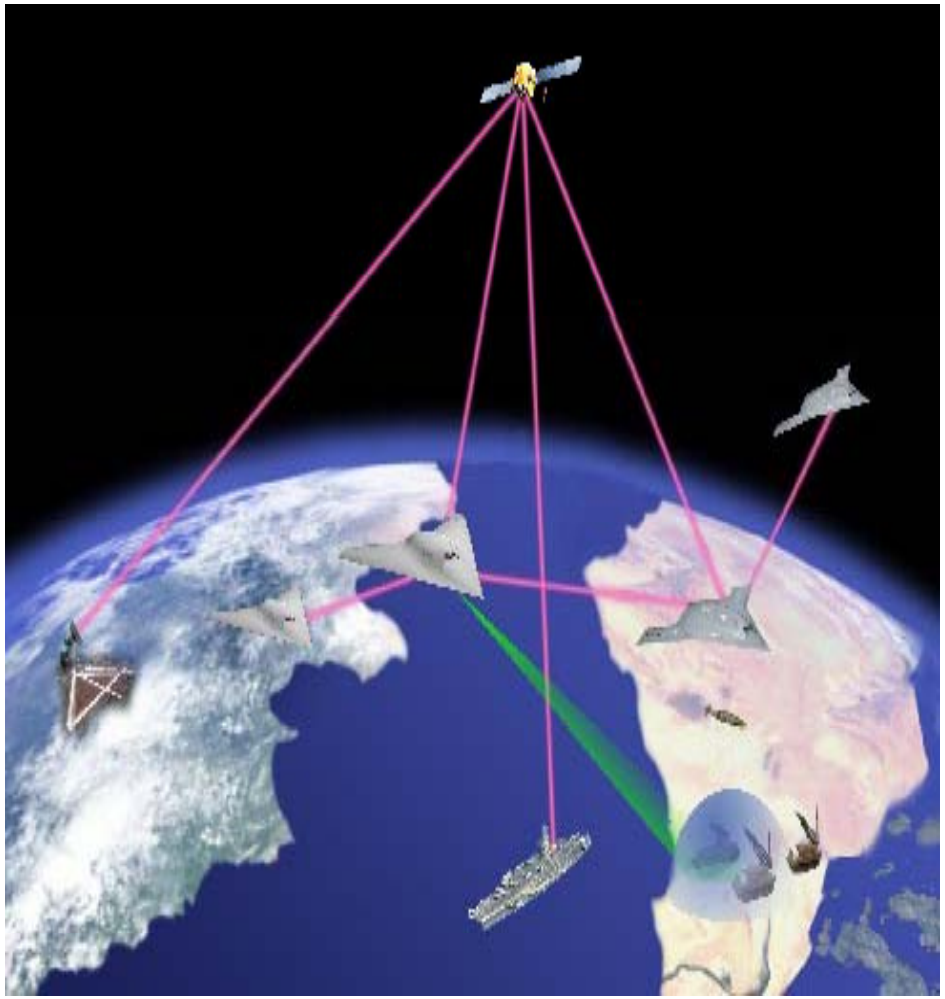


- **The maritime anti-access/area denial threat to carriers is growing**
- **To be operationally relevant, future carriers must be able to fight at greater ranges than in the past – *much* greater**

It is within this context that CSBA became interested in carrier-based unmanned systems

Some Definitions

- **Unmanned aircraft are robotic, fixed- or rotary winged aircraft capable of controlled flight using onboard propulsion and aerodynamic lift, and are designed for return and re-use**
  - **Flight can be directed remotely by a human operator located at a distant airborne, shipboard, or ground-based control station, by an autonomous flight system, or a hybrid of the two**
- **To reflect the fact that these aircraft are part of a system of systems including the unmanned aircraft itself, its control system, and its dedicated communications links, OSD announced they would be referred to as either:**
  - **Unmanned Air Systems (UASs); or**
  - **Unmanned Combat Air Systems (UCASs)**



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Normally, UASs refer to unmanned aircraft that do not dispense weapons, while UCASs refer to those that do …

UAS

UCAS

However, the difference between UASs and UCASs is already starting to blur

MQ-1 PREDATOR WITH HELLFIRES (USAF)

- **With the arming of reconnaissance drones like the MQ-1 Predator and MQ-9 Reaper (Predator B), the distinction can be misleading**
  - **The designation "RQ" means (unarmed) reconnaissance UAS**
  - **The designation "MQ" means multi-mission (armed) UAS**

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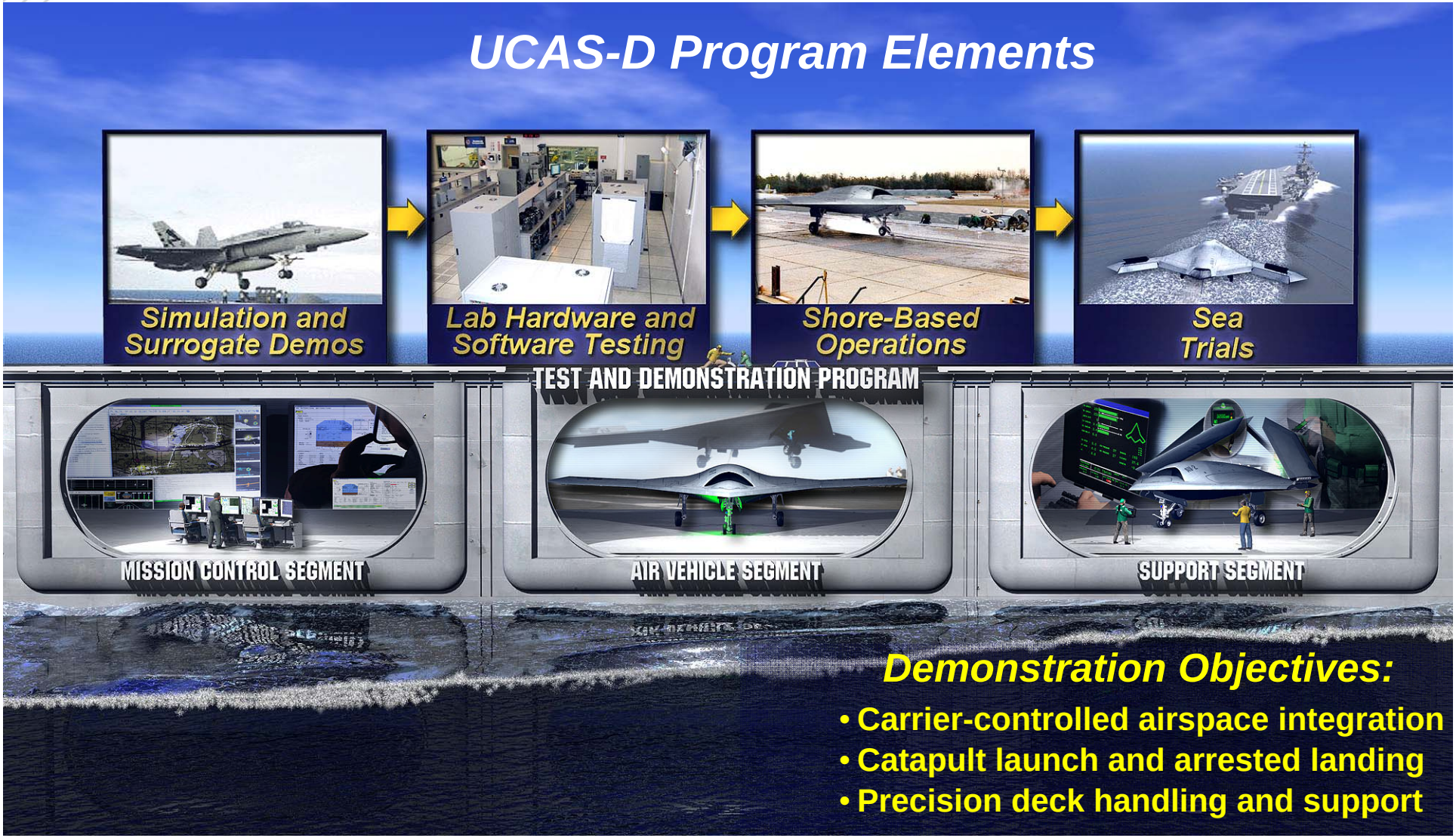
As used today, “UCAS-D” refers to the test and demonstration program necessary to validate unmanned carrier aircraft operations



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"Technology Maturation Efforts" refer to additional technical research and development necessary to transition from the UCAS-D to operational system development and design (SDD)

- **These efforts include, but are not limited to:**
  - ***Autonomous aerial refueling***
  - ***Mission control (combat ops)***
  - ***Marinized low-observables***
  - ***Advanced propulsion***
  - ***LO-integrated AESA arrays***
  - ***Advanced targeting***
  - ***Advanced weapons***

The term “N-UCAS” refers to an operational carrier-based system

Why improve the already great advantage the US battle fleet enjoys in naval tactical aviation?

