UCS Architecture
Overview

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Open Architecture

March 2016

UCS Architecture

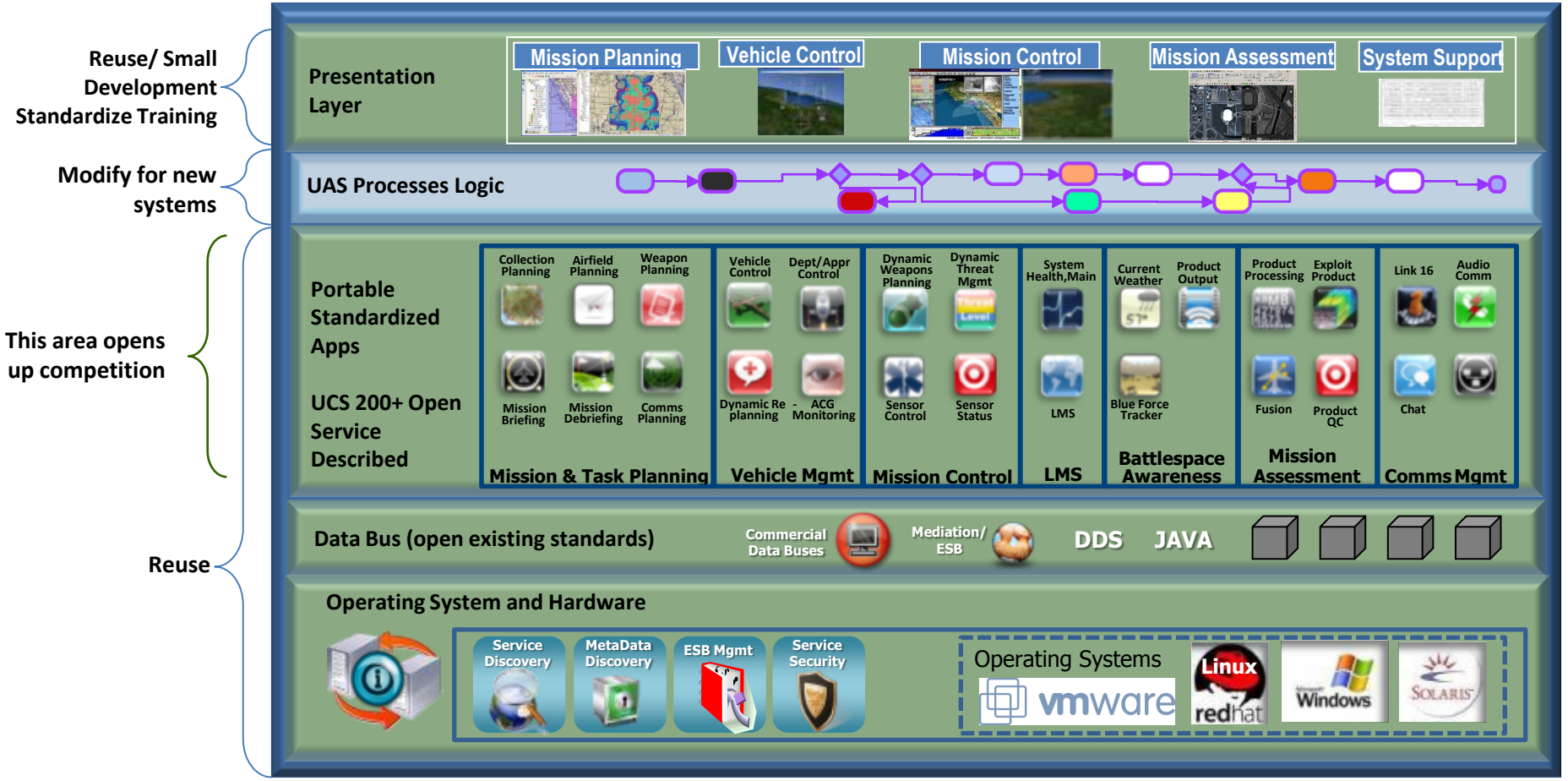
Emerging as DoD information architecture for controlling Robotic and Autonomous Systems (RAS) in all domains

