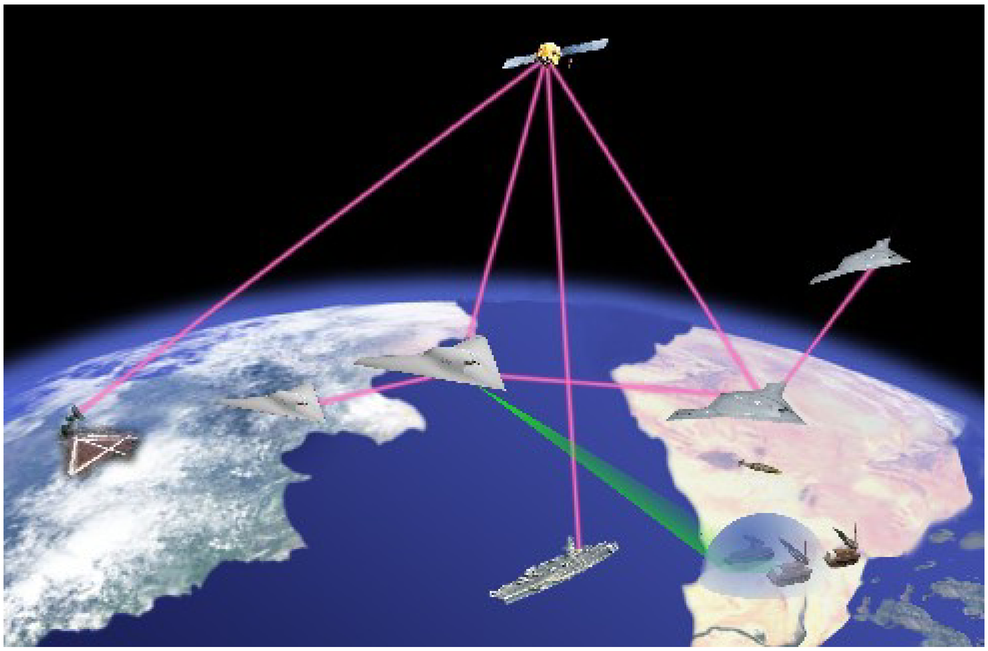
Joint Unmanned Combat Air Systems
J-UCAS Overview



Overview

The Joint Unmanned Combat Air Systems (J-UCAS) program is a joint DARPA/Air Force/Navy effort to demonstrate the technical feasibility, military utility and operational value for a networked system of high performance, weaponized unmanned air vehicles to effectively and affordably prosecute 21st century combat missions, including Suppression of Enemy Air Defenses (SEAD), surveillance, and precision strike within the emerging global command and control architecture.

"J-UCAS is a key transformational program within the Department of Defense's portfolio. The capabilities offered by this family of systems can have profound implications on the Department's future warfighting capability and force structure."
– Mr. Michael W. Wynne, USD(AT&L) (Acting), 23 June 2003

J-UCAS Objective System (J-UOS)

The J-UCAS vision is to develop a weapon system that expands tactical mission options and provides revolutionary new air power and penetrating surveillance capability. The J-UCAS weapon system will exploit the design and operational flexibility of an uninhabited vehicle to enable a new paradigm in warfighting while maintaining the judgment and moral imperative of the human operator. The J-UCAS is designed for minimal maintenance to reduce cost. It will be capable of dynamic mission replanning with varying levels of autonomy. The J-UCAS has the potential to fully exploit the emerging information revolution and provide advanced airpower with increased tactical deterrence at a fraction of the total life cycle costs of current manned systems.

The J-UCAS weapon system will enable a new affordability paradigm by reducing both acquisition, and operation and support (O&S) costs. Removing the pilot from the vehicle eliminates man-rating requirements, pilot systems, and interfaces. New design philosophies can be used to optimize the design for aerodynamics, signature, reduced maintenance and low cost manufacturing processes. Advances in small smart munitions will allow these smaller vehicles to attack multiple targets during a single mission and reduce the cost per target killed, while minimizing the prospects for geolocation errors and fratricide. Improvements in sensor technologies also allow significant advances in surveillance and reconnaissance over high threat areas. The J-UCAS will be highly effective with a significant reduction in life cycle costs over current systems.