- **The US operates 11 of 14 large-deck aircraft carriers now capable of operating heavy, catapult-launched jet aircraft or large, short take-off and arrested landing (STOAL) aircraft**
- **In addition, the US operates 11 of 17 smaller aircraft carriers or large-deck amphibious ships capable of operating vertical take-off and landing (VTOL) or short take-off and vertical landing (STOVL) aircraft**
- **Moreover, US aviation ships are generally much larger than their foreign counterparts, allowing them to carry more and more varied aircraft. For example, a typical US CVW includes:**
  - **44 to 50 strike-fighters (all PGM-capable)**
  - **4 or 5 airborne early warning aircraft**
  - **4 or 5 electronic attack aircraft**
  - **10 to 12 multi-purpose helicopters**
- **The 313-ship Navy includes 11 carriers**
  - **After 2019, the US will have 12 carriers**
  - **No foreign navy plans to operate more than 3**

As the US shifts from a garrison to an expeditionary global defense posture, the value of aircraft carriers to the joint force will only increase

- Since the end of the Cold War "Garrison Era," the number of US forces based on foreign soil has been steadily decreasing
  - European presence is being reduced to 3-4 combat brigades, < 200 aircraft
  - Only one heavy combat brigade will be based in Korea
  - Pacific presence will be much like during the interwar period, with Japan replacing the Philippines as the forward joint basing hub
    - Guam, Hawaii, and Alaska will see increases in US forces and capabilities
- Globally mobile strike bases that can operate with little political constraint will provide the US with tremendous freedom of action in the "Joint Expeditionary Era"

It is in the nation's interest, therefore, to retain and expand the carrier's ability to influence events—by simultaneously *increasing its combat capability* while *decreasing its vulnerability*

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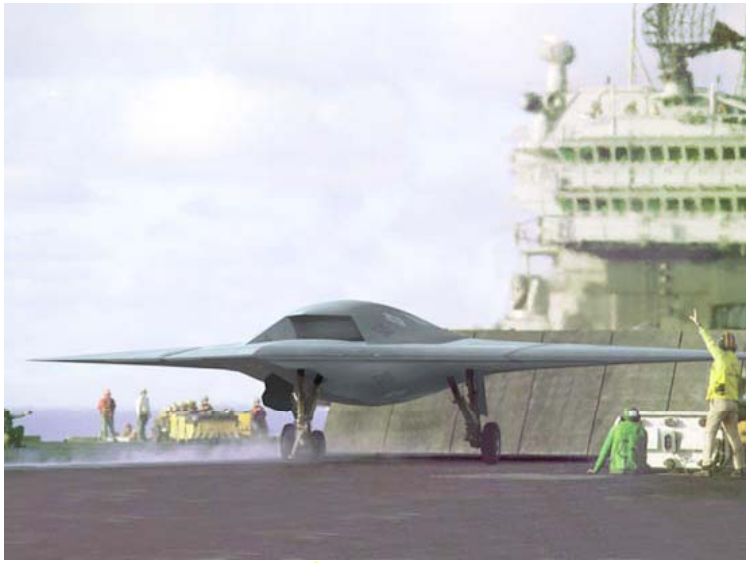
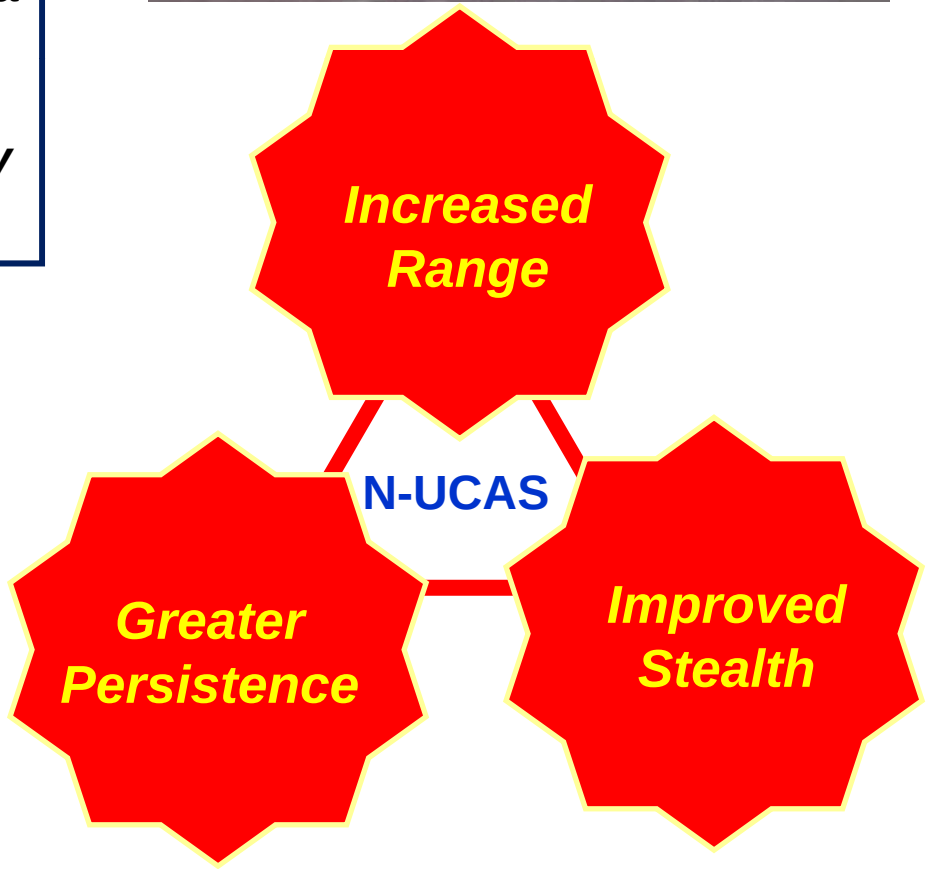
Premise

Incorporating N-UCAS into future CVWs will transform the aircraft carrier from an operational strike system with global mobility but relatively limited tactical reach into a global long-range, persistent surveillance-strike system *effective across multiple 21st century security challenges*





Part II

The US Navy and unmanned aircraft

The rationale for N-UCAS

What's the Big Deal?

- At first glance, N-UCAS may look like "more of the same"
- The US has been the world leader in unmanned aviation for over 50 years
- The advent of the global positioning system (GPS), advances in flight control software, and the increasing demand for surveillance from US combat commanders led to a dramatic rise in the number of UASs
  - In 2002: 127 UASs of five major types (Global Hawk, Predator, Pioneer, Shadow, and Hunter), amassed a total of 26,000 flight hours
  - In 2006: 520 UASs of 16 different types, amassed over 160,000 flight hours
  - These numbers tell only part of the story: If you include thousands of smaller ground combat systems, as of February 2006, DoD operated a total of 3,048 UASs (source: GAO)
- The Navy's UAS story does not follow this script…

Although being a UCAS "first mover," the Navy now lags in unmanned aircraft integration

- **In the late 1950s and 1960s, the Navy developed the world's first operational UCAS: the Drone Anti-submarine Helicopter (DASH)**
  - **Designed to deliver up to two Mk-44 homing torpedoes up to 30 miles away**
- **Although the Navy modified over 100 destroyers and frigates to operate the DASH, they failed to develop a competent operations or maintenance force**
  - **Of the 746 systems built, over half were lost due to accident or pilot error**
- **The DASH experience soured the surface warfare and carrier communities on shipboard unmanned aircraft**
  - **The Navy replaced DASH with manned helicopters (LAMPS)**

After DASH, the Navy's UAS Doldrums

- **Vietnam**
  - **"Belfry Express" on USS Ranger**
  - **Modified DASHs for the *New Jersey***

- **Pioneer emerges from 1983 Bekaa strike**
  - **After decommissioning the battleships, only the Marines continue to operate Pioneer**

- **Navy flirtations with other UASs like the OTH RPV, MR-UAV, Hunter, and Outrider all foundered on increased cost, poor performance, and lack of institutional commitment**

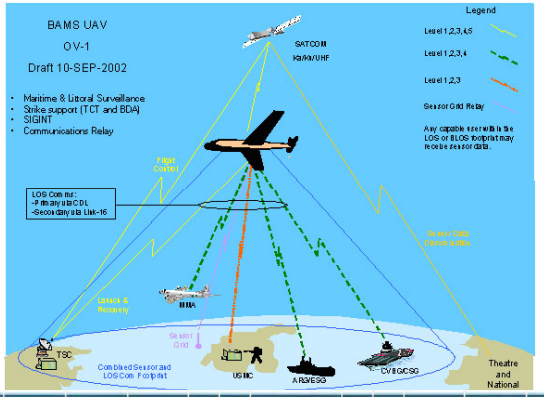
Current Navy UAS Programs

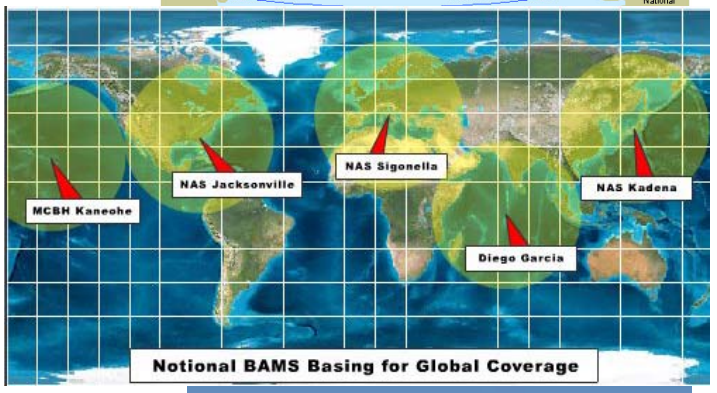
- ***With the exception of small UASs for the SEALs, the Navy currently has no operational unmanned aircraft***

- **Active UAS development programs:**
  - **Broad Area Maritime Surveillance (BAMS), a land-based ocean reconnaissance system**
  - **MQ-8B Fire Scout unmanned helicopter for deployment on the Littoral Combat Ship (LCS)**
  - **… and UCAS-D**

