

UAS Weaponization Technology Pathfinder Program: AMPM UTP

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ABSTRACT

Under AMRDEC's Aviation Multi-Platform Munition Program (AMPM) Science and Technology Program, a "Shadow Hawk" munition (developed by Lockheed Martin Missiles and Fire Control) was commanded and released using AMRDEC's Universal Test Pod (UTP) and successfully impacted the designated ground target. The UTP program pioneered usage of OSD Unmanned Aircraft System (UAS) Control Segment (UCS) Architecture Mission Effects Sub-domain and standardized STANAG 4586 weapon control messages that formed the basis of OSD's Data Link IP (draft). The UTP employed the Universal Armaments Interface (UAI) implemented in the UTP stores management system, which provides a developmental universal, open-architecture weapon interface.

This was the first demonstration of a precision-guided weapon released from a RQ-7B Shadow UAS. It also marks the first-time that UAI protocol, Army/OSD standard weapon data link messages and a weapon control application built to the UCS Architecture Model were used in commanding a small precision-guided weapon from a UAS platform.

AMRDEC's Universal Test Pod, developed in partnership with "Dynetics Incorporated", "General Dynamics - Advanced Information Systems", and "Torch Technologies Incorporated", demonstrates the universal, open-standard attributes of the OSD's Weapons Universal Systems Interoperability Profile (USIP) and OSD's UAS UCS Architecture. An open-standard offers quicker and less-expensive adaptation of new weapons and instills greater competition by publishing weapon interface requirements, without the constraints of single point solution proprietary interfaces and restrictions.

CITATION: Springer, J., Thomas, T., Gregory, D., Low, S. et al., "UAS Weaponization Technology Pathfinder Program: AMPM UTP," *SAE Int. J. Aerosp.* 5(1):2012, doi:10.4271/2012-01-2122.

INTRODUCTION

The AMPM UTP Program demonstrated several key DOD technologies together in the field for the first time on a UAS platform. These key technologies are the OSD's Weapons USIP and UAS UCS Architecture. Both of these technologies will potentially reduce integration cost/schedule, support increase interoperability and promote targeted

capability based upgrade cycles that are separate from the planned block upgrading of the system.

Universal Systems Interoperability Profile: An Overview

A USIP defines profiles of standards sufficient to guarantee a level of interoperability that enables a specific mission capability. A USIP will accomplish this by



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identifying specific parameters within an existing standard, extend an existing standard to increase capability, or define a new standard in the absence of an existing standard. Applicable Services/Agencies agree to a minimum implementation even if they currently do not have capability in the inventory. USIPs are structure to contain technical Interoperability Profiles (IPs) that are self contained and modular so they can be used in multiple USIPs. IPs shall be coordinated directly with existing standards bodies where applicable. [Figure 1](#) below shows the general structure of USIP. USIPs are governed by a defined management plan whose intent is to define the policies and procedures for the creation, modification and promulgation of USIPs and IPs. The management plan also ensures that the USIP process is integrated with DOD policy and acquisition procedures.

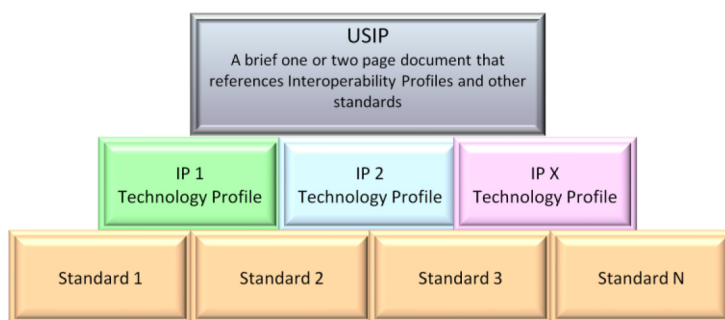


Figure 1. USIP structure including supporting IPs and standards

Weapons USIP

Within the OSD USIP context, the Weapons USIP IP's that were demonstrated/developed during the AMPM UTP Program are shown in [figure 2](#).