- OUSD(AT&L) ADM for DoD UAS Groups 2-5, February 2009
  - Army PEO Aviation ADM mandate
  - SEC Air Force "Unmanned Aircraft Systems Flight Plan 2009-2047"
  - Air Force Global Hawk ADM
  - PEO U&W ADM mandate
- Extended by Navy for Surface & Subsurface PoR systems(UCS-M)
- NAMC extension for small UAS, ground vehicles, and unattended sensors (soldier/marine common controller program)

Developed under open government/industry partnership

- Initial OUSD(AT&L) funded development (over $100m & 85k hrs) under National Technology Transfer and Advancement Act (NTTAA) and OMB Circular A-119.
- Currently managed by Society of Automotive Engineering (SAE) Airspace 4 (AS-4). This portfolio architecture includes:
  - Army and Navy Joint Architecture for Unmanned Systems (JAUS) started in 1998,
  - NATO Standardization Agreement 4586,
  - ASTM F2541-06 for Unmanned Undersea Vehicles (UUV) Autonomy & Control,
  - and OSD's UCS Architecture

Open Reference Architecture

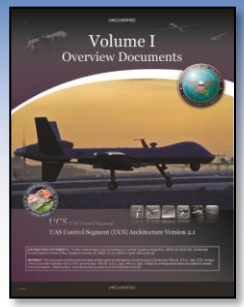


UCS Architecture

Open GCS Architecture for UAS
Joint HMI Style Guide for GCS

DoD Open App Store Marketplace
50+ PoR ready Apps & Demos
PoR: TCS, Block 50, and Global Hawk
PoR: OSRVT

3.4 Architecture Model



HMI Guide

1

2

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

3

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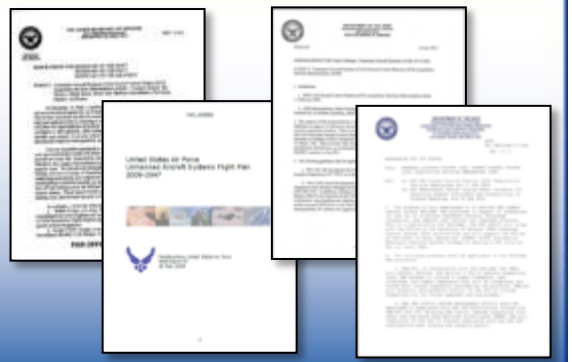

DoD Contract Guidebook & IP Rights
Open Business Model for UAS GCS
RFP Language for UAS GCS

Existing UCS ADMs: OSD, Army, Navy,
Air Force UCS ADMs: GSRA

UCS Alignment

The structure of the UCS Architecture supports content alignment with adjacent architectures

- **Open Group - FACE**
  - FACE plans to reference a common data architecture framework based on UCS data model content (structure will be developed by UCS/FACE Atherton Group)
- **Joint Staff J6 – National Information Exchange Model (NIEM)**
  - UCS and NIEM MilOps in discussion about alignment options for RAS based on UCS data model content
- **SAE - JAUS**
  - SAE AS-4UCS will be adding JAUS extension to UCS Architecture to support UCS-M and NAMC CCA long term
- **NATO JCGUAS**
  - NIAG SG205 is basing NATO Robotic Autonomous Systems (RAS) data model on UCS Architecture R3.4. The UCS Architecture CDM includes STANAG 4586 content.
- **Air Force - UCI/ Navy CSI - NIOP**
  - Ability to map UCI/NIOP message schema to UCS Data Model (DM) has been demonstrated

UCS in Acquisition

The UCS Architecture is based on OA/Open Business Model (OBM) principles and Better Buying Power (BBP 3.0)