What makes UCAS-D important is that it will be the first unmanned aircraft *designed specifically for conventional carrier operations*

Perhaps more importantly, it can add a margin of range, stealth, and persistence not seen in past carrier air wings





Carrier aircraft have generally had shorter "legs" than land-based aircraft


F6F Hellcat


TBF Avenger

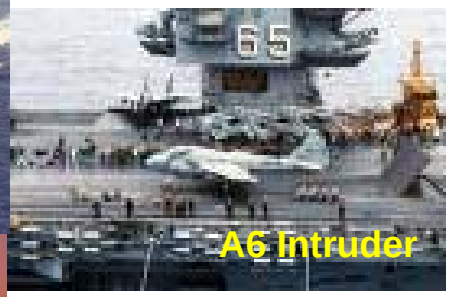
SB2 Helldiver

- World War II CVWs could conduct strikes about 250 nm from the carrier
- Carrier battles fought with roughly equal opposing CVWs were determined by which side could "fire first, effectively"
- Conducting land strikes, however, risked flying against longer-range aircraft
- As it turned out, massed US carrier forces could overwhelm smaller island's air defenses, and larger island air concentrations could be bypassed
- Toward the end of the war, kamikaze attacks (the first "cruise missiles") suggested the difficulty carriers might have against longer-range land-based threats

Through the mid-1970s, the carrier operated from offshore sanctuaries

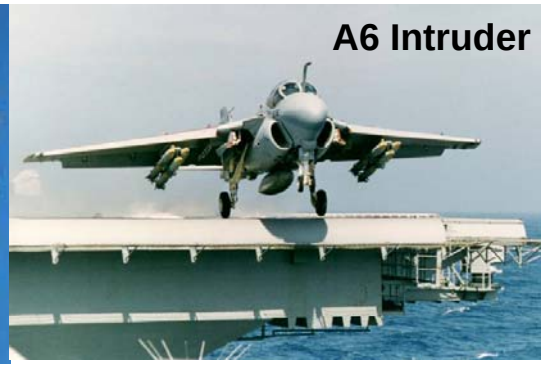

F4 Phantom


A7 Corsair II


A6 Intruder

- In Vietnam, an all-jet CVW could conduct (unrefueled) “alpha strikes” out to 350 NM
  - Speed, lethality, flexibility were all much greater
- Marginal improvement in strike range was consistent with the lack of a serious land-based threat to the carriers in Korean and Vietnam conflicts
- The only demand for longer-range carrier strike aircraft, nuclear attack against the Soviet Union, declined steadily after the 1950s

The Rise of Soviet Carrier Attack Capabilities



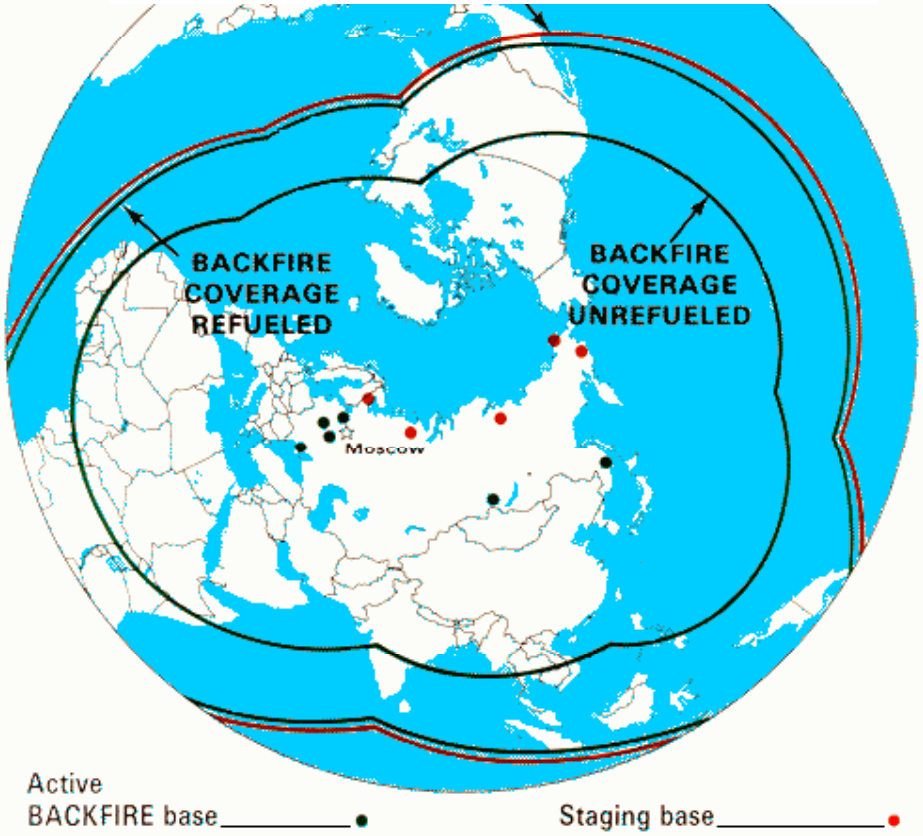
Unrefueled strikes out to 600 NM

- **After Vietnam, In the late 1970s and 1980s, the carrier once again faced a significant land-based aviation threat (as well as a serious submarine threat) from the Soviet Union**
- **This threat was embodied by the Soviet Tu-22M Backfire bomber, armed with Kh-22M Kitchen supersonic anti-ship cruise missiles**
- **Carrier defense mattered again, and range (mainly the F-14's) became the Achilles' Heel**

The Backfire posed a significant threat to US Carrier Battle Groups

- **The supersonic Backfire (~2,500 NM combat radius) resulted from a steady, decades-long Soviet focus on anti-carrier operations**
- **The Backfire's range was extended by the supersonic Kh-22M Kitchen cruise missile, which had an effective range of approximately 270 nm (at the edge of the carrier's extended CAP range)**
- **Backfire raids were cued by Soviet Radar Ocean Reconnaissance Satellites (RORSATs) and Electronic Ocean Reconnaissance Satellites (EORSATs), picket ships, reconnaissance aircraft, and submarines**
- **Backfire/Kitchen also posed a threat to support and commercial shipping**

Backfire/Kitchen Coverage

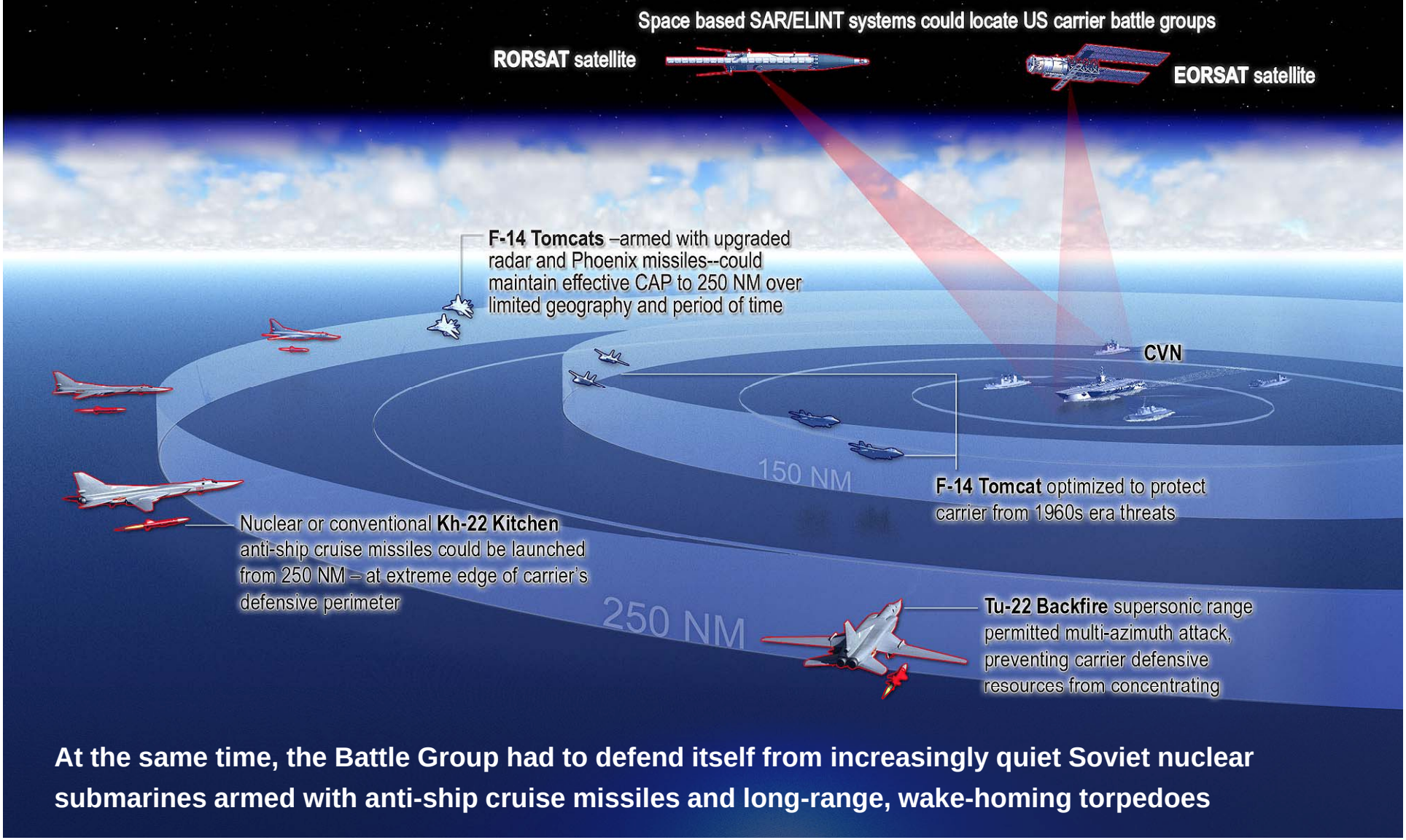


Taking a Knife to a Gunfight

- **The range disparity between US CVW and Soviet long-range strike aircraft put carriers at severe disadvantage when attacking Soviet targets in accordance with the "Maritime Strategy"**
  - **In congressional testimony in 1980, senior Navy officials called the Backfire an "order of magnitude upgrading of Soviet Naval Aviation," with another intelligence official calling the Backfire "a vital part of [Soviet] strategic defense forces to keep Western carrier battle groups from striking important targets within the Soviet land-mass."**

