



**U.S. AIR FORCE** 











# DARPA/USAF Unmanned Combat Air Vehicle System Demonstration Program



Col Michael Leahy, PhD Program Director

DARPA/TTO

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# **UCAV System Concept**



#### **U.S. AIR FORCE**

#### •Revolutionary New Tactical Airpower

- Force Enabler Preemptive and Reactive SEAD
- Provide Persistent All Weather Kinetic and Electronic Attack Capability
- Augment Manned Force Structure
- New CONOPS for High Risk or High Payoff Missions

#### •New Paradigm in Aircraft Affordability

- Reduced Acquisition Costs (>50% Reduction)
- Dramatically Lower O&S Cost (>75% Reduction)
- Maintain Mixed Force Structure









- Prosecution of Advanced IADS & Time Critical Targets
   Link
- High Survivable Design For First Day Penetration



SAR

AT3



# **UCAV Operational System (UOS)**

#### **U.S. AIR FORCE**

#### **MISSION CONTROL STATION**

- Task Allocation by Phase of Mission (FAO, AOR)
- **Dynamic Mission Planning &** Replanning
- Multiple Vehicles-to-Operator ~ 4:1
- **Knowledge Based Functions** to Aid in Decision Making/Mission Execution
- **Object-Based Common** Software Architecture





#### **EHF MILSTAR & UHF DAMA SATCOM MIDS Intra-flight Link** V/UHF Voice/ATC

#### **AIR VEHICLE**

- ~24,000 / 14,000 lb Gross/Empty Weight
- High subsonic med/high altitude ٠
- Wide range of current & advanced weapons
- **ESM & On-Board SAR Targeting Solution** ٠
- Affordable Stealth to the Next Level

#### SUPPORT SYSTEM

- Flexible Transport or Self -Deployment
- 10+ Year Storage
- Integrated Manned / **Unmanned Squadron**
- Simulation Based Training
- Lean Logistics/PHM
- Supportable LO



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## **One Program -- Four Main Thrusts**





Demonstrate UCAV technical feasibility, military utility and operational value



Rapidly field capabilities to support Warfighter's incremental CONOPS



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#### **X-45A Configuration**







# **X-45A Vehicle Integration**







# **X-45A Avionics Installation**



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A24-X

# X-45A Test Accomplishments





# b Both X-45A vehicles delivered to Dryden b First X-45A in Systems Check-Out

- Structural Mode Interaction
- Tow test
- Combined Systems Test/EMC Safety Of Flight Test
- Low Speed Taxi Test Oct 01
- Medium Speed Taxi Test Feb 02
- High Speed Taxi Test Apr 02
- þ First Flight 22 May 02
- þ Second Flight 13 Jun 02

- System Build 1.03
- ← System Build 1.04
- System Build 1.05









#### X-45A First Flight May 22, 2002



#### **Objectives:**

- Safe first landing and gather data to reduce risk for flight 2
- Gear down and reduced C&C
- Takeoff at 68% Fuel
- Rotation Speed: 154 knots
- Airspeed: 195 knots
- Altitude: 7,500 feet
- Landing Speed: 175 knots

#### Flight Duration: 14 mins



## Successfully demonstrated flight characteristics and basic aspects of aircraft operations





**Take-Off & East Test Loop** 



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Landing Lakebed 35







#### X-45A 2nd Flight June 13, 2002



**Objectives:** 

- Conduct constant alpha air data circles at 195 and 175 KCAS
- Conduct level flight accel/decels to gauge power effects on air data
- Conduct waypoint turns at 175 KCAS
- Evaluate a lower landing speed of 170 KEAS

Flight Duration: 31 mins, 37 seconds



# Flight was essentially flawless and all objectives were met







Flight envelope will be expanded following this plan (notional):

- System Build 1.06 -- Aug 2002
  - Flight 3: Swing Gear
  - Flight 4: 250 KCAS at 15k ft
  - Flight 5: Eval climb/descent
- System Build 1.07 -- Nov 2002
  - Flight 6: 25k ft
  - Flight 7: 0.75M at 35k ft
  - Flight 8: Open Weapons Bay Door



# **SCO completion in Dec 2002**





# **Spiral 0 Demo Recent Highlights**





# Containerization/Shipping



#### **Maint/Repair Sim**



#### Wing Attachment



# Mission Simulations Weapon Release/Initial Point SAR Image Point



#### **Early and Sustained Air Force Involvement**



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# **Spiral 0 Demo End-State**





#### Multi-Vehicle Operations

- Inter-Vehicle Comm
- Dynamic/Reactive Taxi
- Coordinated Flight
  - » Rendezvous
  - » Escort Formations
  - » CAP/Loiter Patterns
  - » Collision Avoidance
- Contingency Management
- Distributed Control
- Dynamic Retasking
- Cooperative targeting
- End-to-End Demonstration
  - Preemptive Destruction (Block 2)
  - Peacekeeping (Block 3)





# **Spiral Development Approach**









# X-45B: Spiral 1 Air Vehicle



#### **Design Drivers**

- Tool to Complete Spiral 1 Demonstrations
- Incorporate X-45A Lessons Learned
- Demo Production of Affordable LO Airframe
- Integration of LO Apertures & Antennas
- Integrated Weapons & Distributed Avionics
- Maintenance of LO Airframe Materials
- Incorporation of C2 Open Architecture
- Prove All Critical Aspects of CONOPS
- Robust Baseline for Operational Aircraft





#### **X-45B Configuration**







Empty Weight: 14,000 lb Fuel Volume: 5,400 lb Payload Capability: 2,000 lb Operating Altitude: 40,000 ft Cruise Mach: 0.85 GE F404-GE-102D Engine



# **Spiral 1 Demo Highlights**





#### **Focused on SEAD/EA/Strike**

- **Battlespace Interoperability**  $\bullet$ 
  - Safe Operation around Manned Aircraft
  - Use Off-board Targeting Info
- **Intelligent Multi-Vehicle Flight Ops** •
  - Dynamic Replanning/Autorouting for Survivability & Targeting Updates
  - Attack Planner with Stores Management
  - CM Situational Awareness & Response
  - Multi-ship Combat Operations
  - **Supportability** 
    - Deployment/Weapon loading/Turn Time
    - LO Maintainability Evaluation
- **Graduation Exercise** •
  - **Operate in a Joint Strike Force with Manned Aircraft**





#### **UCAV Technology Base Current Critical Focus Areas**







## **UCAV Path to Combat Ops**







![](_page_21_Picture_0.jpeg)

![](_page_21_Picture_1.jpeg)

![](_page_21_Picture_2.jpeg)

- X-45A flight testing proceeding -- first two flights complete
  - System Check Out (SCO) flights complete end of fall 2002
- Block 2 software in work
  - Targeting multi-vehicle flight tests summer 2003
- X-45B system design underway
  - Defining the requirements for a "fieldable prototype"
  - Solid foundation for early operational assessments
- Acquisition program funded -- planning underway
  - Pushing to field systems for early operational assessment
  - Continuing to lean forward on innovative acquisition approaches

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![](_page_22_Picture_0.jpeg)