- Supports OSD GCS OBM 3.0
  - Target affordability and control cost growth
  - Incentivize productivity in industry
  - Promotes real competition
- In practice the UCS Architecture:
  - As shown to:
    - reduces vendor lock and dependence on vertical integrators
    - promotes component reuse across RAS
    - greatly reduce cost of the system (100s of millions in savings)
    - reduce time to integrate
  - Supports capability management across RAS portfolio
  - Enables access to technologies incubated in small business, academia, and adjacent markets

Programs/Projects

UCS Architecture is being incorporated into multiple DoD programs

Navy

- Common Control Station (CCS) – PMA 281
- Multi-Operator Control Unit (MOCU) – SPAWAR
- Littoral Combat Ship (LCS-MCM)
- PEO IWS – Product Line Architecture (PLA)
- Fire Scout Tactical Control Station (TCS) – PMA 266
- Triton Control Station – PMA 262
- Unmanned Surface Vehicle PoR (JAUS/UCS-M) PMS 406
- Slated Large Diameter UUV PoR
- Based off: Mission Package Common Software Architecture (CSA) - PMS 420

Army

- Universal Ground Control Station (UGCS) – PM-UAS
- Bi-directional Remote Video Terminal (RBRVT) – PM-UAS
- Joint Multi-Role Rotorcraft (JMR) – AMRDEC

Air Force

- Block 50 Ground Control Station (GCS)
- ADM Global Hawk GCS upgrade (ADM only)

Programs seeded by successful technology demonstrations

Technology Demonstrations

In addition to POR, recent/ongoing DoD-funded technology demonstrations show opportunities for additional capabilities

- CMCC/UCI to CCS/UCS mission plan interoperability
  - Supported by mappings between UCS data model and UCI/NIOP
- LCS Mine Counter Measures (MCM) Mission Package
  - Mission Package Common Software Architecture (CSA) – PMA-420/SPAWAR
  - Unmanned Maritime System Reference Architecture (UMS RA) – PEO LCS/NUWC
  - Single Sortie Detect to Engage (SS-DTE) – ONR/NSWC
- CASEVAC with KMAX UAS and Ground Systems
  - Extends UCS Architecture with CASEVAC data model, HMI
  - Air Force CMCC to Navy CCS CGS control of UAS and UGV
- NAMC Common Controller Architecture for dismounted control of heterogeneous RAS using MOCU 4 – multiple Army programs
  - Small UAS
  - UGV
- ONR and OSD Cross Domain interoperability
  - ONR Limited Technology Experiment (LTE) 2012 – Cross Ship platforms, UAS, UUV, and common gateway router
  - CCS LD UUV China Lake risk reduction demo 2015

UCS Architecture

ReUSE/USE Examples

Navy's Common Control Station (CCS) Reusing UCS-Software Services

PEO (U&W) CCS ADM - 1 July 2011

- Funding will come from new and existing UAS PoRs
- Existing programs will transition to CCS as funding / schedule permit
- Large amount of savings can be achieved across Navy's PoRs

Component	Total SLOC	Modified/ Added SLOC	Reuse Rate[2]
STANAG-4586 Service	484,317	722	99.9%
EO/IR Service *	12,000	732	93.9%
Navy Weather Service *	1,500	-	100.0%
Air Force Weather Service *	1,501	-	100.0%
GCCS-M Service *	1,701	-	100.0%
Blue Force Tracker Service *	12,500	-	100.0%
Cusor On Target Service *	1,700	-	100.0%
Stream Catalog Service *	2,300	-	100.0%
Payload C2 Service *	1,700	-	100.0%
Vehicle Flight Status Service [1]	526	-	100.0%
Sensor Product Archive Service *	2,700	-	100.0%
Air Field Management Service *	1,700	-	100.0%
Ballista*	72,000	400	99.4%
DDS-Mule ESB Bridge Generator	10,060	5,013	0.0%
Total Reuse	**606,205**	**6,867**	98.9%
* Estimates of total lines of code (source code not provided)			
[1] Consists of a DDS configuration file			
[2] Numbers contain some rounding error