The Backfire threat spurred new fleet concepts of operation, particularly the "Outer Air Battle"

Outer Air Battle focused the entire carrier battle group exclusively on the Backfire threat



At the same time, the Battle Group had to defend itself from increasingly quiet Soviet nuclear submarines armed with anti-ship cruise missiles and long-range, wake-homing torpedoes

With the collapse of the Soviet Union, the threat to the carrier seemingly disappeared

- Because of the lack of a serious threat to the carriers, the CVW could be optimized for short-range guided weapon strikes in low-threat environments
  - Intense focus on improving carrier sortie generation rates
- The primary CVW strike platform became the F/A-18 A/C "strike-fighter," a superb multi-role aircraft with an unrefueled combat radius of 320-350 nm; typically, strikes were more often conducted between 200 and 250 nm from the carrier
- With the cancellation of the A-12 stealth medium bomber and the retirement of the A6, the independent reach of the CVWs thus decreased dramatically
- To buy back some range, and reflecting the lack of a serious air threat to the carrier, the Navy converted F-14s to "Bombcats," capable of unrefueled strikes out to approximately 500nm before retiring them

Future Carrier Air Wings: 1990s or 1980s?

- The planned 2020 air wing consists of 24 F/A-18 E/F Super Hornets & 20 F-35C Lightning IIs
  - The F/A-18 E/Fs have an unrefueled combat radius of approximately 475 nm
  - The CV version of the JSF should be capable of conducting unrefueled strikes out to 650 nm
  - F-35 will also have stealth, allowing it to operate against advanced air defenses
  - 4 or 5 N-UCASs in a penetrating ISR role?
- The CVN-21 is designed to generate high sortie rates

While these are welcome improvements over the current CVW, the 2020 CVW will essentially duplicate the independent reach of the 1980s CVW, which had a great deal of trouble dealing with Soviet 1970-era technologies

True, air-to-air refueling extends the combat reach of the carrier…

- With air-to-air refueling, the combat reach of the 2020 CVW will extend beyond 475-650 NM
  - During Operation Enduring Freedom (OEF), US carriers conducted strikes into Afghanistan at 900 NM—"the longest range combat sorties ever flown by carrier aircraft."
  - Operation Iraqi Freedom matched those sortie durations due to the requirement for persistence over the target area
- However, launching strikes over these ranges dramatically reduce the carrier's sortie generation rate
  - During OEF, carriers averaged only 30-40 total combat sorties per day
- *Although the machines could fly farther, carrier aircraft sorties are inherently limited by human endurance to about 10 hours*

Thus, 2020 manned aircraft will have the same endurance as the A-1 Skyraider, introduced in fleet service in the 1950s

The Key Question

Will a CVW with endurance no better than a 1950s air wing and with an independent reach no better than 1980s air wing be able to handle expected 21st century national security challenges?

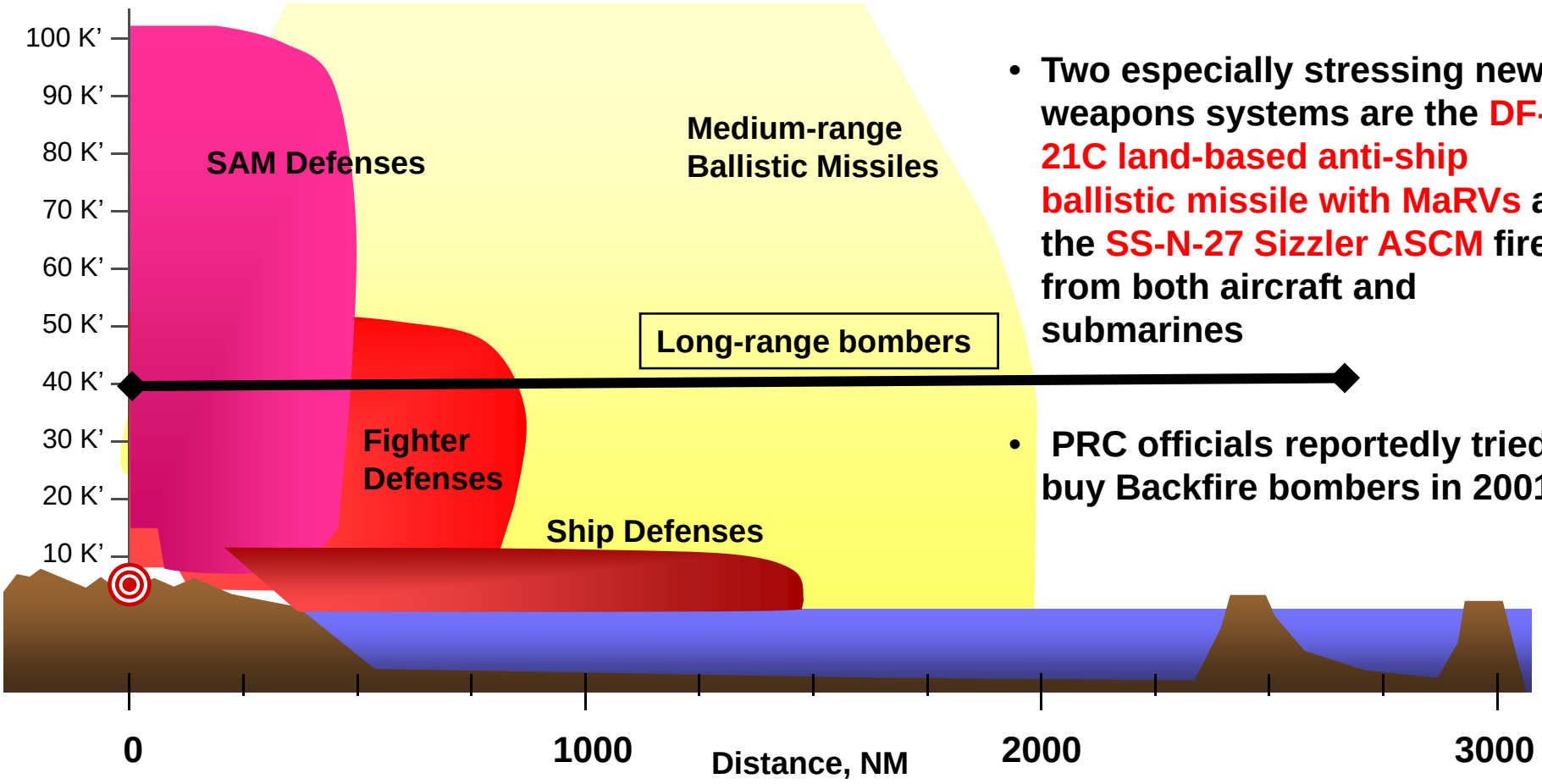
- **The answer: *not likely given current trends***
- **The 2006 QDR highlights four key national security challenges:**
  - **Defending the homeland in depth**
  - **Fighting the "Long War" and defeating global terrorist networks**
  - **Conducting "WMD elimination operations" against regional states**
  - **Hedging against countries at strategic crossroads (e.g., China)**
- **These challenges should shape the carrier air wing in the decades ahead… not a focus on high sortie rates and short-range guided weapon strikes**

Needed: *Range, Stealth*, and *Persistence*

- **Long War: defeating global terrorist networks requires distributed, truly persistent (24/7) surveillance-strike networks**
  - **Operations in Iraq and Afghanistan "have seen persistence eclipse sortie generation" as the key metric for aviation effectiveness**
  - **Networks must be maintained over long ranges due to lack of bases or desire for a minimal regional footprint**
  - **Stealth is less critical for Long War operations but is still useful for denied areas where the most difficult problems can hide**
- **Nuclear-proliferation: Operating against nuclear-armed adversaries also requires distributed, persistent (24/7) surveillance-strike networks**
  - **The networks will be necessary to track, trail, and if necessary, destroy WMD facilities or systems—any nation pursuing WMD will have modern air defenses, demanding a high degree of stealth and persistence**
  - **A nuclear-armed foe will likely be able to dissuade its neighbors from granting the US operational access, requiring that these networks be assembled and operated from range**
  - **Stealth is important in three ways: its opens the possibility for unwarned strikes against an adversary's WMD capabilities; it contributes to persistent coverage over contested airspace; and it forces investment in defense**

Range, stealth and persistence will be particularly vital when facing a peer in the guided weapons/battle network regime