J-UCAS will use a Common Operating System to facilitate the integration of subsystems such as sensors, weapons, and communications while minimizing the impact from platform constraints. In addition, J-UCAS will have a system architecture that ensures intra-operability between the internal components of J-UCAS and inter-operability with external elements such as manned aircraft, command and control centers, and space assets. For initial demonstrations, a single suite of sensors accompanied by common mission avionics, and software applications will be developed. One architecture, one sensor suite, and a Common Operating System will lead to the reduction of costs, the lowering of barriers to the entry of new technology into J-UCAS, as well as the acceleration of a network centric war fighting capability.

Objectives and Concepts of Operation

The J-UCAS program combines the efforts that were previously conducted under the DARPA/Air Force Unmanned Combat Air Vehicle (UCAV) program and the DARPA/Navy Naval UCAV (UCAV-N) program. Although these efforts were specifically targeted towards their service-specific needs, the Defense Department recognized the potential for significant synergy by combining the programs. This includes the following common performance objectives for the demonstrators:

- Radius: 1300 nm
- Persistence: 1000 nm with 2 hrs loiter
- Payload: 4500 lb

The primary technical challenges for both the Navy and Air Force missions are likewise highly common. These include developing an affordable, lethal, low observable air vehicle capable of dynamic distributed control using advanced cognitive aids and advanced targeting processes. The J-UCAS will also be interoperable with other manned and unmanned systems for the military services. It will have secure, robust communications and be capable of adaptive, highly autonomous operations, conducting coordinated multi-vehicle flight. The system will utilize significant improvements in the reliability and maintainability of subsystems and low observables materials, robust prognostics and health management systems, and reduced manpower needed to operate and maintain the vehicles. These features will facilitate a rapid sortie generation rate with a minimum turn time.

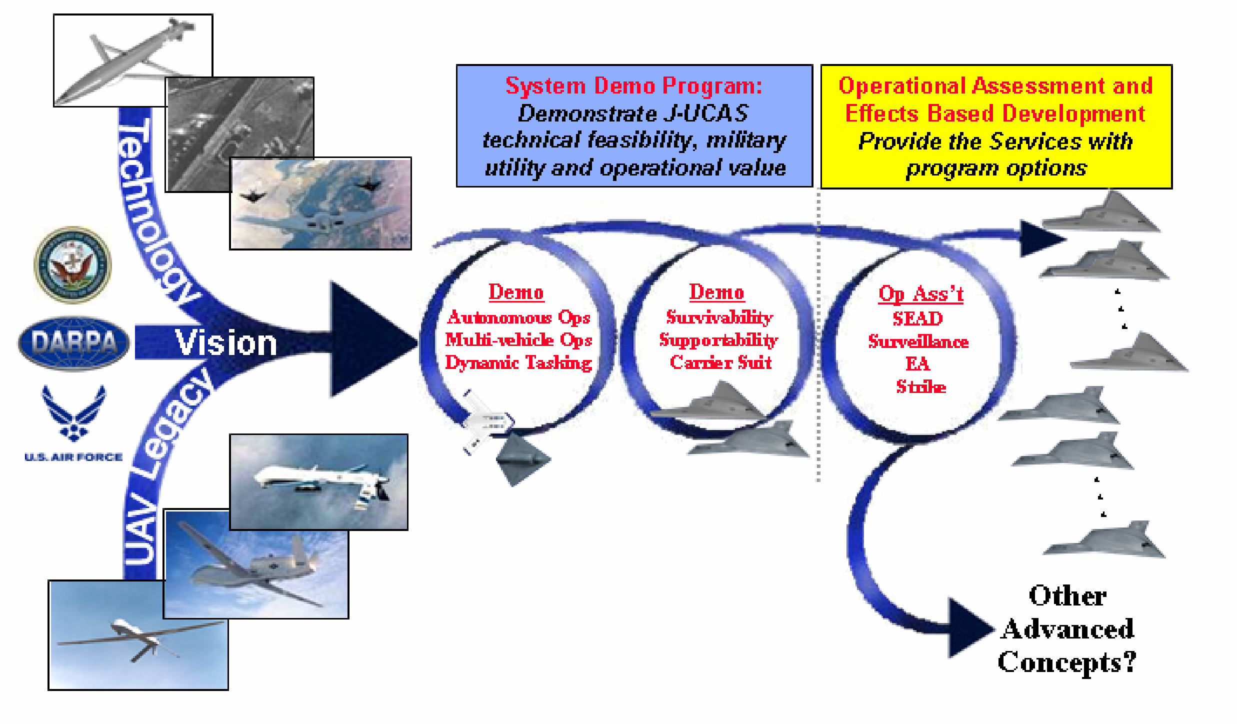
The initial operational role for the J-UCAS desired for the Air Force is as a “first day of the war” force enabler that will complement a strike package by performing the SEAD mission, via lethal and non-lethal means. In this role, J-UCAS would accomplish preemptive destruction and electronic suppression of sophisticated enemy integrated air defense systems (IADS) in support of manned strike packages. Throughout the rest of the campaign, J-UCAS would provide continuous vigilance with an immediate lethal strike capability to prosecute high value and time critical targets. After the conflict, the J-UCAS could fly peacekeeping mission, such as enforcing “no-fly” zones; these typically entail flying long hours of patrols (so called “dull” missions).