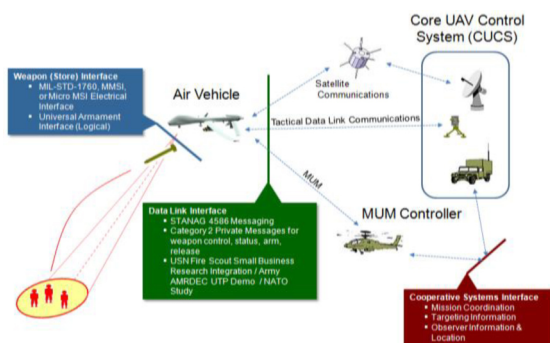


Figure 2. The Data Link Interface (IP7) handles UCS to UA command and control of the weapon subsystem. Weapon Interface (IP6) handles the platform to store interface.

The Data Link Interface (IP 7) describes the necessary messaging for control and monitoring of the armament subsystem on an Unmanned Aircraft (UA) with any Universal Control Segment¹ (UCS) either on the ground or in the air (e.g. Levels Of Interoperability (LOI) 3). LOI 3 is defined as control and monitoring of the UA payload. In this case, payload is defined as the armament subsystem on the UA. The control exercised is from armament subsystem initialization to weapon release. This messaging contains all the status information reported from the armament subsystem. The interface will be transmitted between the UCS and the UA.

The Weapon Interface (IP 6) addresses direct interfaces between unmanned aircraft, air launched mission stores, and associated carriage systems, or suspension and release equipment. Direct interfaces are those interfaces to the carriage system and/or air launched mission store which are directly attached, linked, connected, or must otherwise pass through the launch aircraft. They do not include indirect interfaces to 3rd party systems such as ground control systems, other manned/unmanned platforms (e.g. Net Enabled Weapons), ground support equipment, mission planning systems, etc.

The capability provided by implementation of this IP is twofold. First, is the tactical ability of the unmanned aircraft, enabled through interactions with the control segment, to achieve a specified effect on the battle space via delivery of single or multiple air launched mission stores within acceptable spatial and temporal end game parameters with respect to a desired mean point of impact. The second capability achieved through implementation of this IP is the ability to rapidly integrate weapons and mission stores (and their carriage systems) onto unmanned aircraft without the costly or lengthy development cycles required by disparate and nonstandard interfaces. Given the methods in which unmanned systems are used in both conventional and irregular warfare scenarios, combined with the proliferation of mission store systems produced by US and partner nation industries, this IP operates under the premise that an aircraft system with standardized, configurable interfaces that can more rapidly respond to weapon integration requirements, provides a greater and more responsive capability to the warfighter. The third capability achieved through implementation of this IP is the probable ability to use new weapons across multiple platforms and multiple services without having to modify the platform through the implementation of standardized interfaces. For example, some environmental issues (Temperature, altitude, etc) may prevent the full interoperability across multiple platforms due to the significantly different platform capabilities and concept of operations across the services.

¹Universal Control Segment refers to any device (e.g. GCS, manned air craft, PDA, etc.) capable of handling LOI 3 control of the weapon subsystem.

UCS Architecture

The UCS Architecture is a Business System. The Architecture defines the rules and conventions for interoperable and interchangeable software components and for the subsequent certification of a system composed of these components. In this context, the UCS Architecture supports these OSD-stated, high-level business objectives: acquisition flexibility for control segment subsystems and components, cost control, innovation at all levels of industry, reduced integration time for new capabilities, and reuse across Service and Joint UAS programs where appropriate.

The UCS Architecture may be employed alongside other Government Open Architecture initiatives that address Common Operating Environments, Networking/Communications, and Human-Computer Interfaces or it may be used to 'break open' previously closed and proprietary systems. The principles of the UCS Architecture are these:

Model-Based. The requirements for interoperable and interchangeable software components are defined entirely within a Government-owned model that can be imported directly into the development environment of the software component provider or system integrator.