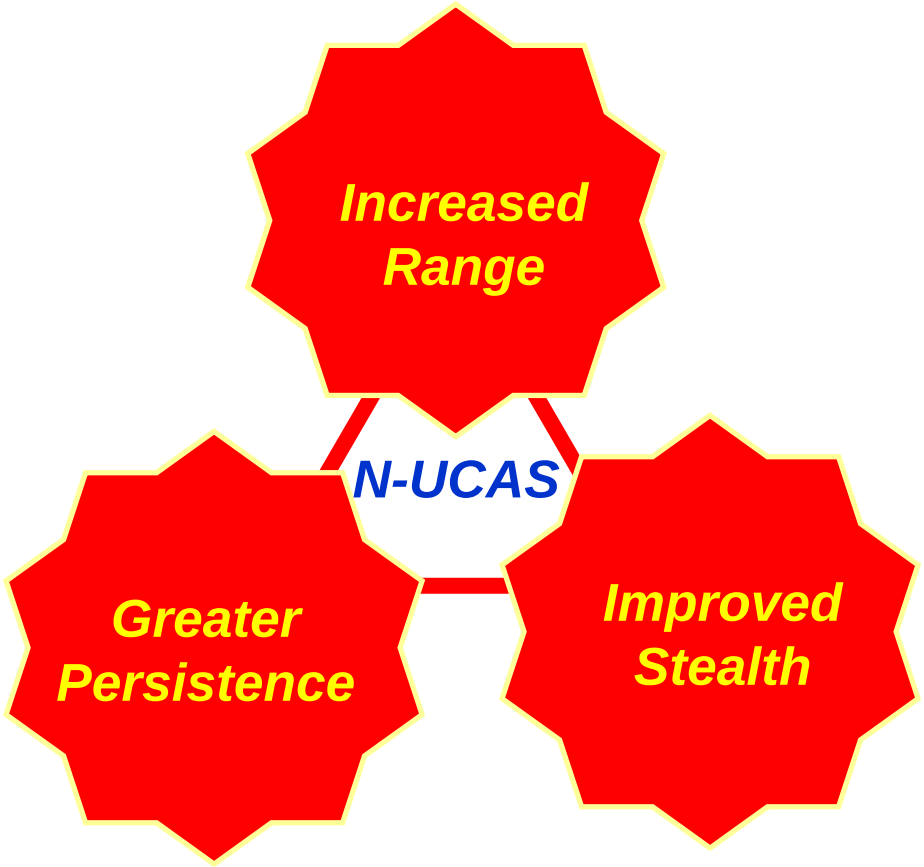
China is developing a layered anti-access/ area denial network that could be much more formidable than the one erected by the Soviets—in the near term, they seek to contest, delay, and deter US carrier operations out to at least 1,600 nm from their coast



- **Two especially stressing new weapons systems are the DF-21C land-based anti-ship ballistic missile with MaRVs and the SS-N-27 Sizzler ASCM fired from both aircraft and submarines**
- **PRC officials reportedly tried to buy Backfire bombers in 2001**

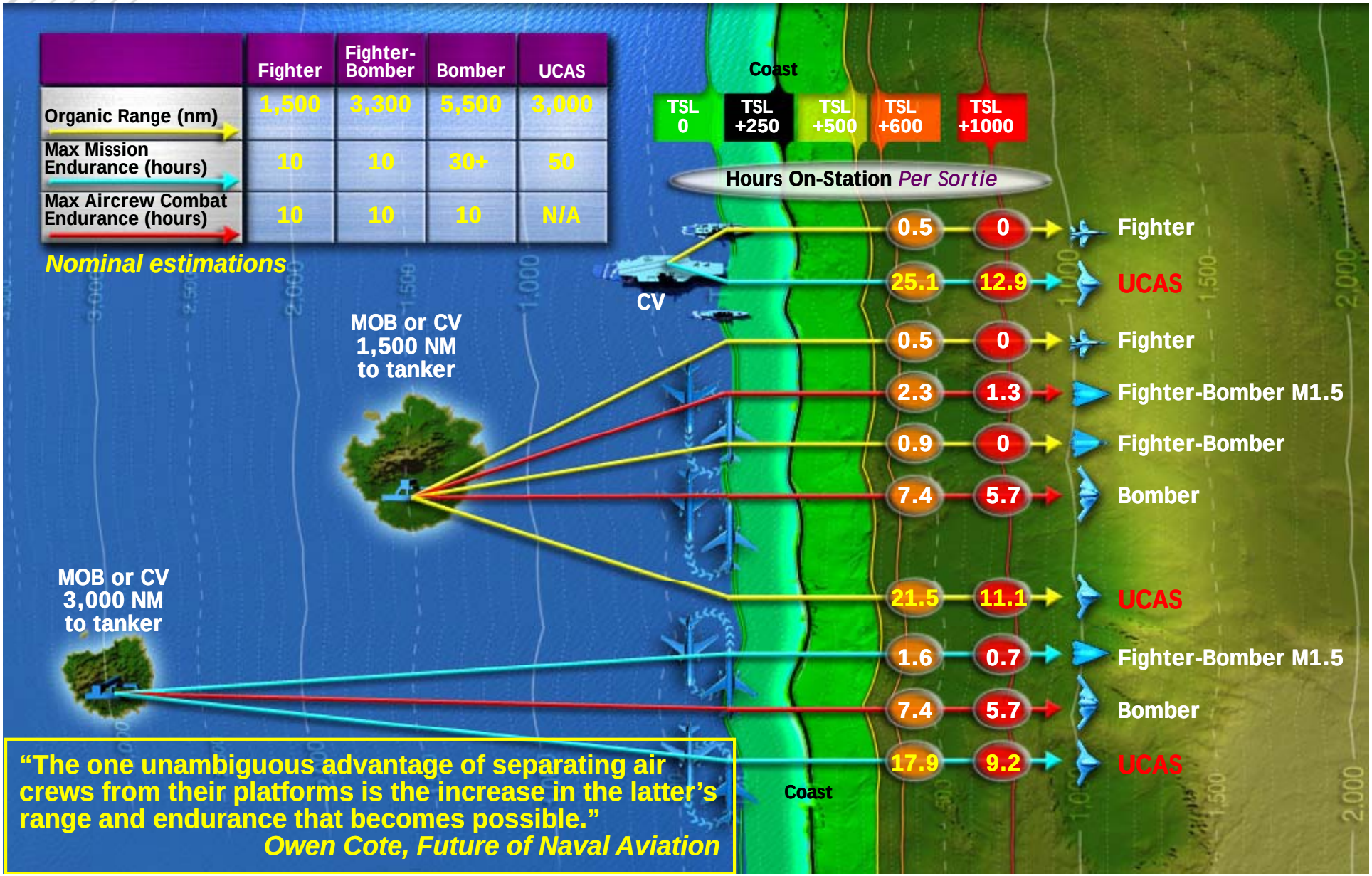
A carrier-based UCAS thus would help address *each* of these 21st century national security challenges

- ***Increased Range*: aerospace experts say an operational N-UCAS could easily achieve an unrefueled combat radius of 1,500 nm or more with the same internal payload as F-35C (two 2,000 pound JDAMs and two AMRAAMs)**
  - ***Unrefueled range about 2.5 times F-35C***
- ***Improved Stealth*: achieving multi-aspect, broad-band stealth requires the removal of vertical appendages**
  - **Tail-less aircraft require high angles of attack on landing, which is a problem for manned carrier aircraft—not for N-UCAS**
- ***Greater Persistence*: a function of a UCAS's unmanned design (potentially 50-100 hours air endurance) and stealth**
  - ***5 to 10 times greater than manned aircraft***



It is the N-UCAS's *combination* of range, stealth, and persistence that make the system so powerful

N-UCAS's unique combination of range, stealth, and persistence results in high on-station times, regardless of environment (uncontested or contested)