The initial operational role for the Navy’s J-UCAS is to provide carrier based, survivable, and persistent surveillance, reconnaissance, and targeting to complement manned assets and long range precisions strike weapons. But to fully exploit its potential and “buy its way” onto the carrier, SEAD and Strike capabilities will be designed in from the outset and fully developed in future spirals. The system will be seamlessly integrated with manned aircraft missions, carrier air traffic control, and deck operations, as well as with the carrier's C4ISR architecture.

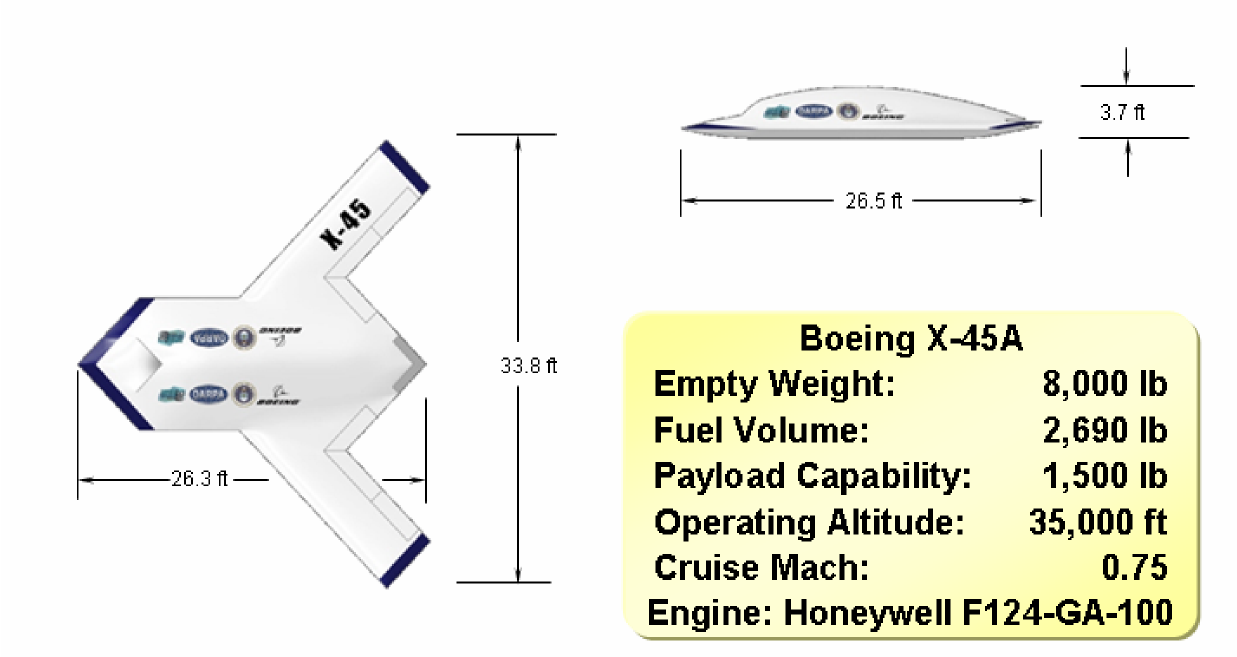
J-UCAS Demonstration Program

The objective of the J-UCAS demonstration program is to design, develop, integrate, and demonstrate the technologies, processes, and system attributes (TPSAs) pertaining to the J-UCAS Operational System.