Multiple Operating Environments. The Government-owned model is transformable to the Operating Environment selected for the UAS Control System. It is anticipated that Government-owned transformations will be developed for the OMG Data Distribution Services (DDS) standard and Web Services. The UCS Architecture may be extended by additional Government-owned transformations as new Operating Environments become popular.

Government-Owned Certification Process. Archetype Information Assurance Cases and Safety Cases are stated as integrated viewpoints of the Government-owned model. This will allow the standardization and reuse of certification artifacts between programs to support the business objectives of OSD.

The primary views of the architecture are shown below. The normative part of the UCS Architecture is the Platform-Independent Model. In the ontology of the UCS Architecture, a service is a capability that is provided by an entity and accessed via a service interface. The PIM includes an Effects Management subdomain, which was derived from the NATO UAS weaponization domain model. Part of this mapping included the translation of the NATO domain model into services and an associated data model.

The current listing of all the UCS service domains and subdomains is:

Primary Mission Control. The subdomains are Cargo Payload Management, Comms Relay Payload Management, Communications Management, Mission Management, Sensor Management, Survivability Management, UAS Health and Status Management, UAS Resource Manager, Vehicle Management, Vehicle Message Layer, and **Effects Management**.

Dynamics Airspace. The subdomains are Air Traffic, Battlespace, Common, Environment, and Situation Awareness.

External Messaging and Communication. The subdomains are Tactical Messaging and Communication, and Collaboration.

Mission and Task Planning. The subdomains are Mission Planning, Data Dissemination, Airspace Planning, Effects Planning, Route Planning, Sensor Planning, and Vehicle Planning.

Sensor Product. The subdomains are Sensor Product Archive, Sensor Product Capture, Sensor Product Exploitation, Sensor Product Management, and Sensor Product Dissemination.

System Support. The subdomains are Logistics Management, Maintenance, Mission Record and Playback, Mission Support Information, and Training.

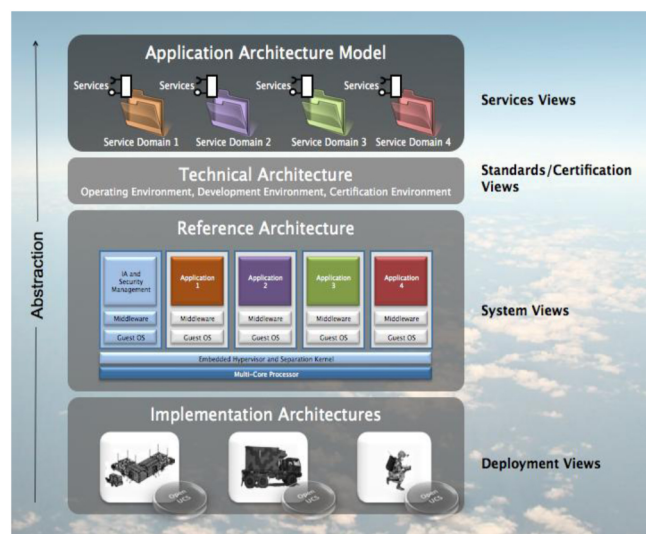


Figure 3. UCS Architecture Views

The PIM is supported by a Technical Architecture that provides requirements/recommendations for operating environments, system development environments (i.e., tools and languages), and certification. Flight-critical and weapons-critical operating environments are specified together with design principles for Multiple Independent Levels of Security (MILS), Multilevel Security (MLS), and Cross-Domain Solutions (CDS). The Technical Architecture, therefore, addresses the system safety, airworthiness, and IA aspects of UAS weaponization within the UCS.

The Reference Architecture binds the service domains, subdomains, and services of the PIM to a platform that conforms to the Technical Architecture, including model tagging, IA and Security Management Services, Infrastructure Services, and logical/physical system partitioning. The Reference Architecture is applied to three notional Implementation Architectures: a fixed-facility, a mobile/transportable system, and a dismounted system.