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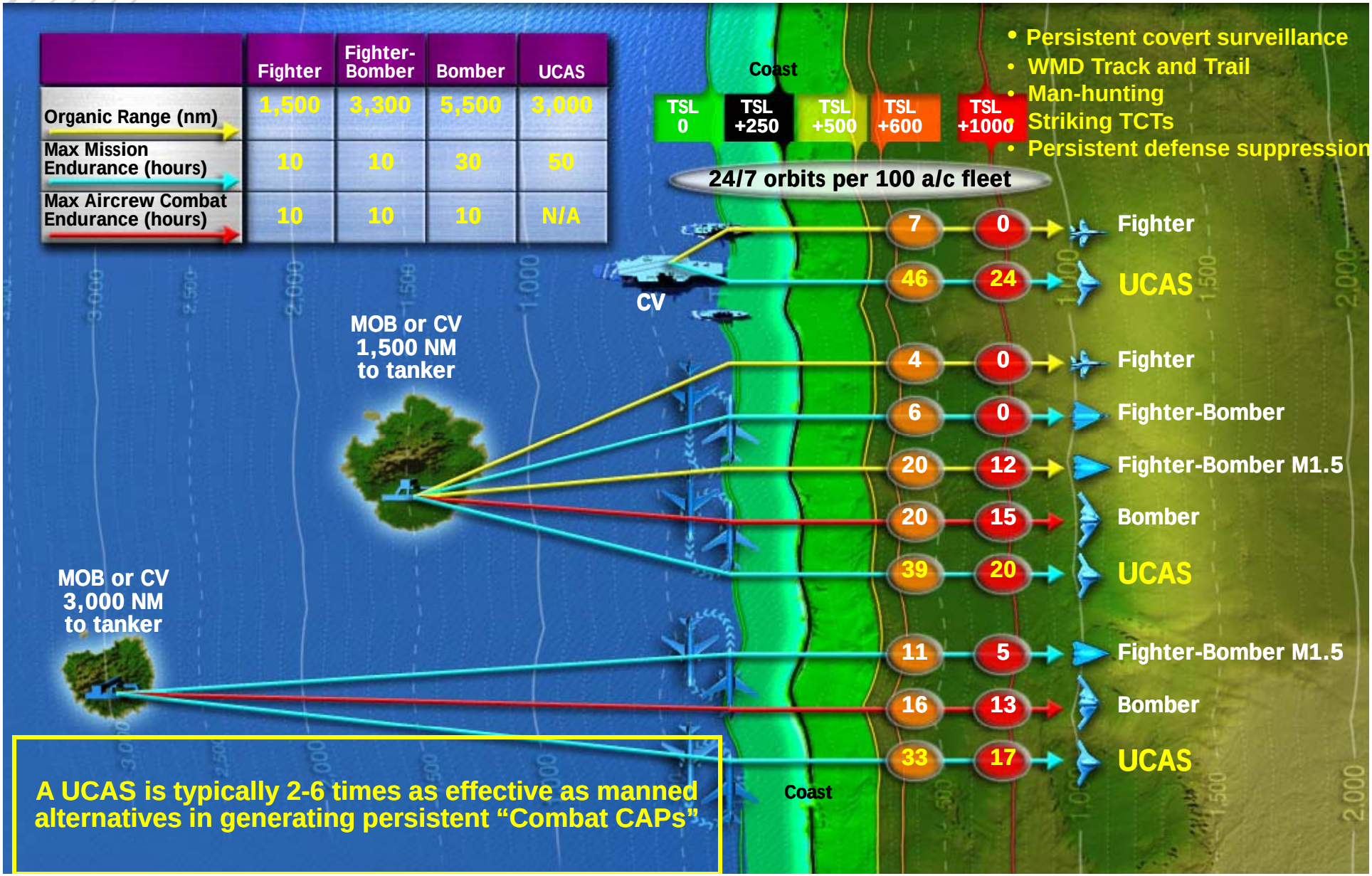
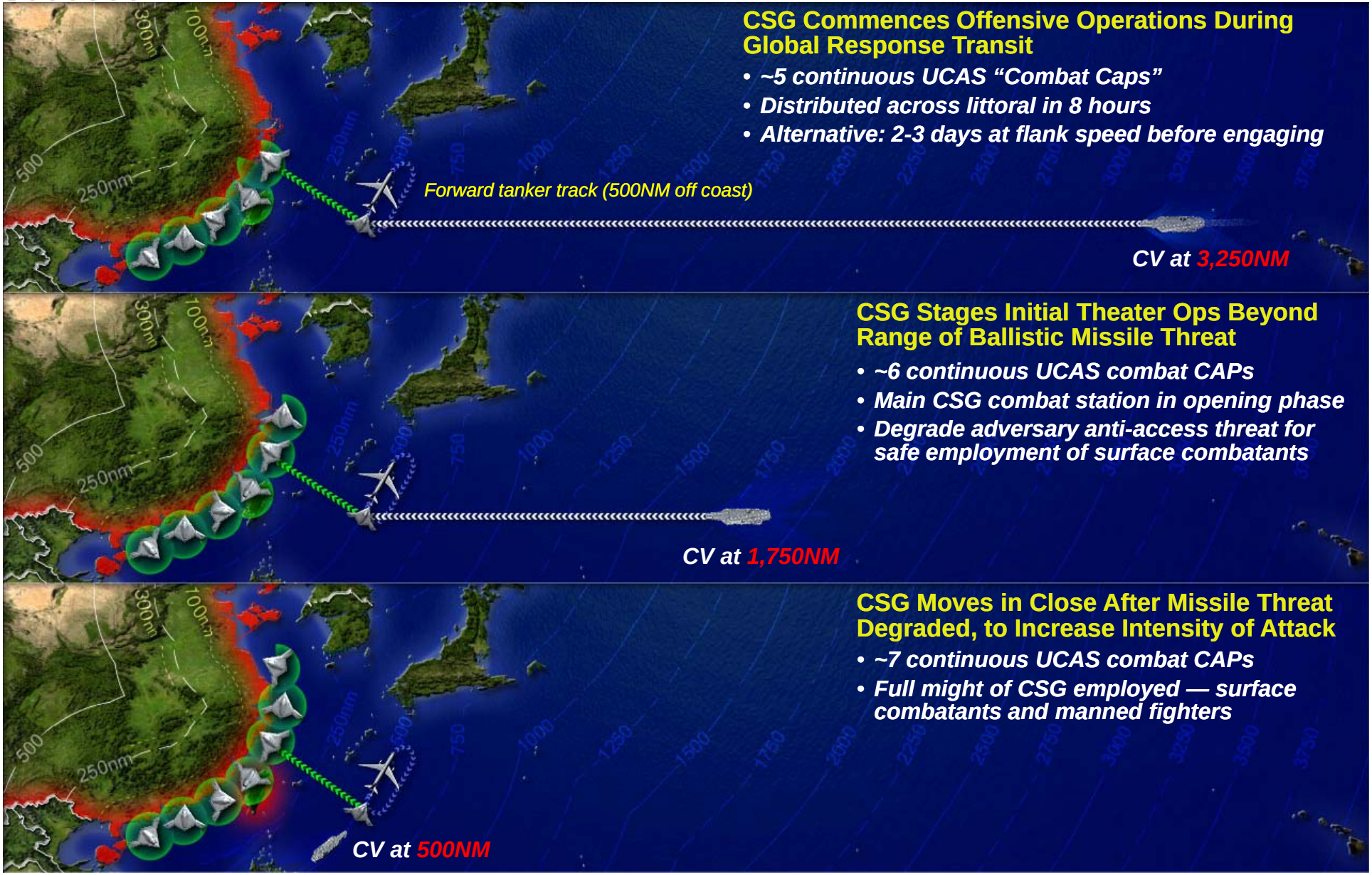
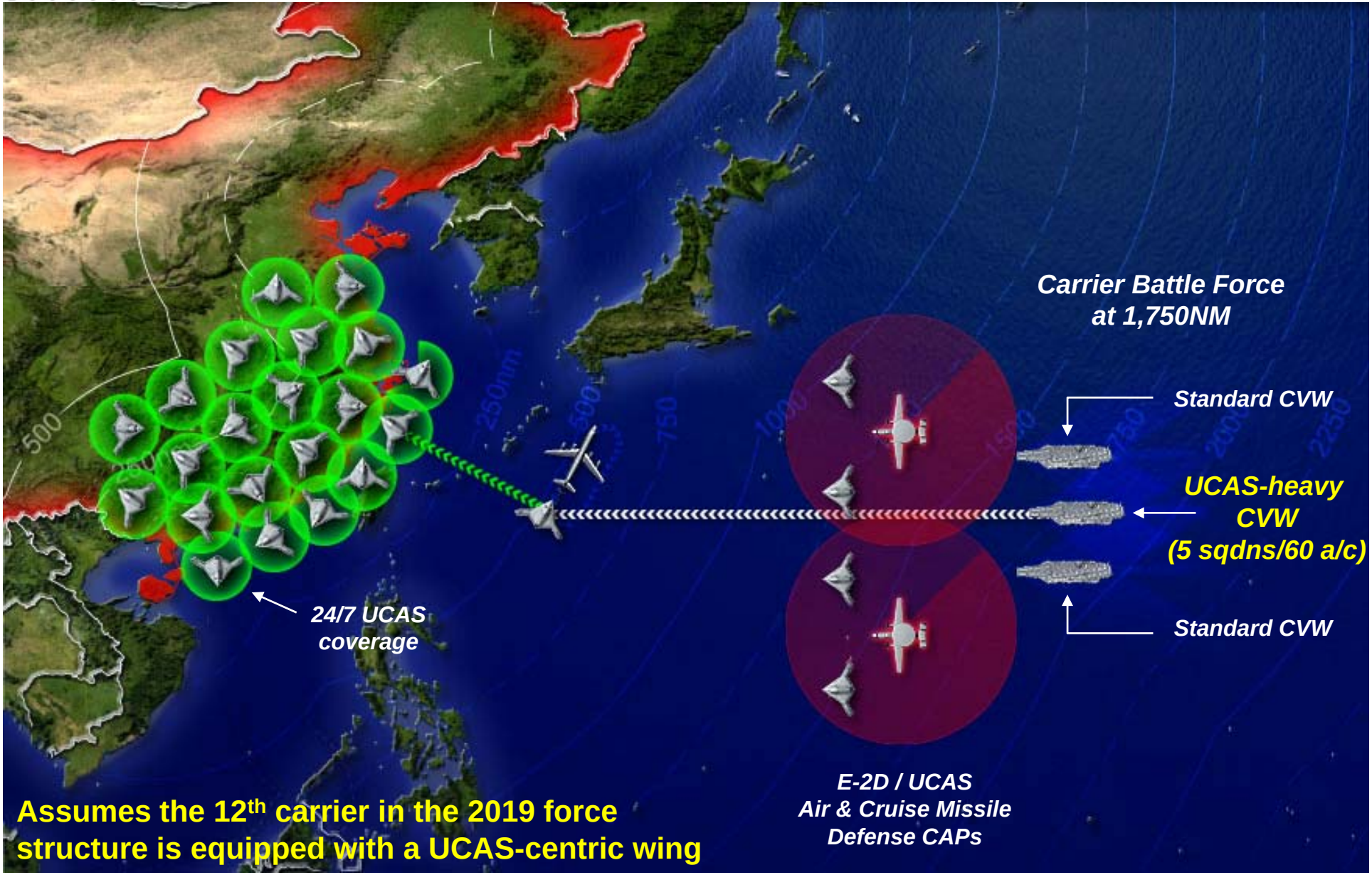
As the number of N-UCAS's goes up, their long loiter times translate into high numbers of persistent "Combat CAPS"—useful in a variety of scenarios…



