Good afternoon. I’ll be discussing the part of the J-UCAS program that most naturally springs to mind – the airplane part. It may not be the most critical part of our system in some ways - but it is the business end of J-UCAS. It is where force is applied, where the battle is won. And it is where the needs of the services are most clearly reflected.

First, an essential question – why develop an unmanned air vehicle for combat? What an unmanned vehicle offers is the removal of human restrictions. Physically removing humans from combat vehicles really gives us an edge in several areas. First, it offers the ability to fly for long periods of time – increased endurance and persistence. This comes partly as a function of increased fuel capacity for a given aircraft size because equipment required to support a human is deleted. More importantly, it gives us a mission time limited only by the machine and not the physiological needs of a pilot. Secondly, there is the potential for greater survivability. This might be through the decreased radar cross section possible without a cockpit; or, perhaps through the ability to pull many more g’s than could be tolerated by even the most experienced fighter pilot. Lastly, it might give us an advantage in cost – perhaps in eliminating the need for training flights.

As Dr. Francis has mentioned, the ancestor of today’s J-UCAS was the Uninhabited Tactical Aircraft (or UTA) program. This early effort featured low cost, small air vehicles that would later be known as Unmanned Combat Air Vehicles (or UCAVs). Their potential advantage was to be inexpensive - and therefore if not expendable, then attritable. In comparison to that earlier time, J-UCAS contractors today are designing or have begun construction of two of the most advanced aircraft ever planned – with or without a cockpit. The evolution of the J-UCAS air vehicles vision that we will discuss illustrates both the wide spectrum of attributes offered by unmanned vehicles, and the changing nature of the services’ tactical environment and strategic vision.

First, some history of the air vehicle side of J-UCAS.

DARPA competitively awarded an agreement to Boeing for the DARPA/Air Force UCAV program in 1999. This agreement was to build the X-45A, a small demonstrator aircraft of only about 12,000 lbs take-off gross weight and only 29 ft wingspan. The X-45A was designed strictly as a demonstrator, with its avionics loaded upon a pallet in its bomb-bay and a minimum life expectancy of its airframe. Though it would be the first of its kind – the first aircraft designed from the ground up as a UCAV and not merely a UAV – it would in fact be destined to spend most of its life as a software development tool for the remainder of its family.

The X-45A first took to the air on May 22nd, 2002. Two X-45As were produced and are still in use today at NASA Dryden Flight Research Center. Along with a T-33 surrogate platform, they continue to provide the tools for software development - and continue to break new barriers in unmanned flight. This includes the first demonstration of "4-D navigation", the precision control of not just trajectory but timing of the vehicle's movements through the tactical environment – a must for integration of J-UCAS into the mixed manned/unmanned strike packages of the future.

Part of the X-45A's unique design was driven by the desire to store the aircraft for long periods in transportable containers. This concept was aimed at reducing the operating and support costs for the vehicles. The containerized UCAV was to have been deployed only when needed for high threat conflicts – perhaps only twice in a ten or twenty year period. All training was to be done via simulation. The containerized UCAV was to be shipped via transport to the area of the fight, where it would deploy at airfields near the scene of action.

Throughout the early portions of the Air Force UCAV program, missions were studied and refined. The highest priority mission was the suppression of enemy air defenses through lethal and non-lethal means. The X-45A's planned offspring, the slightly larger X-45B, was on its way to being a relatively short range, highly survivable vehicle which could kick the door down for manned strikers.

Meanwhile, during these early stages of the Air Force UCAV program, a second DARPA effort was getting underway. The DARPA Naval UCAV program had two performers – Boeing and Northrop Grumman.

Because of the performance required, both companies envisioned a carrier based, catapult launched and arrested landing aircraft. And therefore, both contractors had to come came to grips with the difficult process of designing “sea legs” – carrier capability - into a UCAV. First came the realization that storage in a box was not appropriate for the carrier environment…this was strictly a “real estate” issue. The aircraft carrier is 4-1/2 acres of sovereign US territory that can be moved at will at sea. That small bit of acreage is very costly, even by Los Angeles standards, and anything that goes on it must earn its way aboard. A storage approach would necessarily imply only using the UCAV weapon system in a small part of the spectrum of conflict. An aircraft carrier has missions all across that spectrum, from everyday “presence” missions to the first day and first hour of a major theatre conflict. To displace multi-mission aircraft with stored “silver bullets” was not an attractive option. Besides, the Navy’s real need was for a complement to its already existent manned strike fighters and their stand-off weapons – what was needed was a penetrating, focused surveillance/reconnaissance platform that could provide targeting and bomb hit assessment. In addition, it needed the lethality to deal with fleeting high priority targets where appropriate. Finally it had to be capable of safe carrier landings. This brought a whole new realm of reliability requirements. As a predecessor in the UCAV program once told me, we cannot think of a naval UCAV as an unmanned system. It is instead a part of the biggest manned system in the US military – the aircraft carrier. Our reliability standards will reflect this distinction.