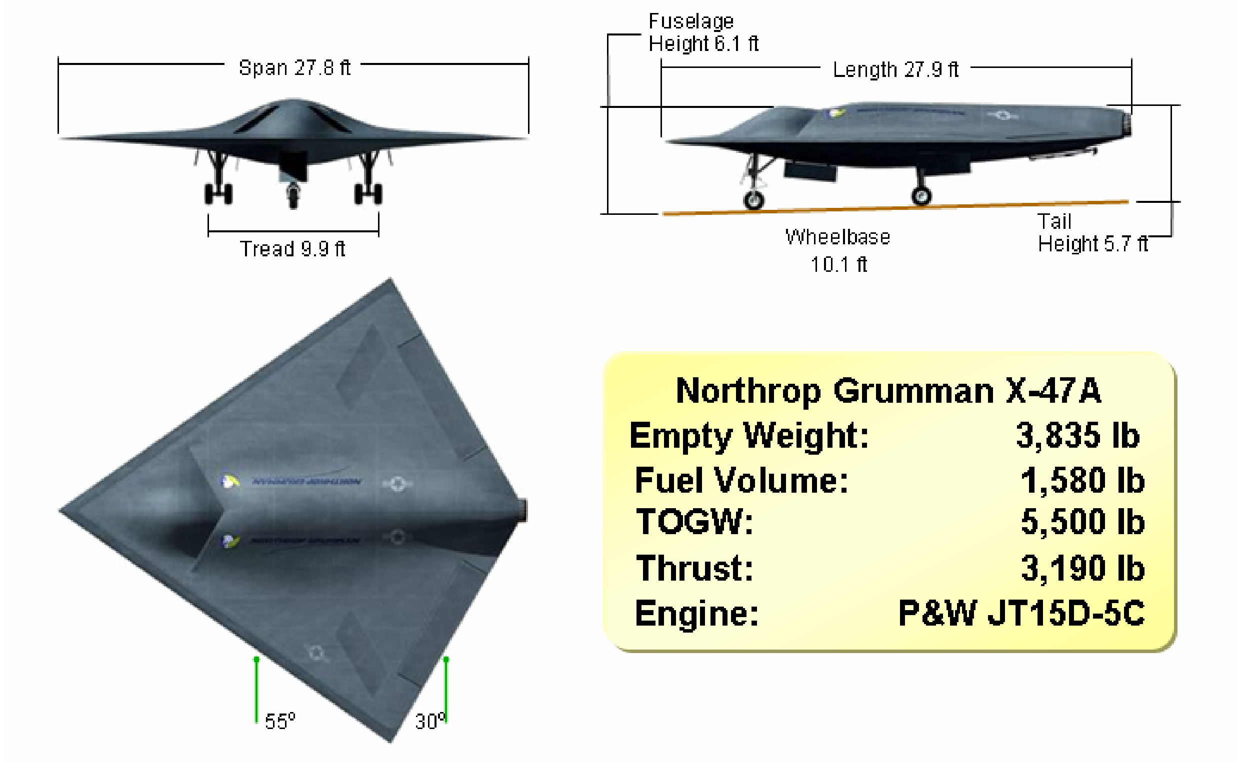
The J-UCAS program is being conducted in multiple overlapping spirals of increasing capability toward the objective system. Spiral 0 consists of two X-45A and one X-47A demonstrator aircraft and their associated simulation, mission control and support systems. Spiral 0 for the X-45A also includes four increasingly capable software blocks, demonstrated through flight. Spiral 1 includes improved air vehicle designs, the low observable X-45C and X-47B demonstrators – allowing for significant payload, range and persistence – as well as improved simulation, mission control and support systems. Future spirals will have greater operational utility, spiraling to the J-UCAS Objective System (J-UOS).