Adding just one 12-plane N-UCAS squadron per CVW provides a step increase in carrier reach and power



Now, imagine a three-CV Carrier Strike Force One With UCAS-Centric Air Wing



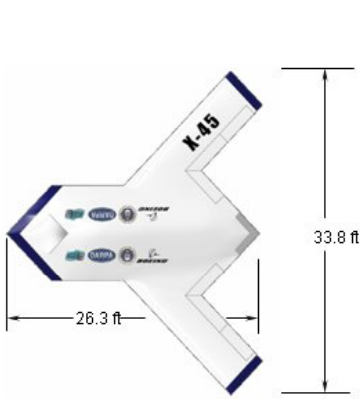
Assumes the 12th carrier in the 2019 force structure is equipped with a UCAS-centric wing

Part III

Preventing a missed opportunity

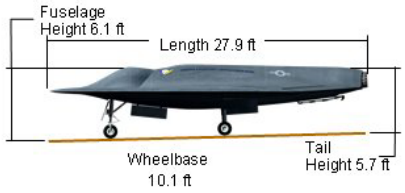
The path toward N-UCAS has been marked by several twists and turns…

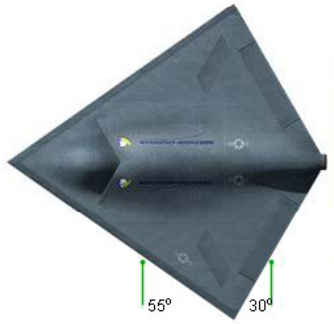
- In 2000, DARPA and the Air Force awarded a contract to Boeing to build a UCAV ("V" for vehicle) demonstrator, which was designated the X-45A
- About the same time, the Navy awarded a contract to Northrop Grumman Corporation to begin work on a UCAV for naval applications, which was dubbed the X-47A
- Note that both companies pursued tail-less designs from the very start



Boeing X-45A

Empty Weight:	8,000 lb
Fuel Volume:	2,690 lb
Payload Capability:	1,500 lb
Operating Altitude:	35,000 ft
Cruise Mach:	0.75
Engine:	Honeywell F124-GA-100





Northrop Grumman X-47A

Empty Weight:	3,835 lb
Fuel Volume:	1,580 lb
TOGW:	5,500 lb
Thrust:	3,190 lb
Engine:	P&W JT15D-5C

In December 2002, an OSD Program Decision Memorandum set up a Joint-UCAS Office

- By Fall, 2003, both the X-45A and the X-47A had conducted flights and the Joint UCAS Office was up and running
  - The Services completed a UCAS operational assessment, which led to increasingly demanding J-UCAS performance specifications
  - The J-UCAS Office crafted an ambitious 7-year plan to develop improved versions of the first "Spiral Zero" proof of concept vehicles, called the X-45C and X-47B, respectively
- Initial plans called for no less than 14 prototypes to be built to conduct a two-year operational assessment, starting in 2007
- In 2010, informed by a parallel DARPA technology assessment, OSD would decide whether or not to pursue joint or separate operational UCAS systems
  - In either case, they would be controlled by a common operating system

However, the 2006 QDR resulted in a major change in direction for the Joint UCAS Program

- **Just two months after the management of the J-UCAS program was transferred from DARPA to the Joint Program, the 2006 QDR announced a major change in direction**
  - **The Air Force would develop a "next generation long-range strike (NGLRS) system, with an initial operating capability in 2018**
  - **The Navy would develop an "unmanned longer-range carrier-based aircraft capable of being air-refueled"**
- **Since then, the Air Force has opted to pursue a medium-range, manned system**
- **For its part, the Navy's plan to acquire a Navy-UCAS (N-UCAS) is split into two principle phases: demonstration and technology maturation; and acquisition (system design and development, production, and fielding)**
  - **Reflects a consistent Navy approach: prove it can operate on the carrier; prove it can perform relevant missions; then built it**
  - **In line with this approach, the Navy sought Requests for Proposal from Northrop Grumman Corporation and Boeing for a UCAS Carrier Demonstration Program (UCAS-D)**
  - **Instead of including mission functionality demonstrations (e.g., including air-to-air refueling, electronic support measures, and multi-ship operations), competitors were expected only to demonstrate carrier approach control operations, launch and recovery, deck operations and supportability**

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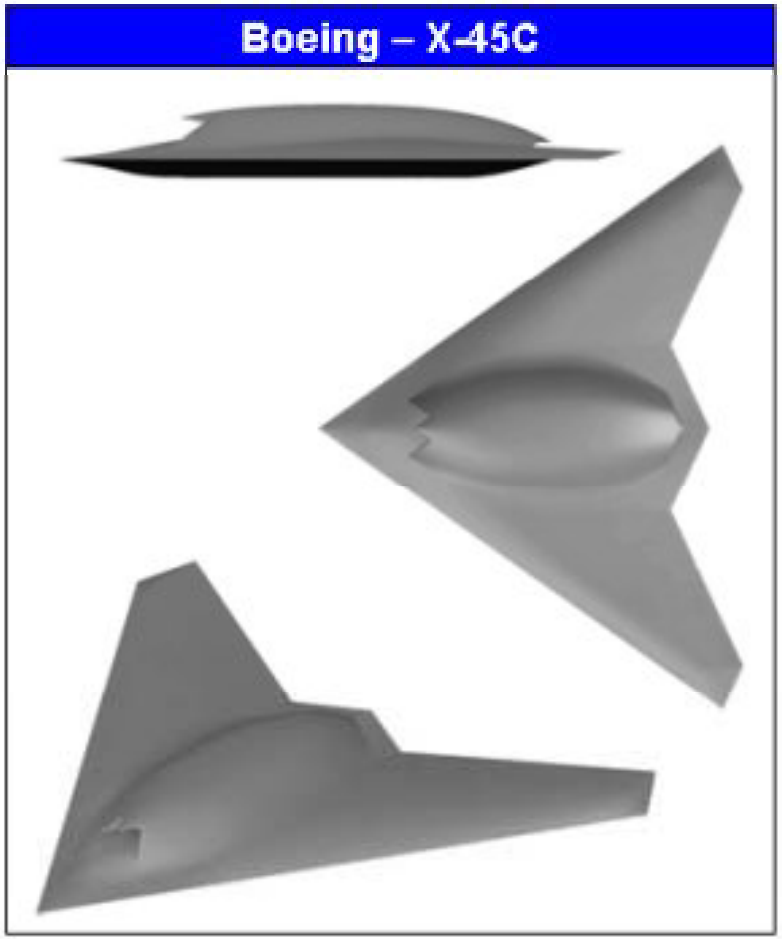
The Navy should announce the winning bid for the UCAS-D Program sometime this month…



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Unquestionably, N-UCAS will have to climb a steep acceptance curve in the Navy

- As suggested by the Air Force's decision to opt for a manned NGLRS system rather than a long-range UCAS, support for unmanned combat air systems in the tactical aviation community may not be solid

- The Navy's past history with unmanned systems means that the institutional approach toward the N-UCAS may be tinged with skepticism
  - Statements like the N-UCAS will have to "earn its way onto the ship" suggest that carrier aviators are not yet convinced the CVW should include unmanned aircraft

- Moreover, the Navy's view toward the N-UCAS suggests it views the system mainly as a penetrating ISR system supporting manned aircarft
  - "The primary focus for developing naval [UAS] capabilities is centered around [ISR] capabilities. Our whole strategy is focused on ISR. The Navy has been very consistent with the capabilities desired in [UASs and UCASs]."