As part of Northrop's Naval UCAV efforts, they produced the X-47A Pegasus vehicle – a demonstrator designed to explore for the first time the applicability of stealthy, tail-less shapes to the aircraft carrier environment. The Pegasus vehicle flew on FEB 23rd,. 2003. A small vehicle of only 5,500 lbs take-off gross weight, it used relative GPS for precision approach and landing, touching down with sufficient accuracy to have caught a wire in a carrier arrested landing.

But as these small aircraft were being demonstrated for the first time, the tactical environment was changing. In Operation Enduring Freedom, both the Air Force and the Navy experienced very long transit times associated with air combat in a remote region. Crews found themselves flying thousands of miles just to get to the combat zone. In addition, the Defense Department was becoming ever more aware of the hazards of anti-access threats – those enemy capabilities which might prevent the establishment of either land- or sea-based tactical units in a threatened region. One result was evolution of the Air Force UCAV design to provide more range and persistence in the battle space.

To answer the Air Force need, the Boeing team created the X-45C, based partly on its X-46 design that had been developed for the UCAV-N. The X-45C is designed to take affordable stealth to the next level and to provide the most persistent, longest range tactical sized aircraft in the modern Air Force inventory. The aircraft weighs in at approximately 36,000 pounds, with a wingspan of nearly 50 ft, and can carry up to 4,500 pounds of ordnance. The X-45C design recently passed muster at its Mid-Term Design Review, and will see first flight in 2006. Boeing proposed a modified version of the X-45C for Navy use.

The Northrop Grumman/Lockheed Martin team was the first to release its vision of a carrier capable UCAV to meet the Navy's need. The "cranked kite" design shows its clear ancestry to the X-47A Pegasus, with the addition of winglets to improve low speed handling and endurance of the vehicle. Weighing in at over 42,000 lbs with 4,500 lbs of weapons payload, it defines the larger end of the current J-UCAS family of vehicles. The X-47B team, recently completed its System Requirements Review, and will also see first flight in 2006.

The development of these vehicles through their prime contractors poses interesting air vehicle challenges. Some examples include:

- The challenge of sense and avoid technology that will enable safe operation of these vehicles in airspace used heavily by civilian transport, in times of peace as well as war.
- The challenge of communications with a low probability of detection.
- The challenge of high bandwidth, beyond line of site communications that will not overwhelm the existing infrastructure.
- The challenge of unmanned aerial refueling.

- The challenge of low observable apertures for sensors and communications.
- The challenge of autonomic logistics and vehicle health management sensors and algorithms.
- And the challenge of automatic target cueing and recognition.

These are but a few of the many challenges, and opportunities, on the air vehicle side of the J-UCAS program.

It is important that you realize, however, that the primary rationale behind the J-UCAS program is not air vehicles – at least it not just about certain air vehicle designs. Though the X-45C and the X-47B will meet clear needs within the services, they need not be the end of J-UCAS platform development. After these air vehicles prove themselves operationally useful, we may see more and more types of unmanned combat air vehicles made available to the warfighter through the J-UCAS infrastructure. It is critical that we establish a system that lowers the barriers for addition of new types of air vehicles to J-UCAS. Perhaps the need may arise for a much larger, inter-continental range vehicle. Or perhaps the services will wish to address the next big leap in anti-air defenses with an extremely small air vehicle that can pull 30 g’s or more. Whatever the direction, the legacy of this J-UCAS Office will be the easy addition of new air vehicles - new warfare capability - into a flexible and a common control system.

And that is the subject of our next speaker, Mr. Marc Pitarys, the J-UCAS Office Deputy for Common Systems and Technologies.