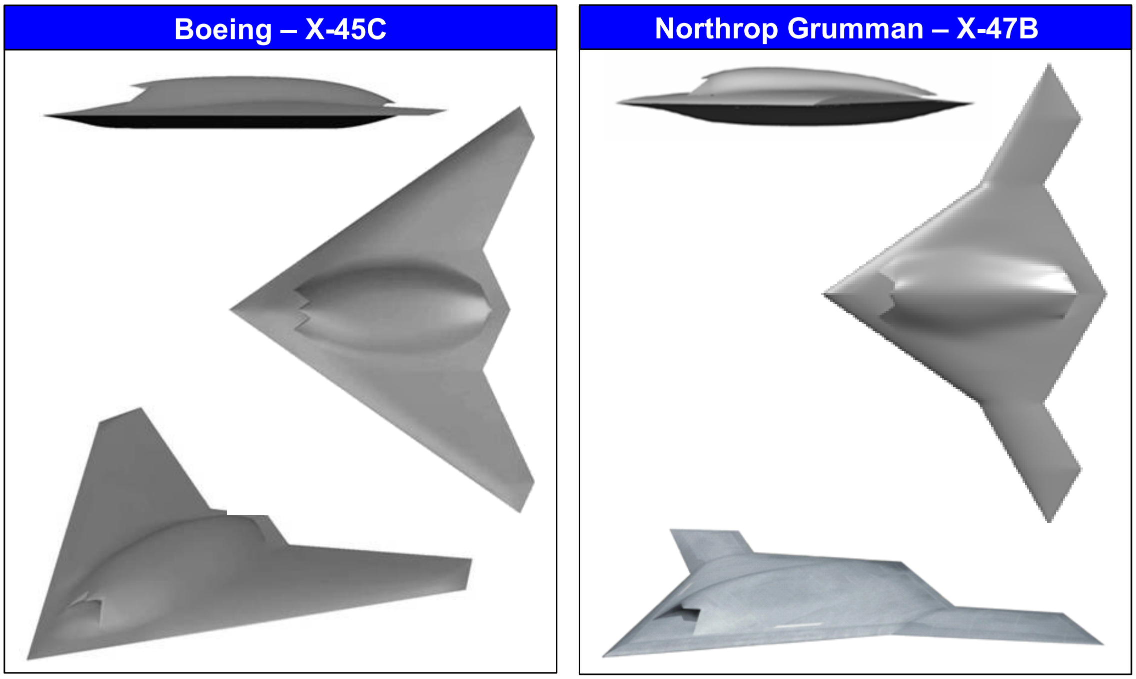
Two X-45A air vehicles were built by Boeing. First flight was in May 2002. Each vehicle has one working weapons bay, with an avionics pallet located in the other bay. The X-45A is all electric, except for the nose wheel steering and hiking system. The engine is fed through a serpentine inlet and uses a yaw thrust vectoring system. The two X-45As have demonstrated the basic functionality of the command and control, and communications and navigation systems, as well as the aerodynamic envelope required for future demonstrations. Characteristics of the X-45A are shown below:



The X-47A, built by Northrop Grumman, demonstrated low-speed handling qualities, air vehicle performance and navigation performance collection. It also simulated a tailhook arrestment point on a carrier flight deck by landing near a predesignated touchdown point and utilized the shipboard-relative global positioning satellite (SRGPS) system as the primary navigation source for increased landing precision. First flight was in February 2003. Characteristics of the X-47A are shown below:



More advanced demonstrators are now under development as part of the J-UCAS program: the X-45C and X-47B are the next step in the evolution of an affordable operational J-UCAS. The larger air vehicles will more closely represent the envisioned operational systems, to include two full weapons bays and incorporation of low observable (LO) technologies. External views of the two air vehicle concepts are provided below:



The network centric nature of the J-UCAS, with the need for collaboration and synchronization coupled with the demanding mission timelines, drives the need for a Common Operating System. A major factor motivating the development of the Common Operating System is the level of integration and interoperability implied by the J-UCAS concept. J-UCAS is not a single ground station and a single platform, but a collection of platforms, as well as multiple control elements all linked together with the infrastructure and support systems to provide a single, seamless integrated capability. The system should be versatile in performing its various mission functions. The J-UCAS elements therefore, have to be intra-operable as well as inter-operable with outside elements of the system. Another motivating factor for the Common Operating System is the level of autonomy versus human-in-the-loop operation needed during the operation of the J-UCAS. This balance between the two at any given point in the mission is dictated by the actual mission itself. A Common Operating System is needed to manage this balance. This Common Operating System is being designed so that it can, in effect, host a number of other configurations that might be required to pursue missions of a similar type as we move into the future and the requirements for the existing platforms change.

Program Management

The J-UCAS program is led by DARPA. The J-UCAS Office, under DARPA leadership -- with support from the Services -- was formally stood-up in October 2003, and is focused on planning and executing a demonstration program that supports both Navy and Air Force emerging requirements. This demonstration program will be followed by robust Operational Assessments (OAs) beginning in FY07. The OAs are expected to provide the Services with several program options in the FY07-09 timeframe.

The development and evolution of requirements is a critical part of the J-UCAS program. The results of the OAs will be key to making decisions about desired capabilities and expectations for follow-on systems development. A joint requirements group, comprised of the Joint Staff, Air Force and Navy, will coordinate with Joint Forces Command and other combatant commanders, to develop and validate J-UCAS requirements. This group will be accountable to the warfighter communities, but provide input directly to the J-UCAS Director.

Point of Contact

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