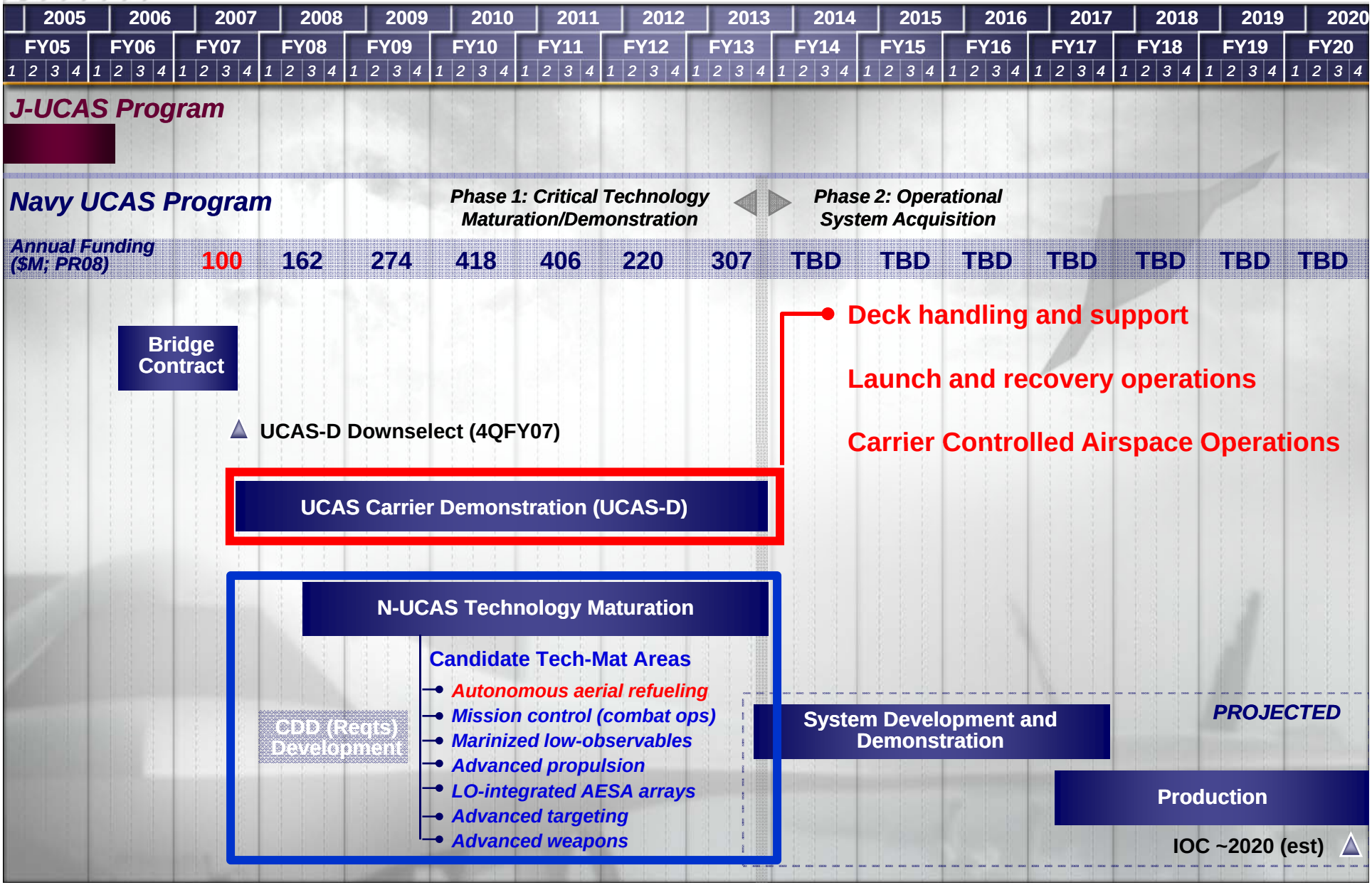
- As we have discussed, the N-UCAS can be so much more; if they were deployed today, the X-45C and the X-47B would be among the most capable carrier aircraft ever employed

The key first step necessary to prove the full potential of carrier-based UCASs is the UCAS-D Program

- **The UCAS-D program is doubly important: it must prove the that unmanned systems can be seamlessly integrated into carrier operations and the carrier "deck cycle," and it must put to rest the lingering doubts within the carrier community about unmanned systems that stretch back to the Navy's abortive experiment with the DASH**

- **At a minimum, the UCAS-D must demonstrate:**
  - **Deck handling and support**
  - **Launch and recovery operations**
  - **Carrier Controlled Airspace Operations**

Equally important are N-UCAS technology maturation efforts



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However, given the number of competing needs in DoD and in the Navy's aviation program, the UCAS-D program is highly vulnerable to a "death from a thousand cuts"

- **FY 06:**
  - **PBD 753 (DoD) reduced FY 2006 J-UCAS funding from $745 to $350 million, and FYDP funding from $5.1 to $4.1 billion**
  - **SAC-D cut J-UCAS from $350 to $150 million (conference funded the program at $300 million)**
- **FY 07:**
  - **SAC-D zeroed out the $239 million N-UCAS request; HAC-D reduced N-UCAS from $239 to $189 million**
  - **Conference funded the program at $100 million**
  - **This cut slipped UCAS-D completion from FY11 to FY13**
- **Further cuts could stunt or marginalize this potentially revolutionary program**
- **Like the aforementioned SSGN, now touted as one of the most "transformational" programs in the Department of the Navy, to make sure that N-UCASs get a fair shake in the budget process, both DoD and Congress may have to signal their interest in the program and monitor its health and funding streams**
- **Indeed, if anything, OSD and Congress should consider expanding the technology maturation program to prove additional N-UCAS functionality and missions**

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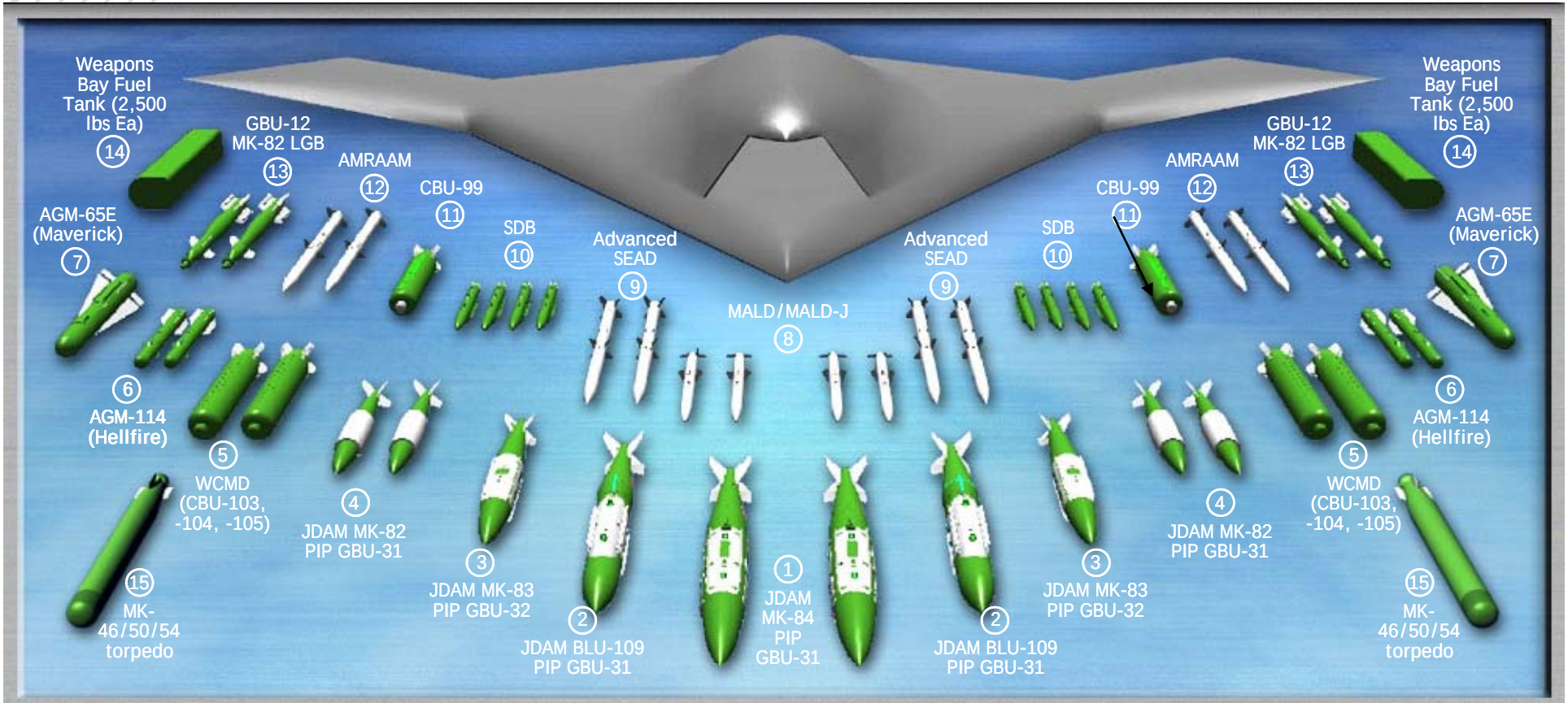
For example, an expanded maturation effort could explore the potential mission flexibility of N-UCAS



No.	Weapon	Qty
1	JDAM MK-84 PIP GBU-31	2
2	JDAM BLU-109 PIP GBU-31	2
3	JDAM MK-83 PIP GBU-32	2
4	JDAM MK-82 PIP GBU-31	4
5	WCMD (CBU-103, -104, -105)	4

No.	Weapon	Qty
6	AGM-114 (Hellfire)	4
7	AGM-65E (Maverick)	2
8	MALD/MALD-J	4
9	Advanced SEAD	4
10	Small Diameter Bomb	12

No.	Weapon	Qty
11	CBU-99	2
12	AMRAAM	4
13	GBU-12 MK-82 LGB	4
14	Wpns Bay Fuel Tank	1-2
15	MK 46/50/54 torpedo	2

Note: Illustrative weapons loads based on a notional weapons bay with a 4,500 lb capacity

This modularity might enable to N-UCASs to perform many more missions than just ISR...

The Bottom Line

- **The N-UCAS's unique combination of great unrefueled range and dramatically improved stealth and persistence could transform carriers and their embarked CVWs from operational strike systems with outstanding global mobility and relatively limited tactical reach into global, long-range, persistent surveillance-strike systems effective across the full range of 21st century security challenges**

- **To achieve this potentially revolutionary transformation, Congress, OSD, and the Navy should support the UCAS-D program and an expanded technology maturation effort to prove that unmanned aircraft can be safely integrated into both carrier flight deck and strike operations, and to expand the mission envelope of N-UCASs**